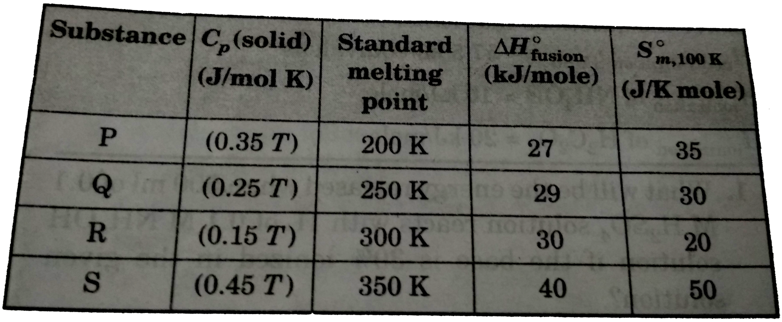
CHEMISTRY

BOOKS - GRB CHEMISTRY (HINGLISH)

THERMODYNAMICS

2

1. Out of different state parameters like E, H, G, A and S, only entropy(s) is the parameter whose absolute value can be determined, by using third law of thermodynamics. While perfect crystals hace zero entropy at $0K$, non-perfect crystals have some residual entropy at $0K$. From this info and the following data chart, answer the questions that follow :



Substance	C_p(solid) (J/mol K)	Standard melting point	$\Delta H^\circ_{\text{fusion}}$ (kJ/mole)	$S^\circ_{m,100\,K}$ (J/K mole)
P	$(0.35\,T)$	200 K	27	35
Q	$(0.25\,T)$	250 K	29	30
R	$(0.15\,T)$	300 K	30	20
S	$(0.45\,T)$	350 K	40	50

What will be molar entropy of liquid R at $300K$?

A. $150J/K$ mole

B. $145J/K$ mole

C. $45J/K$ mole

D. $50J/K$ mole

Answer: a

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2. When acids an bases react they liberate some amount of energy which is represented as ΔH neutralization if one equivalent of acid and base reacts. The energy liberated depends on the concentration of acid and base and also on whether the acid is strong or weak. For strong acids and bases, the value is constant and for weaker acids as bases the magnitude is generally lesser.

Using this info and the date below answer the question that follow :

[Given data :

$\Delta_{\text{neutralization}} HCl/NaOH = -14 Kcal/eq$ (at infinite dil.)

$\Delta H_{\text{ionisation}} CH_3COOH = 2kcal/mol$

$\Delta H_{\text{ionisation}} NH_4OH = 3kcal/eq$]

In which of the following will heat released be same ?

A. $HCl(0.2M, 500ml)$, mixed with $NaOH(0.3M, 500ml)$

B. $HNO_3(0.5M, 200ml)$ mixed with $KOH(0.4M, 280ml)$

C. $H_2SO_4(0.1M, 200ml)$ mixed with $NaOH(0.3M, 1000ml)$

D. $CH_3COOH(0.1M, 1000ml)$ mixed with $NaOH(0.3M, 500ml)$

Answer: a,b

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3. Fuel cells are the commercial cells which converts the chemical energy into electrical energy and differ from the normal batteries since fuel cells require constant source of fuel and oxygen to obtain electric current. However, they can be used to produce electricity as long as the supply of fuel and oxygen is maintained. All fuel cells consist of an andoe and a cathode and an electrolyte which allows charges to move between the two sidez of the fuel cell. Electrons are drawn from anode to cathode through an external circuit and hence produce direct current electricity. Under practical cases, efficient of fuel cell is around $40 - 60\,\%$ and in some cases it may be as high as $85 - 90\,\%$

Some common examples of fuel cell are diect methanol fule cell (DMFC), Direct Borohydride fuel cell (DBFC), alkaline fuel cell (AFC) and others.While in DMFC the electrolyte is an ionomer (proton exchange monomer) in case of AFC and DBFC the electrolyte is an aqueous alkaline solution. Also, in case of DBFC the borohydride gets oxidised to metaborate, In all the above three cases, at cathode reduction of O_2(gas) occurs in a medium controlled by the electrolyte. Based on this information answer the electrolyte. Based on the information answer the question that follow :

Data

$\Big(\Delta H_f^\circ\, CH_3OH(l) = -230kJ/\text{mole}, , \Delta H_f^\circ\, CO_2$=-390kJ//"mole"), (Delta_(f)^(@)H_(2)O(l) = - 285 kJ//"mole",,S_(mH_(2)O(l))^(@)=130J//K "mole"),(S_(mCO_(2(g))) = 210 J//K "mole",S_(mH_(2)O(l))^(@) = 110 J//K "mol"),(S_(mO_(2(g)))=206J//K "mole",,S_(mH_(2(g))) = 130J//K "mole"),("All data at" 300 K.,1/F = 10^(-5)C^(-1)):}`

If in DBFC it is known that sodium borohydride is taken as a fuel than which of the following reaction wil be occuring at approprite electrode in the DBFC ?

A. At cathode, $O_2 + 2H_2O \rightarrow 4e^- \rightarrow 4OH^-$

B. At cathode, $O_2 + 4e^- + 4H^+ \rightarrow 2H_2O$

C. At anode, $NaBH_4 + 8OH^- \rightarrow NaBO_2 + 6H_2O + 8e^-$

D. At anode, $NaBH_4 + 2H_2O \rightarrow NaBO_2 + 8e^- + 8H$

Answer: a,c

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4. While analyzing driving forces for a chemical reaction it is observed that energy and entropy are true forces. The entropy is a typical state function owing to the possibility of calculation of its absolute value. The absolute values of entropies can be compared an calculating by knowing the residual entropies at $0K$ and by calculating the change due to change of state. Using the given information and data for a particular substance x answer the questions that follow :

Useful data :

(p) Standard melting point and boiling point of x is $200K$ and $400K$ respectively.

(q) $\Delta H^{\circ}_{\text{fusion}} = 10kcal/\text{mole}$ and $\Delta H^{\circ}_{vap} = 80kcal/\text{mole.}$

(r) $C_{p.m}(s)x = 0.1Tcal/K\text{mole}, C_{p.m}(l)x = 0.05Tcal/Kmo \leq$

$S^{\circ}_{m.40K}s_x = 5cal/\text{mole}$

Which of the following options regarding absolute molar entropies of x is/are correct?

A. $S^{\circ}_{m,200K}x(s) = 21cal/\text{mole}$

B. $S^{\circ}_{m,400K}x(g) = 281cal/\text{mole}$

C. $S^{\circ}_{m,400K}x(l) = 81 cal/\text{mole}$

D. $S^{\circ}_{m,200K}x(l) = 70 cal/\text{mole}$

Answer: a,b,c

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5. It is observed that when acid and bases react, some energy is released due to neutralization reaction. While in case of strong acid and bases, the energy released in greater, in case of weaker acids of bases, energy released will be lesser. The difference is attributed to energy required for ionization. From the above information and data below answer the questions that follow:

$\Delta H_{\text{neutrization SA/SB}}$=-57.5 kJ/equivalent,

$\Delta H_{\text{ionization}} of NH_4OH$=10kJ/mole,

$\Delta H_{\text{ionization}}$ of $H_2C_2O_4$=20kJ/ mole.

What will be $\Delta H_{\text{neutralization}}$ of $H_2C_2O_4$ with NaOH per mole of $H_2C_2O_4$ if acid is assumed to be completely unionized in the following?

A. 37.5kJ/mole

B. $-75kJ/\text{mole}$

C. $95kJ/\text{mole}$

D. $-3507kJ/\text{mole}$

Answer: c

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6. Cycloalkenes and alka- dienes are structural isomers and it is observed that the isomerisation reaction of cyclo-butene into 1,3, buta-diene follows 1st order kinetics with respect to cyclobutene. The rate constant of the reaction can be determined by hydrogenting (reaction with H_2 to remove unsaturation) the reaction mixture and different instant and measuring the amount of hydrogen required. In one such experiment two separate glass flasks of volume 1 litres. were added with same amount of cyclobutene and sealed. While one flask was broken after 138.6 min and the contents required 39.2 ml of H_2 gas at 1 atm pressure and 273K, where as other flask was broken after a very long time and the contents required 44.8 ml of H_2 gas at 1 tam pressure and 273K . From the information given above and given data, anwer the questions that follows:

ΔH_f° Cyclobutene=175kJ/mol

ΔH_f° Buta-1,3-diene =125kJ/mol

The rate at which heat is released in isomerisation of cyclobutene at t=69.3 min

A. 50kJ

B. 5J/min

C. 0.25J/min

D. 10J/min

Answer: c

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7. Dissociation of $NH_3(g)$ over solid platinum follows zero order kinetics.

$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

The rate of reaction is $2 \times 10^{-3} M\sec^{-1}$. Also at 300K, thermodynamic data are:

$\Delta H_f^{\circ}\ NH_2$=-45kJ/mole $S^{\circ}_{N_2}$=190J/K mole

$S^{\circ}_{NH_3}$=200J/K mole, $S^{\circ}_{H_2}$=130J/K mole

From the above data and the assumption that $\Delta H^{\circ}_{\text{Rxn}}$ are independent of temperature, anwer the question that follows. [Take $R \times 300$kJ]

What is the rate at which heat is absorbed at time t=50 sec. if volume of vessel is kept at 1 litre?

A. 0.18kJ$\sec^{-1}$

B. $0.36 kJ\sec^{-1}$

C. 0.09k

D. 0.17kJ $\sec^{-1}$

Answer: d

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8. Entropy change for reversible phase transition at constant pressure P and temperature T is calculated by the formula $\Delta S = \frac{\Delta H}{T}$, where ΔH is the enthalpy change for phase transition. For irreversible phase transition $\Delta S > \frac{\Delta H}{T}$.

Consider a phase transition.

$Sn(\text{white, s}) \Leftrightarrow Sn(\text{grey,s})$

ΔH° at 1 atm and$300K = -2kJmol^{-1}$

The equilibrium temperature at 1 atm is 400 K.

Assume $C_{p,m}$ of Sn (white,s) and Sn(grey,s) are equal.

ΔG° for above phase transition at 1 atm and 300K is :

A. $-500Jmol^{-1}$

B. $-500kJmol^{-1}$

C. 0

D. $-100Jmol^{-1}$

Answer: a

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9. The solubility on any substance in water may be classified as :

Molecular ability: AB(s/l/g) $\overset{aq}{\Leftrightarrow}$ AB(aq)

Ionic solubility : AB (s/l/g) $\overset{aq}{\Leftrightarrow} A^{+}(aq) + B^{-}(aq)$

For a substance AB(s) the following thermodynamic informations are available at 300K:

Molecular solubility: ΔH°=+20kcal/mol,

ΔS°=+40kcal/K-mole

Ionic solubility: ΔH°=-25 kcal/ mol,

ΔS°=-50 cal/K-mole

The equilbrium constant for the ionic and molecular solubility of AB(s) in water at 300K are respectively:

A. $e^{50/3}, e^{-40/3}$

B. $10^{50/3}, 10^{-40/3}$

C. $e^{-50/3}, e^{40/3}$

D. $10^{-50/3}, 10^{40/3}$

Answer: a

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10. Equilibrium constant for a reaction can be obtained by kinetics approach or by thermodynamics approch. While from kinetics approach at equililbrium, the rate of forward and backward will be same, from thermodynamics approach Gibbs free energy will be minimized at equilibrium. Using this information and following thermodynamics values, answer the question that follow:

$\Delta G_f^\circ A(g)$=-200kcal/mole

$\Delta G_f^\circ B(g)$ =-320 kcal/mole

$\Delta G_f^\circ C(g)$=-300kcal/mole

$\Delta G_f^\circ D(l)$=-224.606 kcal/mole

$\Delta G_f^\circ D(g)$= -226.9.9 kcal/ mole,

All values at 500K

Calculate equilibrium concentration of B(g) if A(g) at 10 bar, B(g) at 2 bar,C(g) at 20 bar is mixed with excess liquid D such that following equilbrium gets established at 500K:

$A(g)B(g) \Leftrightarrow C(g) + D(g)$

A. 2M

B. $\frac{2}{41.57}$

C. $1M$

D. $\frac{1}{41.57}$

Answer: b

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11. A gaseous sample is generally allowed to do only expansion/compression type of work against its surroundings. The work done in case of an irreversible expansion (in the intermediate stages of expansion/ compression the states of gases are not defined). The work done can be calculated using

$dw = -P_{\text{ext}}dV$

while in case of reversible process the work done can be calculated using dw=-PdV where P is pressure of gas at some intermediate stages. Like for an isothermal reversible process, since

$P = \frac{nRT}{V}$,so,

$$w = \int dw = -\int_{V_i}^{V_f} \frac{nRT}{V} . dV = -nRT \quad In\left(\frac{V_f}{V_i}\right)$$

Since,dw=PdV, so magnitude of work done can also be calculated by calculating the area under the PV curve of the reversible process in PV diagram.

There are two sample of same gas initially at same initial state. Gases of both the sample are expanded. Ist sample using reversible isothermal process and IInd sample using reversible adiabatic process till final pressures of both the samples become half of the initial pressure , then :

A. Final volume of Ist sample $<$ final volume of Iind sample

B. final volume of IInd sample $<$ final volume of Ist sample

C. final volumes will be equal

D. information insufficient

Answer: b

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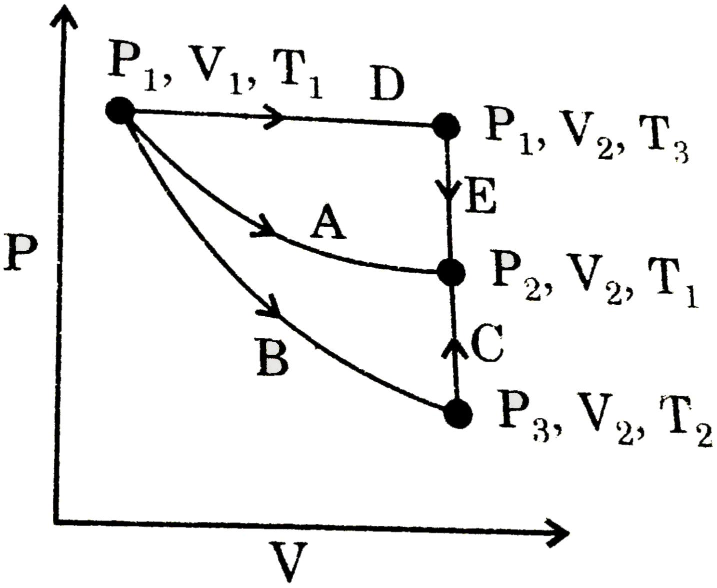
12. For an ideal monoatomic gas, an illustration of three different paths A, (B+C) and (D+E) from an initial state P_1, V_1, T_1 to a final state P_2, V_2, T_1 is shown in the given figure .



Path A represents a reversible isothermal from P_1V_1 to P_2, V_2, path (B+C) represent a reversible adiabatic expansion (B) from P_1, V_1, T_1 to P_3, V_2, T_2 followed by reversible heating of the gas at constant volume (C) from P_3, V_2, T_2 to P_2, V_2, T_1. Path (D+E) represents a reversible expansion at constant pressure $P_1(D)$ from

P_1, V_1, T_1 to P_1, V_2, T_3 followed by a reversible cooling at constant volume $V_2(E)$ form P_1, V_2, T_3 to P_2, V_2, T_1

What is ΔS for path (A)?

A. $nr\ \text{In}\frac{V_2}{V_1}$

B. $-nr\ \text{In}\frac{V_2}{V_1}$

C. zero

D. $nR\left(V_2 - V_1\right)$

Answer: a

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13. Entropy is a state function and its depends on two or three variable temperature (T), pressure(P) and volume (V). Entropy change for an ideal gas having number of moles (n) can be determined by the following equation:

$$\Delta S = 2.303nC_v \ \log\left(\frac{T_2}{T_1}\right) + 2.303nR \ \log\left(\frac{V_2}{V_1}\right)$$

$$\Delta S = 2.303nC_p \quad \log\left(\frac{T_2}{T_1}\right) + 2.303nR \quad \log\left(\frac{P_2}{P_1}\right)$$

Since free energy change for a process or a chemical equation is a deciding factor of spontaneity, which can be obtained by using entropy change (ΔS) according to the expression, $\Delta G = \Delta H - T\Delta S$ at a temperature T.

An isobaric process having one mole of ideal gas has entropy change 23.03J/K for the temperature range $27\,^\circ C$ to $327\,^\circ C$. What would be the molar specific heat capacity (C_(v))?

A. $\frac{10}{\log 2}$J/K mol

B. $\frac{10}{\log 2}$ - 8.3J/K mol

C. $10 \times \log 2$J/K mol

D. $10\ \log 2$+8.3 J/K mol`

Answer: b

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14. For a process top be spontaneous, at constant temperature and pressure, there must be decreases in free energy of the system in the direction of the process, i.e. $\Delta G_{P.T.} < 0$. $\Delta_{P.T.} = 0$ implies the equilibrium condition and $\Delta G_{P.T.} > 0$ corresponding to non-spontaneity. Gibb's Helmholtz equation relates the free energy change to the enthalpy and entropy change of the process as :

$\Delta G_{P.T.} = \Delta H$ - $T\Delta S$......(i)

The magnitude of ΔH does not change much with the change in temperature but the entropy factor $T\Delta S$ changes appreciably. Thus, spontaneity of a process depends very much on temperature.

For edothermic proces, both $\Delta H$and ΔS are positive. The energy factor,the first factor of equation, opposes the spontaneity whereas entropy factor favours it . At low temperature, the favourable factor $T\Delta S$ will be small and may be less than $\Delta H, \Delta G$ will have positive value indicating the non-spontaneity of the process. On raising temperature, the factor $T\Delta S$ increases appreciably and when it exceeds $\Delta H, \Delta G$ would become negative and the process would be spontaneous.

For an exothermic process, both ΔH and ΔS would be negative. In this case, the first factor of equation(i) favours the spontaneity whereas the second factor opposes it. At high temperature, when $T\Delta S > \Delta H, \Delta G$ will have positive value, showing thereby the non-spontaneity of the process. However, on decreasing temperature, the factore $T\Delta S < \Delta H, \Delta G$ becomes negative and the process occurs spontaneously. Thus, an exothermic process may be spontaneous at low temperature and non-spontaneous at high temperature.

For the reaction $25\,^{\circ}C, X_2O_2(l) \rightarrow 2XO_2(g) \quad \Delta H = 2.1$ kcal and $\Delta S = 20$ cal K^{-1}. The reaction would be:

A. spontaneous

B. non-spontaneous

C. at equilibrium

D. unpredictable

Answer: a

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15. Standard Gibbs energy of reaction $\left(\Delta_r G^\circ\right)$ at a certain temperature can be completed as $\Delta_r G^\circ = \Delta_r H^\circ - T\delta_r S^\circ$ and the change in the value of $\Delta_r H^\circ$ and $\Delta_r S^\circ$ for a reaction with temperature can be computed as follows:

$$\Delta_r H^\circ_{T_2} - \Delta_r C^\circ_p \left(T_2 - T_1\right)$$

$$\Delta_r S^\circ_{T_2} - \Delta_r S^\circ_{T_1} = \Delta_r C^\circ_p \, In\left(\frac{T_2}{T_2}\right)$$

$$\Delta_r G^\circ = \Delta_r H^\circ - T.\Delta_r S^\circ$$

$$\Delta^\circ_r G^\circ = -RTInK_{eq}$$

Consider the following reaction :

$$CO(g) + 2H_2(g) \rightarrow CH_3OH(g)$$

Given

$$\Delta_r H^\circ \left(CH_3Oh, g\right] = -201KJ/mol$$

$$\Delta_r H^\circ (CO, g) = -114KJ/mol$$

$$s^\circ \left(CH_3OH, g\right) = 240J/mol - k,$$

$$S^\circ \left(H_2 g\right) = 198J/mol - K$$

$$C^\circ_{p.m}\left(h_2\right) = 28.8JK^{-1}mol^{-1}$$

$$C_{p.m(CO)} = 29.4J/mol - K$$

$C^{\circ}_{p.m}\left(CH_{3_{\square}}OH\right) = 44J/mol - K$

and $In\left(\frac{320}{300}\right) = 0.06$, all data at$300K$.

$\Delta_r H^{\circ}$ at 300K for the reaction is :

A. $-87K\frac{J}{m}ol$

B. $87KJ/mol$

C. $172J/mol - K$

D. none of these

Answer: a

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16. Enthalpy of neutralzation is defined as the enthalpy change when 1 mole of acid /base is completely neutralized by base /acid in dilute solution .

For Strong acid and strong base neutralization net chemical change is

$H^{+}(aq) + OH^{-}(aq) \rightarrow H_2O(l)$

$\Delta_r H^\circ = -55.84 KJ/mol$

$\Delta H^\circ_{\text{ionization}}$ of aqueous solution of strong acid and strong base is zero .

when a dilute solution of weak acid or base is neutralized, the enthalpy of neutralization is somewhat less because of the absorption of heat in the ionzation of the because of the absorotion of heat in the ionization of the weak acid or base ,for weak acid /base

$\Delta H^\circ_{\text{neutrlzation}} = \Delta H^\circ_{\text{ionization}} + \Delta_r H^\circ \left(H^+ + OH^- \rightarrow H_2O\right)$

What is ΔH° for complate neutralization of strong diacidic base $A(OH)_2 by HNO_3$?

A. $-55.84 KJ$

B. $-111.68 KJ$

C. $55.84 KJ$

D. none of these

Answer: b

17. 9.0 gm ice $0 ^\circ C$ is mixed with 36 gm of water at $50 ^\circ C$ in a thermally insulated container.using the following data , Answer the qusestion that follow :

$C_p\left(H_2O\right) = 4.18Jg^{-1}k^{-1}, \Delta H_{\text{fusion}} \ (ice) = 335Jg^{-1}$

$\Delta S_{ice} is$:

A. $11.04JK^{-1}$

B. $3.16JK^{-1}$

C. $14.2JK^{-1}$

D. $7.84Jk^{-1}$

Answer: c

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18. Liquid water freezes at 273K under external pressure of 1atm . The process is at eruilibrium

$H_2O(l) \rightarrow H_2O(S)at273K \text{ and } 1atm$

however , it required to calculate the thermodynamic parameters of the fusion process occurring at same pressure and different temperature . Using the following dat ,answer the questions thaat follow:

$d_{ice} = 0.9gm/, d_{H_2O(l)} = 1gm/cc, 1L - atm = 101.3J$

$C_p\left[H_2O(s)\right] = 36.4JK^{-1}mol^{-1}$

$C_p\left[H_2O(l)\right] = 75.3Jk^{-1}mol^{-1}$

$\Delta H_{\text{fusion}} = 6008.2mol^{-1}. Alldataat273K.$

ΔS_{fusion}at 263 K and 1atm will be :

A. $22.01JK^{-1}mol^{-1}$

B. $22.84JK^{-1}mol^{-1}$

C. $21.36JK^{-1}mol^{-1}$

D. $20.557JK^{-1}mol_{-1}$

Answer: d

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19. A mixture of hydrogen gas and theortical amount of air at $25\ ^\circ$ C and a total pressure of 1atm , is exploded in a closed right vessel . If the process ossurs under adiabatic conditions then using the given data anwer the question that follow :

Given :

$C_p(N_2)$ and $C_p(H_2O)$are8.3 and $11.3 cal deg^{-1} mol^{-1}$ not necessarily in the same order.

$\Delta H_f[H_2O(g)] = -57.8 kcal$

$\left[\text{take air as } 80\% N_2, 20\% O_2 \text{by volume.}\right]$

What will be the maxiimum temperature attained if the process occurs in adiabatic container?

A. $\cong 2940K$

B. $\cong 2665K$

C. $\cong 1900K$

D. $\cong 298K$

Answer: a

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20. The commercial production of 'Water gas' utilzes the endothermic reaction

$C(s)+H_2O(g) \rightarrow H_2(g)+CO(g)$

the heat required for this reaction is generated by combustion of coal to CO_2 using stoichiometric amount of air (79% N_2 by volume and 21%O_2 by volume). the superheated steam undergoes 75% conversion . usingthe following data ,answer the question that follows :

$\Delta H_f[CO(g)] = -110.53KJmol$

$\Delta H_f\left[H_2O(g)\right] = -241.81KJ/mol$

$\Delta H_f\left[CO_2(g)\right] = -314.0Kj/mol$

Match the gas and percentage of each gas in one litre product gases.

Gas	percentage
$(a)N_2$	$(p) \approx 23.1$
$(b)CO_2$	$(Q) \approx 36.4$
$(C)H_2$	$(R) \approx 7.7$
$(d)H_2O$	$(S) \approx 9.7$

A. (A-P),(B-Q),(C-R),(D-S)

B. (A-Q),(B-p),(c-S),(D-R)

C. (A-R),(B-s),(C-P),(D-R)

D. (A-Q),(B-S),(C-P),(D-R)

Answer: d

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21. Heat of neuralisation is amount of heat evolved or absorbed when $1g$ - equivalent of an acid reacts with $1g$ - equivalent of a base in dilute solution . If weak acid or weak bae are neutralised, the heat released during neutralisation is somewhat lesser than $-13.7kcal$ or $-57.27kJ$. Het of neutralisation is also referred as heat of formation of water from H^+ and OH^- ions $i.e.$, $H^+ + OH^- \rightarrow H_2O, \Delta H = -13.7kcal.$

$200mL$ of $0.1MNaOH$ is mixed with $100mL$ of $0.1MH_2SO_4$ in 1 experiment. In II experiment $100mL$ of $0.1MNaOH$ is mixed with $50mL$ of $0.1MH_2SO_4$.

Select the correct statements:

(1) heat liberated in each of the two reactions is $274cal$.

(2) heat liberated in I is $274cal$ and in II is $137cal$. ,brgt (3) temperature rise is I reaction is equal to the temperature rise in II.

(4) temperature rise in I reaction is equal to the temperaure rise in II

A. 1,3

B. 2,4

C. 2,3

D. 1,4

Answer: b

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3

1. Fuel cells are the commercial cells which converts the chemical energy into electrical energy and differ from the normal batteries since fuel cells require constant source of fuel and oxygen to obtain electric current. However, they can be used to produce electricity as long as the supply of fuel and oxygen is maintained. All fuel cells consist of an andoe and a cathode and an electrolyte which allows charges to move between the two sidez of the fuel cell. Electrons are drawn from anode to cathode through an external circuit and hence produce direct current electricity. Under practical cases, efficient of fuel cell is around $40 - 60\,\%$ and in some cases it may be as high as $85 - 90\,\%$

Some common examples of fuel cell are diect methanol fule cell (DMFC), Direct Borohydride fuel cell (DBFC), alkaline fuel cell (AFC) and others.While in DMFC the electrolyte is an ionomer (proton exchange monomer) in case of AFC and DBFC the electrolyte is an aqueous alkaline solution. Also, in case of DBFC the borohydride gets oxidised to metaborate, In all the above three cases, at cathode reduction of O_2(gas) occurs in a medium controlled by the electrolyte. Based on this information answer the electrolyte. Based on the information answer the question that follow :

Data

$\Big(\Delta H_f^\circ\, CH_3OH(l) = -230 kJ/\text{mole}, , \Delta H_f^\circ\, CO_2$=-390kJ//"mole"),

(Delta_(f)^(@)H_(2)O(l) = - 285 kJ//"mole",,S_(mH_(2)O(l))^(@)=130J//K "mole"),(S_(mCO_(2(g))) = 210 J//K "mole",S_(mH_(2)O(l))^(@) = 110 J//K "mol"),(S_(mO_(2(g)))=206J//K "mole",,S_(mH_(2(g))) = 130J//K "mole"),("All data at" 300 K.,1/F = 10^(-5)C^(-1)):}$If \in AFC$, H_(2)(g)` is used as anode then identify the options which are not correct for AFC.

A. Electricity and water will be obtained due to reaction

B. E°_{cell} at $300K = 1241V$ approx.

C. Magnitude of electrical work obtained will be less than magnitude of heat liberated at constant pressure.

D. The cathodic reaction will be

$$O_2 + 4e^{-}4H^{+} \rightarrow 2H_2O$$

Answer: b,d

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2. It is observed that when acid and bases react, some energy is released due to neutralization reaction. While in case of strong acid and bases, the energy released in greater, in case of weaker acids of bases, energy released will be lesser. The difference is attributed to energy required for ionization. From the above information and data below answer the questions that follow:

$\Delta H_{\text{neutrization SA/SB}}$=-57.5 kJ/equivalent,

$\Delta H_{\text{ionization}} of NH_4OH$=10kJ/mole,

$\Delta H_{\text{ionization}}$ of $H_2C_2O_4$=20kJ/ mole.

What will be final temperature attained if all the heat release in neutralization of 1 L of 0.2 M NH_4OH with 2 L of 0.1 M HCl increase the temperature of the final solution having density 0.95gm/ ml and specific heat capacity=$\frac{1}{3}J/gm\,^{\circ}\text{C}$ if original temperature was $27\,^{\circ}\text{C}$? Assume weak base to be completely unionized.

A. $310\,^{\circ}C$

B. 300K

C. 310K

D. 290K

Answer: c

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3. Cycloalkenes and alka- dienes are structural isomers and it is observed that the isomerisation reaction of cyclo-butene into 1,3, buta-diene follows 1st order kinetics with respect to cyclobutene. The rate constant of the reaction can be determined by hydrogenting (reaction with H_2 to remove unsaturation) the reaction mixture and different instant and measuring the amount of hydrogen required. In one such experiment two separate glass flasks of volume 1 litres. were added with same amount of cyclobutene and sealed. While one flask was broken after 138.6 min and the contents required 39.2 ml of H_2 gas at 1 atm pressure and 273K, where as other flask was broken after a very long time and the contents required 44.8 ml of H_2 gas at 1 tam pressure and 273K . From the information given above and given data, anwer the questions that follows:

ΔH_f° Cyclobutene=175kJ/mol

ΔH_f° Buta-1,3-diene =125kJ/mol

which of the followin cannot be a possible value of volume of hydrogen measured at 1 atm and 300K required if the first bottle is broken at any other tim?

A. 20ml

B. 25ml

C. 29ml

D. 40ml

Answer: a

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4. Dissociation of $NH_3(g)$ over solid platinum follows zero order kinetics.

$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

The rate of reaction is $2 \times 10^{-3} M\text{sec}^{-1}$. Also at 300K, thermodynamic data are:

$\Delta H_f^{\circ}\ NH_2$=-45kJ/mole $S^{\circ}_{N_2}$=190J/K mole

$S^{\circ}_{NH_3}$=200J/K mole, $S^{\circ}_{H_2}$=130J/K mole

From the above data and the assumption that $\Delta H^{\circ}_{\text{Rxn}}$ are independent of temperature, anwer the question that follows. [Take $R \times 300$kJ]

The temperature at which dissociation of ammonia attains equilibrium at 1 bar pressure is given by?

A. 500K

B. 400K

C. 300K

D. 200K

Answer: a

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5. The solubility on any substance in water may be classified as :

Molecular ability: AB(s/l/g) $\overset{aq}{\Leftrightarrow}$ AB(aq)

Ionic solubility : AB (s/l/g) $\overset{aq}{\Leftrightarrow} A^{+}(aq) + B^{-}(aq)$

For a substance AB(s) the following thermodynamic informations are available at 300K:

Molecular solubility: ΔH°=+20kcal/mol,

ΔS°=+40kcal/K-mole

Ionic solubility: ΔH°=-25 kcal/ mol,

ΔS°=-50 cal/K-mole

When the temperature of aqueous solution AB(s) is increased from 00K then the extent of :

A. molecular as well as ionic solubility increases

B. molecular as well as ionic solubility decreases

C. molecular solubility increases but ionic solubility decrease

D. molecular solubility decreases but ionic solubility increases

Answer: c

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6. A gaseous sample is generally allowed to do only expansion/compression type of work against its surroundings. The work done in case of an irreversible expansion (in the intermediate stages of expansion/ compression the states of gases are not defined). The work done can be calculated using

$dw = -P_{ext}dV$

while in case of reversible process the work done can be calculated using dw=-PdV where P is pressure of gas at some intermediate stages. Like for an isothermal reversible process, since

$P = \frac{nRT}{V}$,so,

$$w = \int dw = -\int_{V_i}^{V_f}\frac{nRT}{V}.dV = -nRT\ In\left(\frac{V_f}{V_i}\right)$$

Since,dw=PdV, so magnitude of work done can also be calculated by calculating the area under the PV curve of the reversible process in PV diagram.

In the above problem:

A. work done by gas Ist sample > work done by gas in IInd sample

B. work done by gas in IInd sample > work done by gas in Ist sample

C. work done by gas Ist sample=work done by gas in IInd sample

D. none of the above

Answer: a

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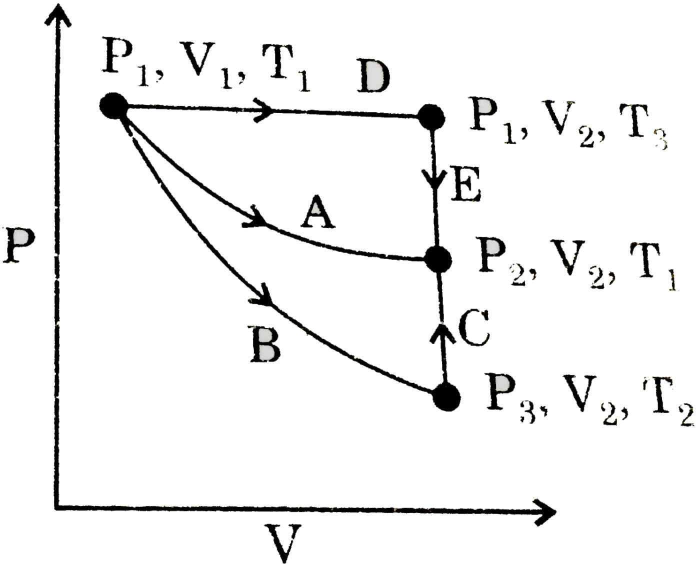
7. For an ideal monoatomic gas, an illustration of three different paths A, (B+C) and (D+E) from an initial state P_1, V_1, T_1 to a final state P_2, V_2, T_1 is shown in the given figure .



Path A represents a reversible isothermal from P_1V_1 to P_2, V_2, path (B+C) represent a reversible adiabatic expansion (B) from P_1, V_1, T_1 to P_3, V_2, T_2 followed by reversible heating of the gas at constant volume (C) from P_3, V_2, T_2 to P_2, V_2, T_1. Path (D+E) represents a reversible expansion at constant pressure $P_1(D)$ from P_1, V_1, T_1 to P_1, V_2, T_3 followed by a reversible cooling at constant volume $V_2(E)$ form P_1, V_2, T_3 to P_2, V_2, T_1

What is ΔS for (D+E)?

A. zero

B. $\int_{T_3}^{T_1} \frac{C_V(T)}{T} dt$

C. $-nR\ \text{In}\frac{V_2}{V_1}$

D. $nR\ \text{In}\frac{V_2}{V_1}$

Answer: d

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8. Entropy is a state function and its depends on two or three variable temperature (T), pressure(P) and volume (V). Entropy change for an ideal gas having number of moles (n) can be determined by the following equation:

$$\Delta S = 2.303nC_v \log\left(\frac{T_2}{T_1}\right) + 2.303nR \log\left(\frac{V_2}{V_1}\right)$$

$$\Delta S = 2.303nC_p \log\left(\frac{T_2}{T_1}\right) + 2.303nR \log\left(\frac{P_2}{P_1}\right)$$

Since free energy change for a process or a chemical equation is a deciding factor of spontaneity, which can be obtained by using entropy change (ΔS) according to the expression, $\Delta G = \Delta H - T\Delta S$ at a temperature T.

For a reaction $M_2O(s) \rightarrow 2M(s) + \frac{1}{2}O_2(g), \Delta H = 30$ kJ/mol and ΔS =0.07kJ/K-mol at 1 atm. Calculate upto which temperature the reaction would not be spontaneous.

A. $T > 428.6K$

B. $T > 300.8K$

C. $T < 300.8K$

D. $T < 428.6K$

Answer: d

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9. For a process top be spontaneous, at constant temperature and pressure, there must be decreases in free energy of the system in the direction of the process, i.e. $\Delta G_{P.T.} < 0. \Delta_{P.T.} = 0$ implies the equilibrium condition and $\Delta G_{P.T.} > 0$ corresponding to non-spontaneity. Gibb's Helmholtz equation relates the free energy change to the enthalpy and entropy change of the process as :

$\Delta G_{P.T.} = \Delta H$ - $T\Delta S$......(i)

The magnitude of ΔH does not change much with the change in temperature but the entropy factor $T\Delta S$ changes appreciably. Thus, spontaneity of a process depends very much on temperature.

For edothermic proces, both $\Delta H \text{and } \Delta S$ are positive. The energy factor,the first factor of equation, opposes the spontaneity whereas entropy factor favours it . At low temperature, the favourable factor $T\Delta S$ will be small and may be less than $\Delta H, \Delta G$ will have positive value indicating the non-spontaneity of the process. On raising temperature, the factor $T\Delta S$ increases appreciably and when it exceeds $\Delta H, \Delta G$ would become negative and the process would be spontaneous.

For an exothermic process, both ΔH and ΔS would be negative. In this case, the first factor of equation(i) favours the spontaneity whereas the second factor opposes it. At high temperature, when $T\Delta S > \Delta H, \Delta G$ will have positive value, showing thereby the non-spontaneity of the process. However, on decreasing temperature, the factore $T\Delta S < \Delta H, \Delta G$ becomes negative and the process occurs spontaneously. Thus, an exothermic process may be spontaneous at low temperature and non-spontaneous at high temperature.

For the reaction at 298K, $2A + B \rightarrow C \quad \Delta H$=100 kcal and ΔS = 0.050 kcal K^{-1}. If ΔH and ΔS are assumed to be constant over the temperature range, just above what temperature will be reaction become spontaneous?

A. 1000K

B. 1500K

C. 2000K

D. 2500K

Answer: c

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10. Standard Gibbs energy of reaction $\left(\Delta_r G^\circ\right)$ at a certain temperature can be completed as $\Delta_r G^\circ = \Delta_r H^\circ - T\delta_r S^\circ$ and the change in the value of $\Delta_r H^\circ$ and $\Delta_r S^\circ$ for a reaction with temperature can be computed as follows:

$$\Delta_r H^\circ_{T_2} - \Delta_r C_p^\circ \left(T_2 - T_1\right)$$

$$\Delta_r S^\circ_{T_2} - \Delta_r S^\circ_{T_1} = \Delta_r C_p^\circ In\left(\frac{T_2}{T_2}\right)$$

$$\Delta_r G^\circ = \Delta_r H^\circ - T.\Delta_r S^\circ$$

$$\Delta_r^\circ G^\circ = -RTInK_{eq}$$

Consider the following reaction :

$$CO(g) + 2H_2(g) \rightarrow CH_3OH(g)$$

Given

$$\Delta_r H^\circ \left(CH_3Oh, g\right] = -201KJ/mol$$

$$\Delta_r H^\circ (CO, g) = -114KJ/mol$$

$$s^\circ \left(CH_3OH, g\right) = 240J/mol - k,$$

$$S^\circ \left(H_2g\right) = 198J/mol - K$$

$$C^\circ_{p.m}\left(h_2\right) = 28.8JK^{-1}mol^{-1}$$

$C_{p.m(CO)} = 29.4J/mol\text{-}K$

$C^{\circ}_{p.m}\left(CH_{3_{\square}}OH\right) = 44J/mol\text{ - }K$

and $In\left(\frac{320}{300}\right) = 0.06$, all data at$300K$.

$\Delta_r s^{\circ}$ at 320K is:

A. 155.18 J/mol-K

B. 150.02J/mol-K

C. 172J/mol-K

D. none of these

Answer: d

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11. Enthalpy of neutralzation is defined as the enthalpy change when 1 mole of acid /base is completely neutralized by base /acid in dilute solution .

For Strong acid and strong base neutralization net chemical change is

$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

$\Delta_r H^\circ = -55.84 KJ/mol$

$\Delta H^\circ_{\text{ionization}}$ of aqueous solution of strong acid and strong base is zero .

when a dilute solution of weak acid or base is neutralized, the enthalpy of neutralization is somewhat less because of the absorption of heat in the ionzation of the because of the absorotion of heat in the ionization of the weak acid or base ,for weak acid /base

$\Delta H^\circ_{\text{neutrlzation}} = \Delta H^\circ_{\text{ionization}} + \Delta_r H^\circ \left(H^+ + OH^- \rightarrow H_2O\right)$

under same conditions ,how many mL of 0.1 m NaOH and 0.05 M H_2A (strong diprotic acid) solution should be mixed for a total volume of 100mL to producce the hight rise in temperature ?

A. $25:75$

B. $50:50$

C. $75:25$

D. $66.66:33.33$

Answer: b

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12. 9.0 gm ice $0\,^{\circ}C$ is mixed with 36 gm of water at $50\,^{\circ}C$ in a thermally insulated container.using the following data , Answer the qusestion that follow :

$C_p(H_2O) = 4.18 Jg^{-1}k^{-1}, \Delta H_{\text{fusion}}\ (ice) = 335 Jg^{-1}$

$\Delta S_{\text{water}} is$:

A. $-12.64 JK^{-1}$

B. $-0.34 JKJ^{-1}$

C. $-5.42 JK^{-1}$

D. $12.64 JK^{-1}$

Answer: a

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13. Liquid water freezes at 273K under external pressure of 1atm . The process is at eruilibrium

$H_2O(l) \rightarrow H_2O(S)at273K$ and $1atm$

however , it required to calculate the thermodynamic parameters of the fusion process occurring at same pressure and different temperature .

Using the following dat ,answer the questions thaat follow:

$d_{ice} = 0.9gm/, d_{H_2O(l)} = 1gm/cc, 1L - atm = 101.3J$

$C_p\left[H_2O(s)\right] = 36.4JK^{-1}mol^{-1}$

$C_p\left[H_2O(l)\right] = 75.3Jk^{-1}mol^{-1}$

$\Delta H_{\text{fusion}} = 6008.2mol^{-1}. Alldataat273K.$

At 1 atm and at different temperature given below Match the conditions and the temperature for the ' fusion ' process.

Condition	*Temperature*
$(a)Spontaneous$	$(P)273K$
$(B)Atequilibrium$	$(Q)260K$
(c)Not feasible	$(R)280k$

A. (A-R),(B-P),(C-Q)

B. (A-Q),(B-P),(C-R)

C. (A-R),(B-Q),(C-P)

D. (A-P),(B-Q),(C-R)

Answer: a

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14. A mixture of hydrogen gas and theortical amount of air at 25° C and a total pressure of 1atm , is exploded in a closed right vessel . If the process ossurs under adiabatic conditions then using the given data anwer the question that follow :

Given :

$C_p\left(N_2\right)$ and $C_p\left(H_2O\right)$are8.3 and $11.3 cal deg^{-1} mol^{-1}$ not necessarily in the same order.

$\Delta H_f\left[H_2O(g)\right] = -57.8 kcal$

$\left[\text{take air as } 80\,\%\,N_2, 20\,\%\,O_2 \text{by volume.}\right]$

What will be the final pressure in atm?

A. $\cong 8.5$

B. $\cong 7.6$

C. $\cong 5.46$

D. $\cong 0.85$

Answer: a

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4

1. A gaseous sample is generally allowed to do only expansion/compression type of work against its surroundings. The work done in case of an irreversible expansion (in the intermediate stages of expansion/ compression the states of gases are not defined). The work done can be calculated using

$dw = -P_{\text{ext}}dV$

while in case of reversible process the work done can be calculated using

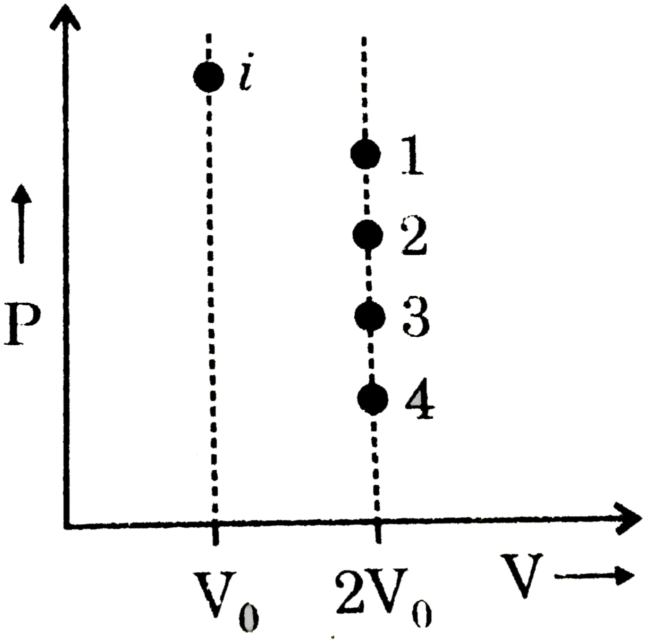
dw=-PdV where P is pressure of gas at some intermediate stages. Like for an isothermal reversible process, since

$P = \frac{nRT}{V}$,so,

$$w = \int dw = -\int_{V_i}^{V_f}\frac{nRT}{V}.dV = -nRT \quad In\left(\frac{V_f}{V_i}\right)$$

Since,dw=PdV, so magnitude of work done can also be calculated by calculating the area under the PV curve of the reversible process in PV diagram.

If four identical samples of an ideal gas initially at similar state $\left(P_0, V_0, T_0\right)$ are allowed to expand to double their volumes by four different processes.



(P)By isothermal irreversible process

(Q) By reversible process having equation $P^2V =$ constant

(R) By reversible adiabatic process

(S)By irreversible adiabatic expansion against constant external pressure.

Then in the graph shown the final state is represented by four different points then, the correct match can be :

A. $1 - P, 2 - Q, 3 - R, 4 - S$

B. $1 - Q, 2 - P, 3 - S, 4 - R$

C. $2 - R, 3 - Q, 4 - P, 1 - S$

D. 3-Q,1-P,2-S,4-R`

Answer: b

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2. For a process top be spontaneous, at constant temperature and pressure, there must be decreases in free energy of the system in the direction of the process, i.e. $\Delta G_{P.T.} < 0. \Delta_{P.T.} = 0$ implies the equilibrium condition and $\Delta G_{P.T.} > 0$ corresponding to non-spontaneity. Gibb's Helmholtz equation relates the free energy change to the enthalpy and entropy change of the process as :

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A reaction has a value of ΔH=-40 kcal at 400K . Above 400K, the reaction is spontaneous, below this temperature, it is not. The value of ΔG and ΔS at 400K are respectively:

A. $0, \ -0.1, calK^{-1}$

B. $0, 100calK^{-1}$

C. $-10kcal, \ -100calK^{-1}$

D. $0, \ -100calK^{-1}$

Answer: d

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3. Standard Gibbs energy of reaction $\left(\Delta_r G^\circ\right)$ at a certain temperature can be completed as $\Delta_r G^\circ = \Delta_r H^\circ - T\delta_r S^\circ$ and the change in the value of $\Delta_r H^\circ$ and $\Delta_r S^\circ$ for a reaction with temperature can be computed as follows:

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$$\Delta_r S^\circ_{T_2} - \Delta_r S^\circ_{T_1} = \Delta_r C_p^\circ \, In\left(\frac{T_2}{T_2}\right)$$

$\Delta_r G^\circ = \Delta_r H^\circ - T.\Delta_r S^\circ$

$\Delta_r^\circ G^\circ = -RTInK_{eq}$

Consider the following reaction :

$CO(g) + 2H_2(g) \rightarrow CH_3OH(g)$

Given

$\Delta_r H^\circ \left(CH_3Oh, g\right] = -201KJ/mol$

$\Delta_r H^\circ (CO, g) = -114KJ/mol$

$s^\circ \left(CH_3OH, g\right) = 240J/mol - k,$

$S^\circ \left(H_2 g\right) = 198J/mol - K$

$C_{p.m}^\circ \left(h_2\right) = 28.8JK^{-1}mol^{-1}$

$C_{p.m(CO)} = 29.4J/mol - K$

$C_{p.m}^\circ \left(CH_{3_\square} OH\right) = 44J/mol - K$

and $In\left(\frac{320}{300}\right) = 0.06$, all data at300$K$.

$\Delta_r H^\circ$ at 320K is :

A. $-288.86KJ/mol$

B. $-289.1KJ/mol$

C. $-87.86K\frac{J}{m}ol$

D. none of these

Answer: c

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4. 9.0 gm ice $0^{\circ} C$ is mixed with 36 gm of water at $50^{\circ} C$ in a thermally insulated container.using the following data , Answer the qusestion that follow :

$C_p\left(H_2O\right) = 4.18Jg^{-1}k^{-1}, \Delta H_{\text{fusion}}\ (ice) = 335Jg^{-1}$

What I dthe total entropy change in the process?

A. $-1.56JK^{-1}$

B. $-1.60Jk^{-1}$

C. $1.56JK^{-1}$

D. $1.60JK^{-1}$

Answer: c

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5. Liquid water freezes at 273K under external pressure of 1atm . The process is at eruilibrium

$H_2O(l) \rightarrow H_2O(S) at 273K$ and $1 atm$

however , it required to calculate the thermodynamic parameters of the fusion process occurring at same pressure and different temperature . Using the following dat ,answer the questions thaat follow:

$d_{ice} = 0.9 gm/, d_{H_2O(l)} = 1 gm/cc, 1L - atm = 101.3J$

$C_p\left[H_2O(s)\right] = 36.4 JK^{-1} mol^{-1}$

$C_p\left[H_2O(l)\right] = 75.3 Jk^{-1} mol^{-1}$

$\Delta H_{\text{fusion}} = 6008.2 mol^{-1}. All data at 273K.$

for the fusion process at 263 k, match the conditiions with the pressure .

Condition	Temperature
(a)Spontaneous	(P)1atm
(B)Atequilibrium	(Q)1060atm
(c)Not feasible	(R)2000atm

A. (A-Q),(B-R),(c-P)

B. (A-P),(B-Q),(c-R)

C. (A-R),(B-Q),(C-A)

D. (A-P),(B-R),(C-Q)

Answer: c

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6. A mixture of hydrogen gas and theortical amount of air at 25° C and a total pressure of 1atm , is exploded in a closed right vessel . If the process ossurs under adiabatic conditions then using the given data anwer the question that follow :

Given :

$C_p(N_2)$ and $C_p(H_2O)$ are 8.3 and $11.3 cal deg^{-1} mol^{-1}$ not necessarily in the same order.

$\Delta H_f[H_2O(g)] = -57.8 kcal$

$\left[\text{take air as } 80\% N_2, 20\% O_2 \text{by volume.}\right]$

If at a initial temperature $T_1, (e_1)$ is initial energy and higher final temperature ,T_2, E_2 is the final internal energy , then which option is true?

A. $E_1 > E_2$

B. $E_2 > E_1$

C. $E_1 = E_2$

D. can't be compared from the given data

Answer: c

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5

1. A gaseous sample is generally allowed to do only expansion/compression type of work against its surroundings. The work done in case of an irreversible expansion (in the intermediate stages of expansion/ compression the states of gases are not defined). The work done can be calculated using

$dw = -P_{\text{ext}} dV$

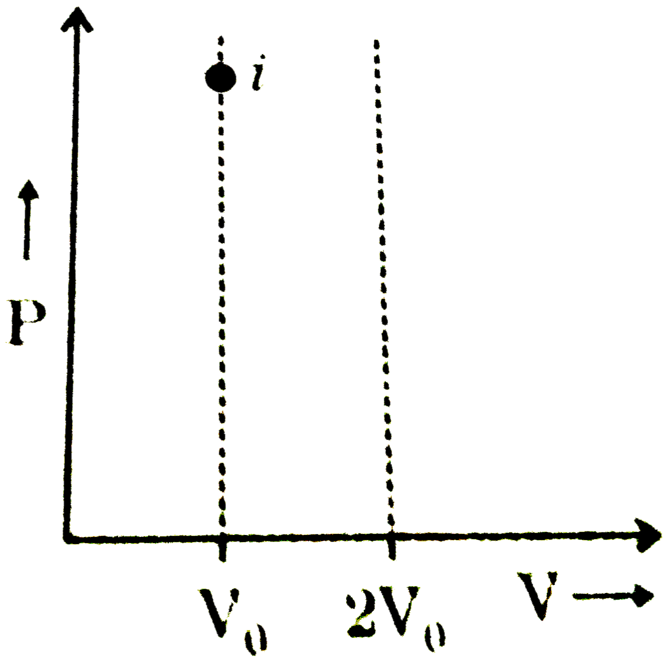
while in case of reversible process the work done can be calculated using dw=-PdV where P is pressure of gas at some intermediate stages. Like for an isothermal reversible process, since

$P = \frac{nRT}{V}$,so,

$$w = \int dw = -\int_{V_i}^{V_f} \frac{nRT}{V} . dV = -nRT \quad In\left(\frac{V_f}{V_i}\right)$$

Since,dw=PdV, so magnitude of work done can also be calculated by calculating the area under the PV curve of the reversible process in PV diagram.

Two samples (initially under same states) of an idea gas are first allowed to expand to doubletheir volume using irreversible isothermal expansion against constant external pressure, then samples are turned back to their original volume first by reversible process having equation PV^2= constant then:



A. final temperature of both samples will be equal

B. final temperature of first sample will be greater than of second sample

C. Final temperature of second sample will be greater than of first sample

D. none of the above

Answer: c

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2. For a process top be spontaneous, at constant temperature and pressure, there must be decreases in free energy of the system in the direction of the process, i.e. $\Delta G_{P.T.} < 0. \Delta_{P.T.} = 0$ implies the equilibrium condition and $\Delta G_{P.T.} > 0$ corresponding to non-spontaneity. Gibb's Helmholtz equation relates the free energy change to the enthalpy and entropy change of the process as :

$\Delta G_{P.T.} = \Delta H$ - $T\Delta S$......(i)

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The enthalpy change for a certain reaction at 300K is -15.0 k cal mol^{-1}. The entropy change under these conditions is -7.2 cal $K^{-1}mol^{-1}$. The free energy change for the reaction and its spontaneous/non-spontaneous character will be :

A. -12.84 kcal mol^{-1}, spontaneous

B. 12.84 kcal mol^{-1}, non-spontaneous

C. -17.16kcal mol^{-1},spontaneous

D. none of the above

Answer: a

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3. Standard Gibb's energy of reaction $\left(\Delta_r G^\circ\right)$ at a certain temperature can be computed $\Delta_r G^\circ = \Delta_r H^\circ - T.\Delta_r S^\circ$ and the change in the value of $\Delta_r H^\circ$ and $\Delta_r S^\circ$ for a reaction with temperature can be computed as follows :

$$\Delta_r H^\circ_{T_2} - \Delta_r H^\circ_{T_1} = \Delta_r C^\circ_p\left(T_2 - T_1\right)$$

$$\Delta_r S^\circ_{T_2} - \Delta_r S^\circ_{T_1} = \Delta_r C^\circ_p \ln.\left(\frac{T_2}{T_1}\right)$$

$$\Delta_r G^\circ = \Delta_r H^\circ - T.\Delta_r S^\circ$$

and by $\Delta_r G^\circ = -\text{RT}\ \ln K_{eq}$.

Consider the following reaction : $CO(g) + 2H_2(g) \Leftrightarrow CH_3OH(g)$

Given : $\Delta_f H^\circ\left(CH_3OH, g\right) = -201\ \text{kJ/mol}$, $\Delta_f H^\circ(CO, g) = -114\ \text{kJ/mol}$

$S^\circ\left(CH_3OH, g\right) = 240\ \text{J/K-mol}$, $S^\circ\left(H_2, g\right) = 29\ \text{JK}^{-1}\ \text{mol}^{-1}$

$S^\circ(CO, g) = 198\ \text{J/mol-K}$, $C^\circ_{p,m}\left(H_2\right) = 28.8\ \text{J/mol-K}$

$C^\circ_{p,m}(CO) = 29.4\ \text{J/mol-K}$, $C^\circ_{p,m}\left(CH_3OH\right) = 44\ \text{J/mol-K}$

and $\ln\left(\frac{320}{300}\right) = 0.06$, all data at 300 K

$\Delta_r G^\circ$ at 320 K is :

A. $-48295.2 KJ/mol$

B. $-240.85 KJ/mol$

C. $240.85 KJ/mol$

D. $-81.91 KJ/mol$

Answer: d

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Reasoning type

1. Statement-1: Adiabatic free expansion of any subatance in a cosed system will not cause any change in temperature of the substance.

Statement-2: In adiabatic free expansion of any substance in a closed system, internal energy will remain constant.

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: d

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2. Statement-1: The heat absorbed during the adiabatic expansion of an a ideal gas against vacuum is zero.

Statement-2:The volume occupied by an ideal gas is zero.

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: c

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3. Consider a reaction :

$A(g) + 2b(g) \rightarrow C(g)$

$\Delta H^{\circ}_{300} = 40KJ, \Delta S^{\circ}_{300} = -400J/K$

Given :ΔH° and ΔS° are temperature indendent.

Statement-1: The above reaction will be non-spontaneous if only A and B both are at standard conditions .

Statement-2: The above reaction will be non-spontaneous if only A and B both are at Standard conditions .

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: d

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4. Statement-1: The enthalpy of formation of H_(2)O(l)is greater than of H_(2)O(g) in magnitude.

Statement -2: Enthalpy chnge Is negative for the condensation reaction

$H_2O(g) \rightarrow H_2O(l)$

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: a

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5. Statement -1: heat of neutralistion of perchoric acid , $HClO_4$ with NaOH is same as that of Hcl with NaOH .

Statement -2: Both HCl and $HClO_4$ are strong acid

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: a

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6. Statement -1: When a gas at high pressure expands against vaccum, the magnitude of work done is maximum.

Statement -2: Work done in expansion deends upon the pressure inside the gas and increase in volume.

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: d

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7. Statement -1 in the following reaction :

$C(s) + O_2(g) \rightarrow CO_2(g), \Delta H = \Delta U - RT$

Statement -2: ΔH Is related to ΔU by the equation ,

$\Delta H = \Delta + \Delta n_g RT$

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: d

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8. Staement -1: The heat absorbed during the isothermal expansion of an ideal gas againt vacuum is zero .

Statement -2: The volume occupied by the molecules of an ideal gas is zero.

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: b

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9. Staetement -1: The magniyude of the work involed in an isothermal expansion is greater than that involved in an adiabatic expansion.

Statement -2: P-v cure (pon y -axas and V on X-axas) decrease more repidly for reversible asiabatic expansion compared to reversible isothermal expansion starting from same initial state.

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: a

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10. Statement -1: Entropy change in reversible adiabatic expansion of an ideal gas is zero.

Statement-2: The increase in entropy due to volume increase just compensates the decrease in entropy due to fall in temperature.

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: a

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11. Statement -1: The Standard free energy changes of all spontaneously occurring reactions are negative .

Statement-2: The standard free energies of the elements in their standard states at 1 bar and 2985K aare taken aszero.

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: b

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12. Statement -1: Enthalpy and entropy of any elements substance in the standard states are taken as zero .

Statement-2: At absolute zero , partiles of the perfectly crystalline substance become completely motioness.

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: d

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13. Statement-1: A reaction which is spontaneous and accompained by decrease of randomness must be exothermic.

Statement -2: All exothermic reaction that are accomained by decrease of randomness.

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: c

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14. Statement -1: Many endothermic reactions that are not spontaneous at room temperature become spontaneous at high temperature.

Statement-2: ΔH° of the endothermic recation increases with increases with increase in temperature.

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: b

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15. Statement-1: Decrease of free energy during the process under constant temperature and pressure provides a measure of its spontaneity.

Statement -2: A spontaneous change must have +ve sign of ΔS_{system}.

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: c

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16. Statement -1: For every chmical reaction at equilibrium , standard Gidds energy of reaction is zero

Statement-2: At constant temperature and pressure , chemical reactions are spontaneious in the direction of decreasing gibbs energy.

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: d

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17. Statement-1: There is a natural asymmetry between work to heat and converting heat to work .

Statement-2: No process is possible in which the sole result is the absorption of heat from a reservoir and its complaete conversion into work .

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: a

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18. Statement-1: A reaction with $K_p = \frac{1}{1.005} atm^2$ is expected to be spontaneous with negative conditions .

Statement-2: Reactions with negative$\Delta G^{\circ}_{\text{reaction}}$ will be spontaneous at standard condition .

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: a

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19. Statement-1: Combustion of all organic compounds is an exothermic reaction .

Statement-2: The enthalpy of formation of all elements in their standard state are zero.

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: b

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20. Statement-1:A liquid crystallises into a solid and is accompainied by decrease in entropy.

Statement -2: In crystals, moles cules organise in an ordered manner.

A. Statement-1 is True, Statement -2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement -1 is True ,Starement -2 is True ,Statement-2 is not a correct explanation for Statement-1

C. Statement-1 is True ,Statement-2 is False.

D. Statement-1 is False ,Statement-2 is True.

Answer: a

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MULTIPE OBJECTIVE TYPE

1. Which of the following statement (s) is /are true ?

A. for any substance $\Delta S^{\circ}_{vap} > \Delta S^{\circ}_{fusion}$

B. Greater amount of heat will be requried to dissociate ammmonia gas into nitrogen and hydrogrn gas at constant pressue condition at same temperature

C. The reaction having rate law $= K[A]^2[B]^1$ will follow first order kinetics if concentration of $[B]$ is kept constant .

D. Normally of $KMno_4$ in alkaline medium may be either equally to molarity or may be three times molarity

Answer: a,b,d

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2. Which of the following option(s) will show a decrease in Gibbs free energy ?

A. Combustion of propane at 1 bar and 500 K.

B. Vapourisation of any liquild at 1 atm and above its normal bolling point.

C. Fusion of H_2O at 1 atm and $0\,^{\circ}C$ if its normal melting point is $0\,^{\circ}$ C.

D. Vapourisation of H_2O at $100\,^{\circ}C$and 1 bar if its normal boling ponts is $100\,^{\circ}C$.

Answer: a,b,d

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3. The enthalpy and entropy change of trimerization of gas phase $\left(3A(g) \rightarrow A_3(g)\right)$ at $300K$ are $-100K/J\text{mole}$ amd $-400J/K\text{mole}$ respectively . If the bolling points of A and A_3 are 300 K and 400 K respectively .

Given : $C_{\text{pm}_{A_3(g)}} = C_{\text{pm}_{A_3(l)}}, d_{A(l)} = 1.2g/ml,$

$d_{A_{3(l)}}$ = $1.5g/ml$, molar masss of A =20 garm

Assume : Density of $A_3(l)$ and $A(l)$ are independent of pressure.

A. ΔH " for trimerisation in liquid phases "

at$300K$ =-$125KJmol^{-1}$

B. ΔS "for trimerisation in liquid phase "

at $300K$ =-$275kJmol^{-1}$

C. At standard state of $300K\Delta G$ of the reaction :

$3A(l) \rightarrow A_3(l)\text{is}7500J$

D. The equilibrium pressure of the reaction

$3(A) \rightarrow A_3(l)is7.501 \times 10^8\text{Pa at}300K$

Answer: c,d

View Text Solution

4. A substance A has the following variation of vapour presesure with temperature for its solid state and liquild state . Indentify the options which are correct :

Date : For solid A: $\log_{10} P = 4 - \dfrac{200}{T}$

For liquind A : $\log_{10} P = 3.48 - \frac{1500}{T}$

where P is in mm of Hg and T in K.

A. Enthalpy of vapourisation and enthalpy of fusion will be temperature independent.

B. $\Delta H_{\subset .}$ will be approximately $9.212 kcal/mol$.

C. ΔH_{fusion} will be approximately $2.303 kcal/mol$.

D. ΔH_{vap} will be approximately $6.909 kcal/mol$.

Answer: a,b,c,d

View Text Solution

5. In the thermite reaction used for obtaining energy, aluminium and ferric oxide react to from iron and aluminium oxide . From the given datw identify the option (s) which is (are) correct :

[Given :$\Delta H_f^{\circ} Al_2O_3 = -390 KJ/\text{mole}$,

$\Delta H_f^{\circ} Fe_2O_3 = -176 kJ/mol$, density of aliuminium $= 2.7 gm/ml$

density of $Fe_2O_3 = -3.2 gm/ml]$

A. Maximum calorific value of the fuel can be $1000 J/gm$.

B. Maximum calorific vale of the fuel can be $\frac{21.4}{7} kJ/ml$.

C. $2.14 kg$ of the mixture can produce 2500 kJ of heat .

D. $140 ml$ of the mixture can produce 280 kJ of heat .

Answer: a,b,d

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6. Which of the following statement(s) are incorrect ?

A. Combustion of methane in an abiabatic rigid container will cause no charge in temperature of the system .

B. It is possible to have both adiabatic reversible and adicbatic irreversible peocesses between two states.

C. For a reaction involing only ideals gasese, occuring at constant temperature there will be no chager in internal energy

D. P-V work is always non -zero when there is change in volume .

Answer: a,b,c,d

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7. Which of the following process must be spontaneous ?

A. Isobaric and isoentropic process with negative enthalpy charge.

B. Isobaric and isoentropic process with negative internal energy change .

C. A process with constant internal energy and isothermal with an increase in entropy of system

D. An adiabatic process with constant volume consition and entropy of system increasing .

Answer: a,d

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8. 3 moles of an ideal gas$(\gamma = 5/3)$ is subjected to following charge of state .

Identify the correct statement :

satete A(400 K, 2 bar) $\xrightarrow{\text{Reversible}}$ isothermal cooling state B

$\left(T_B, T_B\right) \xrightarrow{\text{Reversible}}$ isothermal expansion$StateC$

$(300K, 1\text{bar}) \xrightarrow{\text{Asiabatic}}$ free expansion$StateD\left(T_D, 0.5\text{bar}\right)$

A. T_B and T_D will be same and equal to 300 K

B. $\Delta H_{AD} = 750R$

C. $\Delta S_{AC} = 0$

D. $\Delta E_{BD} = 0$

Answer: a,d

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9. One mole of an ideal diatomic gas $\left(C_v = 5calK^{-1}\text{mole}^{-1}\right)$ chagre its state from state 1 $\left(27\,^{\circ}C1L\right)$ to state 2 $\left(127\,^{\circ}C, 10L\right)$. For this process, which of the following is (are) correct? $\left(Given: R = 2calK^{-1}\text{mole}^{-1}\right)$

A. $\Delta H = 700cal$

B. $\Delta U = 500cal$

C. $\Delta S = 5\ln\left(\frac{4}{3}\right) + 2\ln 10calK^{-1}$

D. ΔG of the process can't be calculated using given information.

Answer: a,b,c,d

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10. An ideal gas is expanded so that the amount of heat transferred to the gas is equal to the double the decrease in enthalpy . Indentify the options which are correct .[Symbols have usual meaning]

A. $PV^{\frac{3\gamma}{2\gamma+1}}$ = constant

B. Molar heat cacity $=2C_p$

C. $TV^{\frac{\gamma-1}{2\gamma+1}}$ = constant

D. $P^{1-\gamma}T^{\gamma}$=constant

Answer: a,c

View Text Solution

11. For a reaction $:2A(g) \rightarrow B(g), \Delta H = -40Kcal$. If rate constant for disapperance of A is $10^{-2}M^{-1}\sec^{-1}$ then identify the opations which will be correct

[Assume gases to behave ideally and reaction to be occuring at 300 K] [Take : R=2 cal/mole K]

A. The reaction must be elementary reaction.

B. Change in internal energy of the reaction will be $-19.7kcal/\text{mole}$ ofA consumed.

C. The rate at which heat will be liberated initially when 2 moles of A is taken in 3 litre rigid vessel will be approx $0.26 kcal / \sec.$

D. Time requried for concentration of A

Answer: b,d

View Text Solution

12. For which of the reaction reaction $|\Delta H| > |\Delta U|$?

A. $C_2H_6 + \frac{7}{2}O_2 \rightarrow 2CO_2 + 3H_2O$ at 1 bar and 27

B. $C_6H_6(l) \rightarrow C_6H_6(g)$

C. $N_6(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$

D. $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

Answer: b,c,d

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13. Which of the following statement(s) is/are incorrect for a reaction , $A_2(g) + B(g) \rightarrow A_2B(g)$ assuming ideal gas behaviour if ΔH_R° =- $100 Kcal/\text{mole}$ and ΔS_R° =-$\frac{1}{3} kcal/$ mole K at temperature $T = 300K.$

A. The reaction is at equilibrium when occuredat 1 bar pressure of each gas and 300 K.

B. No non-P V work can be obtained from the reaction at 300 K at stander conditions

C. In a rigid container the above reaction will be spontaneious at 300 K.

D. When performed in a rigid conatiner the reaction will be endothermic.

Answer: c,d

View Text Solution

14. One mole of an ideal diatomic gas $\left(C_v = 5cal\right)$ was transformed is $25\,^\circ$ and 1 L to the state when temperature is $100\,^\circ$ and volume 10 L. Then for the process :(R=2 Calories/mole/K) (take calopries as unit of energy and kelvin for tempertaure)

A. $\Delta H = 525$

B. $\Delta S = 5In\frac{373}{298} + 2In10$

C. $\Delta E = 525$

D. ΔG of the process cannot br calculated using given information.

Answer: a,b,d

View Text Solution

15. Consider the reactions:

(P) $S(\text{rhombic}) + \frac{3}{2}O_2(g) \rightarrow SO_3(g), \quad \Delta H_1$

(Q) S$(\text{Monoclinic})0 + \frac{3}{2}O_2(g) \rightarrow SO_2 \quad \Delta H_2$

(R) $S(\text{rhiombic}) + O_3(g) \rightarrow SO_3(g) \quad \Delta H_3$

(S) $S(\text{monoclince}) + O_3(g) \rightarrow SO_3(g) \quad \Delta H_4$

A. $\Delta H_1 < \Delta H_2 < \Delta H_4$ (magnitude only)

B. $\Delta H_1 < \Delta H_3 < \Delta H_4$(magnitude only)

C. $\Delta H_1 < \Delta H_2 = \Delta H_3 < \Delta H_4$(magnitude only)

D. $\Delta H_1 + \Delta H_4 = \Delta H_2 < \Delta H_3$

Answer: a,b,d

View Text Solution

16. The normal boiling point of a liquid X is 400 K. Which of the following statement I dtrue about the process $X(l) \rightarrow X(g)$?

A. At 400 k and 1 atm pressure $\Delta G = 0$

B. At 400 k and 2 atm pressure $\Delta G = + ve$

C. At 400 k and 0.1 atm pressure $\Delta G =$ - ve

D. At 410 k and 1 atm pressure $\Delta G = +ve$

Answer: a,b,c,d

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17. The following is(are) endothermic reaction (s):

A. Combustion of methane

B. decomposition of water

C. dehydrogenation of etheane to ethylene

D. conversion pf graphite to diamond.

Answer: b,c,d

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18. Among the following , the state function (s) is(are):

A. internal energy

B. irrevcersible expansion work

C. reversible expansion work

D. molar enthalpy

Answer: a,d

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19. The value of $\Delta H_{transition}$ of C(diamond) is 1.9 kJ/mol at $25\,^{\circ}$C. Entropy graphite id higher than entropy of diamond . The implies that.

A. C(diamond) is thermodynamically more satble than (graphite) at $25\,^{\circ}$C.

B. C(graphite) is thermodynamically more satble than (diamond) at $25\,^{\circ}$C.

C. diamond will provide more heat om complete sombustion at $25\,^{\circ}$ C.

D. $\Delta G_{transition}$ of $C(\text{diamond})\text{to}C(\text{graphite})$ is -ve

Answer: b,c,d

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20. Which of the following stament (s) is/are false ?

A. All adiabatic processes are isoentropic (orisentrophic) processes

B. When $\left(\Delta G_{system}\right)_{T,P} < 0:$ the reaction must be exothermic.

C. dG=VdP-SdT is applicable for closed system both PV and non -PV work

D. the heat of vaproisaton of water at 100° C is $40.6kJ/mol$. When 9 gm of water vapour condeneses to liquid at 100°C and 1 atm, then $\Delta S_{system} = 54.42J/K$

Answer: a,b,c,d

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21. Which of the following stament (s) is/are false ?

A. $\Delta E = 0$ for combutins of $C_2H_6(g)$ in a sealed rigid adiabatic container

B. $\Delta_f H^\circ (S, \ \text{monoclinic}) \neq 0$

C. If dissociation enegry $CH_4(g)$ is $1656 KJ/\text{mole}$ and $C_2H_6(g)$ is $2812 kJ/\text{mole}$,then value of C-C bond energy will be $328 kJ/\text{mol}$.

D. If $\Delta H_f\left(H_2O, g, \right) = -242 kJ/mol, \ \Delta H_{vap}\left(H_2O, l\right) = 44 kJ/mol$ then $\Delta_f H^\circ \left(OH^-, aq\right)$ will be be-142 kJ/mol

Answer: a,b,c,d

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22. From the following date , mark the opation(s) where ΔH is correctly written for the given reaction .

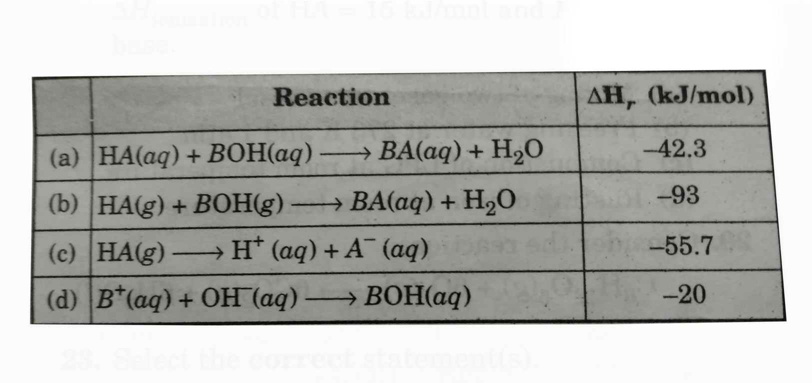
Given: $H + (aq) + OH - (aq) \rightarrow H_2O(l)$,

$\Delta H = - 57.3kJ$

$\Delta H_{solution} HA(g) = - 70.7kJ\text{mole}$

$\Delta H_{solution} BOH(g) = - 20kJ\text{mole}$

$\Delta H_{\text{ionzatoin}}$ of $HA = 15kJ/\text{mole}$ and BOH is a strong base.



	Reaction	ΔH_r (kJ/mol)
(a)	$HA(aq) + BOH(aq) \longrightarrow BA(aq) + H_2O$	–42.3
(b)	$HA(g) + BOH(g) \longrightarrow BA(aq) + H_2O$	–93
(c)	$HA(g) \longrightarrow H^+(aq) + A^-(aq)$	–55.7
(d)	$B^+(aq) + OH^-(aq) \longrightarrow BOH(aq)$	–20

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23. Select the correct statement (s).

A. System having non-permeable and adiabatic boundry must be isolated .

B. Molarity , normality and molality all are intensive properties .

C. $\Delta U = q + w$ can be used for any system.

D. Closed system can transfer energy only .

Answer: b,d

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24. Select the correct statement for an ideal gas undergoinf reversible or irreversible adiabatic process from same initial process

A. For same final pressure, final ktemperature is more in irreversible process

B. For same final volume, final temperature is more in irreversible process

C. For same final temperature final pressure is more in irreversible process

D. For same final temperature final volume is more in irreversible process

Answer: a,b,d

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25. For the charge :

$R \to P : \quad \Delta H = \text{ - } ve$

If in above reaction , the randomnes of system increases then:

A. $\Delta H_f(P) > \Delta H_f(R)$

B. $\Delta H_C(P) > \Delta H_C(R)$

C. $\Delta G_f(P) > \Delta G_f(R)$

D. $\Delta S_f(P) > \Delta S_f(R)$

Answer: b,d

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26. Which of the following statement is .are correct ?

A. Internal energy can be written as U=f(P,T) for a substance (no physical or chemical change)

B. Absolute value of entropy can be determined

C. The heat absored during the isothernal expansion of an ideal gas against vacuum is zero

D. During an adiabatic reversible expansion of an ideal gas, temperature of the system increases.

Answer: a,b,c,d

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27. For a soild A(s) following sate is giiven is given

$\Delta H^{\circ}_{fusion} = 20kJ\text{mole}^{-1}$

$\Delta S^{\circ}_{fusion} = 50 kJ\text{mole}^{-1} K^{-1}$

Identify correct option(s) at 1 bar .

A. Freezing is reversible at 450 K

B. Freezing is spontaneous at 500 K

C. Melting is spontaneous at 500 K

D. Melting is non-spontaneous at 400 K

Answer: b,c

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28. Which of the following processe will lead to increase in entropy of universe?

A. Mixing of two gases in a vessel

B. Freezing water at 273 K and 1 atm

C. Combustion of LPG at room temperature

D. Rusting of iron at room temperature

Answer: a,c,d

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29. Consider the reaction,

$C_6H_{12}O_6(g) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$,

which of the following expressions is /are correct?

A. $\Delta H^{\circ}_{reaction} = 6\Delta H_f^{\circ}\left(CO_2\right) + 6\Delta H_f^{\circ}\left(H_2O\right) - \Delta H_f^{\circ}\left(C_6H_{12}O_6\right)$

B. $\Delta G^{\circ}_{reaction} = 6\Delta G_f^{\circ}\left(CO_2\right) + 6\Delta G_f^{\circ}\left(H_2O\right) - \Delta G_f^{\circ}\left(C_6H_{12}O_6\right)$

C. $\Delta S^{\circ}_{reaction} = 6\Delta S_f^{\circ}\left(CO_2\right) + 6S^{\circ}\left(H_2O\right) - S^{\circ}\left(C_6H_{12}O_6\right)$

D. $\Delta S^{\circ}_{reaction} = 6\Delta S^{\circ}\left(CO_2\right) + 6S^{\circ}\left(H_2O\right) - S^{\circ}\left(C_6H_{12}O_6\right) - 6S^{\circ}\left(O_2\right)$

Answer: a,b,d

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30. The integral enthaiply of solution of one mole of H_2SO_4 with n mole of water is given by the equation

$\Delta H = \dfrac{-75.6n}{n + 1.8}$ which of the following option(s) is/are correct ?

A. When 1 mole of H_2SO_4 is dissolved in 2 mole of

$H_2O. \Delta H_{sol} = -39.79kJ$

B. When 1 mole of H_2So_4 is dissolved in 7 mole of

$H_2O, \Delta H_{sol} = -60.14kJ$

C. When 1 mole of H_2So_4 is dissolved in 7 mole of

$H_2O, \Delta H_{sol} = -23.5kJ$

D. When 1 mole of H_2So_4 is dissolved in 7 mole of

$H_2O, \Delta H_{sol} = -75.6kJ$

Answer: a,b,d

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31. The standard enthaply of fromation of CO_2will be given by:

A. standard enthaply of combustion of diamond

B. standard enthaply of combustion of graphite

C. standard enthaply of combustion of CO

D. sum of standard enthaply of formation ans enthalpy of combustion of CO.

Answer: b,d

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32. Which of the following is always negative ?

A. Enthalphy of the hydration of ion

B. Enthalphy of neutralization

C. Enthalphy of hydrogenation

D. Enthalphy of solution

Answer: a,b,c

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33. Which is an irreversible processe ?

A. Mixing of two gases by diffusion

B. Evaporation of water at 373 K and 1 atm pressure

C. Dissolution of NaCl in water

D. Melting of ice at 273 k and 1 atm

Answer: a,c

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34. Select the correct option :

A. As P(Pressure) is a state function , therefore ΔP does not depend upon path

B. $\Delta U = (Q + W)$ is applicable for any process, in any system

C. $\frac{1}{2}kT$ energy is associated with each degree of freedom in case of ideal gas

D. In an isolated system , heat trasfer as well as mass trasfer is not possible

Answer: a,d

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35. The correct statement (s) is/are:

A. All system maximze their entropy at equilibrium

B. Al substance have zero entropy at absolute zero temperature

C. At constant P,T if $\Delta G < 0$ then the process must be work producing

D. In all adiabatic processes, entropy of surroundings is constant

Answer: c,d

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36. Which of the following statement is /are correct ?

A. $\Delta G_f^\circ ofH_2(g)$ at 298 K is zero

B. $\Delta G_f^\circ ofD_2(g)$ at 298 K is zero

C. $\Delta H_f^\circ ofH_2(g)$at 298 K is zero

D. S° of $H^+(aq.)$ at 298 K is zero

Answer: a,b,c,d

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37. For the ideal gas , the work of reversible expansion under isothermal conditions can be calculated by

using the expression $w = -nRT\text{In}\frac{v_f}{v_I}$

A sample containing 1.0 mol of an ideal gas is expanded isothermally and reversibly to ten times of its original is carried put at 300 K and at 600 K respectvely . Choose the correct option .

A. Work done at 600 K is 20 times the work done at 300 K.

B. Work done at 300 K is twice the work done at 600 K.

C. Work done at 600 K is twice the work done at 300 K.

D. $\Delta U = 0$ in both cases.

Answer: c,d

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38. Select the correct option(s).

A. $Q = nC_v dt$ is applicable to all substance during heating/cooling at constant volume

B. $\gamma = \frac{5}{3}$ for monomatomic ideal gas, at any temperature

C. $dU = nC_v dT$ is applicable for real gas at constant volume

D. molar heat capacity , pressure and temperature are intensive properties

Answer: a,b,c,d

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39. Assume ideal gas behavior for all the gases considered and vibratonal degree of freedom to be active. Separated equimolar sample of Ne, O_2, So_2 and CH_4 were subjedted to a two step process as mentioned . Initiallyt all are at same state of temperture and pressure.

Step -I: All undergo reversible abiabatic expansion to attain same final volume thereby causing the decreasae in their temperature.

Step -II : After step I, all are given appropriate amount of heat isochorically to restore the original temperature .

Mark the correct optoin(s).

A. Due to step I only , the decrease in temperature will be maximum for Ne.

B. During step II , heat given will be minimum for CH_4

C. There will be no net change in internal energy for any of the gas after both the steps of process are completed.

D. The ($\circ$)P - V graph of CH_4 and SO_2 wll be same for overall process.

Answer: a,c

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40. In which cases(s) , 1st molecule in the pair has lower entroy per mole/

A. $H_2(g)$ at 25° C in a volume of 10 L and $H_2(g)$ at 25° C in volume of 50 L

B. O_2 at 25° C and 1 atm and O_2 at 25° C and 1 atm

C. H_2 at 25° C and 1 atm H_2 at 100° C and 1 atm

D. CO_2 at STP and CO_2 at 100° C and 0.1 atm

Answer: a,c,d

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41. Select the incorrect statement (s) .

A. $\Delta H_{\text{atomisaton}}$ of graphite id equal to $\Delta H_f[C(g)]$

B. ΔH_{Comb} of H atom is equal to $\Delta H_f\left[\left(H_2O\right)l\right]$

C. $\Delta H_f\left[H_2O(l)\right]$ is zero

D. ΔH_{comb} of graphite is equal $\Delta H_f[CO(g)]$

Answer: b,c,d

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42. An ideal gasa undergoes through folowing cyclic procees.

1-2 : Reversible adialbatic comparession from

$P_1V_1T_1 \text{to} P_2V_2T_2$

2-3 : Reversible isochoric heating from

$P_2V_2T_2$ to $P_3V_3T_3$

3-4 Reversible adialbatic expansion from

$P_3V_3T_3$ to $P_4V_4T_4$

4-1 Reversible isochoric cooling from

$P_4V_4T_4$ to $P_1V_1T_1$

Eefficiencyof the cycle is :

A. $\left(\frac{T_4 - T_1}{T_3 - T_2}\right)$

B. $1 - \frac{T_1}{T_2}$

C. $1 - \left(\frac{V_2}{V_1}\right)^{\gamma - 1}$

D. $1 - \left|\frac{Q_{4-1}}{Q_{2-3}}\right|$

Answer: a,b,c,d

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43. Thermodynamics mainly deals with:

A. interrelation of various from of energy and their transformation from one form to another .

B. energy change in the processes which depend only on initinal and final states of the microscophi system containing a few moleculas .

C. how and what rate these energy transformations are carried out.

D. the system in equilibrium state or moving from one equlildrium state to another equilibrium state.

Answer: a,d

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44. In a exothermic reaction, heat is evolved , and system losses heat to the surrounding . For such system:

A. q_q wil be negative

B. $\Delta_r H$ will be negative

C. q_r will be positive

D. $\Delta_r H$ will be positive

Answer: a,b

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45. The spontaneity means having the potential to proceed without assistance of external agency. The processes which occur spontaneously are

A. flow of heat from colder to warmer body.

B. gas in a container contracting into one corner .

C. gas expanding to fill the available volume .

D. buring carbon in oxygen to given carbon dioxide.

Answer: c,d

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46. Consider the following reaction between zinc and oxygen and choose the correct options out of the options given below

$2Zn(s) + O_2(g) \rightarrow 2ZnO_s : \Delta H = -693.8 kJmol^{-1}$

A. The enthalpy of two moles of ZnO is less than the total enthalpy of two moles of Zn and one omle of oxygen by 693.8 kJ.

B. The enthalpy of two moles of ZnO is more than the total enthapy of two moles of Zn and one moles of oxygen by 693.8 kJ.

C. $693.8 kJmol^{-1}$ energy is evolved in the reaction .

D. $693.8 kJmol^{-1}$ energy is absorbed in the reaction .

Answer: a.c

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47. Which of the following are correct regarding standerd molar entroy at 298K ?

A. $S^{\circ}_{O3} > S^{\circ}_{O2}$

B. $S^{\circ}_{C_2H_6} > S^{\circ}_{CH_4}$

C. $S^{\circ}_{H^{+}(aq)} > 0$

D. $S^{\circ}_{Na(s)} > 0$

Answer: a.b,d

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48. Which of the following statement are always correct ?

A. The entropy changes of a system particulaing in adiabatic process is always positive

B. The entropy changes of a system particulaing in adiabatic irrversible process is always positive .

C. The entroy change of surrounding is always zero in abiabatic process.

D. The entrophy change of a system participating in adiabatic process is always zero .

Answer: b,c

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49. Metal ions are activators and increase catlytic activity of enzyme molecular . If water vapours is assumed to be a perfect gas, molar enthalpy change for vaporisation of 1 mole of water 1 bar 100°C is

$41 kJ/mol$. Choose the correct statement(s).

$(Taken R = 8.3 J/\text{mole}/K)$

A. $\Delta U_{\text{vaporisation}}$ of 1 mole of water at 1 bar and $100\,^{\circ}C = 37.904 kJ/\text{mol}$

B. $(\Delta U = \Delta H)$ for conversion of the water into ice at $0\,^{\circ}C$

C. In the isothermal process of (b), $\Delta H = 0$

D. $(\Delta H = \Delta U)$ for conversion of 1 mole of water into steam $100\,^{\circ}$C

Answer: a,b

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50. 1 mole of an ideal monatomic gas is subjected toi the following reversible charge of state

$A \xrightarrow{\text{Isothermal}} \text{Expansion} B \xrightarrow{\text{Isochoric}} \text{Cooling}$

(5 atm , 500K)

$C \xrightarrow{\text{Adiabatic}} \text{compression} A$

(300K)

Then , which of the following are correct?

[Given $(0.6)^{2.5} = 0.3, \text{in}2 = 0.7$]

$(R = 0.08L - atm/\text{mol} - K = 2cal/\text{mol} - k)$

A. Pressure of point B is 2.5 atm

B. Volume at point C is 16 litre

C. Magnitude of work involved in complete process is 100 cal

D. Change in enthalpy of process of process $C - A$ is $+1$ kcal .

Answer: a,b,c,d

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51. An ideal gas expanded adiabaticlly such that , T $\propto V^{-1/2}$ then :

A. γ of gas will be 1.5

B. $V \propto P^{2/3}$

C. $P \propto T^3$

D. $P \propto T^2$

Answer: a,b,c

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52. Which of the following is /are correct ?

A. $\Delta H = \Delta U + \Delta(PV)$ when P and V both changes

B. $\Delta H = \Delta U + P\Delta V$ when pressure is constant

C. $\Delta H = \Delta U + V\Delta P$ when volume is constant

D. $\Delta H = \Delta V + P\Delta V + V\Delta P$ when nP and V both changes

Answer: a,b,c

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53. Which of the following statements is/are ture ?

A. $\Delta U = 0$ for combaustion of $CH_4(g)$ is a sealed rigid adiabatic container

B. ΔH_f for s(mmonoclinci) is non -zero

C. If heat of atomisation of $CH_4(g)$ is 360 kcal/mole and C-C bond energy is 0 Kcal /mole then heat of atomication ofC_2H_6 is $600 kcal/\text{mole}$

D. Work done may be zero in cyclic process

Answer: a,b,c,d

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54. Which of the following are false about Gibbs free energy?

A. $\Delta G = \Delta H - T\Delta S$

B. $\Delta G > 0$ indicates that process is spontaneous

C. $\Delta G^\circ < 0$ implies $K_{eg} < 1$

D. $\Delta G = 0$ implies$K_{eq} = 1$

Answer: b,c,d

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55. Choose the correct statement(s).

A. During adiabatic expansion of an ideal gs ,magnitude of work obatained id equal to ΔH of gas.

B. For same change in temperature of ideal gas, more work done by system through adiabatic than irreversible process.

C. During boiling of H_2O at 1 atm , 100° C kineticx energy of H_2O molecules increase .

D. For same change in volume of ideal gas,decrease in internal energy is more in adiabatic expansion than in isobaric expnsion if expansion starts with same intial state.

Answer: b,d

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56. Which among the following properties is/are extenstive properties?

A. Mole

B. Heat capacity

C. Molar enthalpy

D. Entropy

Answer: a,b,d

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57. Which of the following statement are false ?

A. For every change in an isolated system $\Delta T = 0$

B. For evergy change in an isolated system $W = 0$

C. For evergy change in an isolated system that has no macroscopic change in kinetic or potential energy ,$\Delta V = 0$

D. the magnitude of the slpoe of an adiabatic curve is greater than the magnitude of the slpoe of an isothermal curve for the same values of pressue and volume

Answer: a,d

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58. A gas may expand either abiabatically or isothermally .A number of P-V curves are drawn for the two processes over different ranges of pressure and volume . It will be found that :

A. two adiabtaic curves do not intersect.

B. two isothermal curves do not intersect.

C. an adiabatic curve and an isothermal curve may intresect.

D. the magniture of the slpoe of an adiabatic curvesis greater than the magnitude of the slope of an isothermal curves for the same values of pressure and volume.

Answer: a,b,c,d

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59. Suppose that the voulme of a certain ideal gas is to be doubled by one the following processes :

(1) isothermal expansion

(2) adiabatic expansion

(3) free expansion in isulated condition

(4) expansion at constant pressure .

If E_1, E_2, E_3 and E_4 respectively are the changes in average kinetic energy of the molecules for the four processes, them :

A. $E_2 = E_3$

B. $E_1 = E_3$

C. $E_1 > E_4$

D. $E_4 > E_3$

Answer: b,d

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60. Choose the correct statement(s).

A. If system A and B each consit of pure liquild water at 1 bar pressure and if $T_A > T_B$, then the internal energy of system A must be greater than that of B.

B. ΔU for a reversible phase change at constant at T and P is zero .

C. During adiabatic reversible compression the temperature of ideal gas increases.

D. During sameincrease in volume of ideal gas at 1 atm, 300 K more work will be done by gas if isothermal process.

Answer: c,d

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61. One mole of an ideal monoatomic gas undergo process from the state A to state C as :

$$\text{State}\,1atm\,300kA \xrightarrow{\text{isochoric}} process\,\text{state}\,600KB \xrightarrow{\text{Adiabatic reversible}} \text{process}\,\text{State}\,64atm\,C$$

Choose the correct option (s).

A. Pressure of gas at state B in 2 atm

B. $\Delta H_{AB} = 900 cal$

C. $\Delta U_{AC} = 6300 cal$

D. $W_{BC} = 5400 cal$

Answer: a,c,d

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62. One mole of N_2 gas undrgoes following process

$$\text{State}0^{\circ}C1atmA \xrightarrow{\text{One step}} \text{irreversible process}\text{stateB}2atm0^{\circ}$$

Choose the correct statement (s):

A. $\Delta H = 0$

B. $\Delta S = -0.0821In2\frac{atm - liter}{k}$

C. $q = -44.8atm - litre$

D. $W = 22.4atm - litre$

Answer: a,b,d

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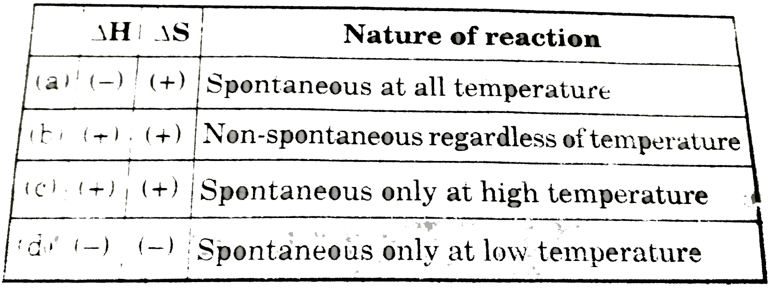
63. In the following table, which of the options are correct ?



	ΔH	ΔS	Nature of reaction
(a)	(–)	(+)	Spontaneous at all temperature
(b)	(+)	(+)	Non-spontaneous regardless of temperature
(c)	(+)	(+)	Spontaneous only at high temperature
(d)	(–)	(–)	Spontaneous only at low temperature

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64. Which among the following are state functions ?

A. Internal energy

B. Enthalphy

C. Gibbs energy

D. Change in internal energy

Answer: a,b,c

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65. Choose the correct statement(s) among the following :

A. Internal energy of H_2O remains constant during converstion of liquid into its vapour at connstant temperture .

B. During fusion of ice into water enthalpy change and internal energy change are almost same at constant temperature.

C. Molar heat capacity of gasaes are temperature dependent

D. During comparession of an ideal gas at constant pressure, the temperature of gas decreases.

Answer: b,c,d

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66. One mole Of an ideal triatomic gas undergoes compression process adiabatically . Then:

A. Temperature change of gas will be more if process is carried out reversibly

B. Work involved during the process will be more if process is carreid out reversibly

C. Change in internal energy of gas will be less if process is carreid out reversibly

D. Change in enthalphy of gas will be less if process is carried out reversibly

Answer: c,d

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67. For an ideal gas undergoing expansion compression process . The relationships which hold good are:

A. $\left(\frac{\partial U}{\partial P}\right)_T = 0$

B. $\left(\frac{\partial H}{\partial T}\right)_V = C_p$

C. $\left(\frac{\partial U}{\partial T}\right)_P = C_V$

D. $C_v = C_p + R$

Answer: a,b,c

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68. An ideal gas is expandend isothermally from $\left(P_1V_1\right)$ and to $\left(P_2V_2\right)$ against a constant external pressure. Which of the following is/are correct regarding above process ?

A. If $P_{ext} = P_2$ piston will not stop automatically at the final state

B. If $P_{ext} = P_2$ piston will not stop automatically at the final state

C. Magnitude of work during expansion can vary in the range of $0 \le |W| \le P_2\left(V_2 - V_1\right)$

D. Work will be zero when P_{ext} is zero and will bre maximum when P_{ext} is eqaul to pressure of system at final state

Answer: b,c,d

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69. In an adiabatic process, the work involed during expansion or compression of an ideal gas is given by :

A. $nC_V\Delta T$

B. $\frac{nR}{\gamma - 1}\left(T_2 - T_1\right)$

C. $-nRP_{ext}\left[\frac{T_2P_1 - T_1P_2}{P_1P_2}\right]$

D. $-2.303RT\log\left(\frac{V^1}{V_2}\right)$

Answer: a,b,c

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70. Consider the following reaction

$2Fe_2O_3 + 3C(s) \rightarrow 4Fe(s) + 3Co_2(g)$

$\Delta H^\circ ofFe_2O_3$ and CO_2are - $820kJ/\text{mol}$ and

-$390kJ/\text{mol}$ respectively

The reaction respectively .

A. endothermic

B. exothermic

C. spontaneous at high temperature

D. spontancous at low temperature

Answer: a,c

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71. Choose the correct statement(s).

A. For phase transformation of liquid water at 1 atm , 373 K to water vapour at 1 atm, 373 K , ΔG will be zero .

B. Two solid blocks of same material and same mass having different temperature are kept in an isolated system then entropy of system must increase.

C. Intensive properties are not additive in nature while extensive properties are additive in nature.

D. No cyclic process is possible in which the sole result is absorption of heat from a hot reservoir and its complete conversion into work

Answer: a,b,c,d

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72. Which of the following process is/are always exothermic ?

A. Enthalphy of combustion

B. Enthalphy of neutralisation

C. Enthalphy of atomisation

D. Enthalphy of fromation

Answer: a,b

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73. A system is changed from initial state to final state in such a manner that $\Delta H = q$. If the same change from initial state to final state were made by different path , which of the following statements are correct?

A. ΔH remains the same

B. ΔH will depends upon the path

C. Heat exchange will be same if the path is isobaric

D. Heat ecchanged q will be different if the path is non-iosbric.

Answer: a,c,d

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Comprehension Type

1. Bomb calorimeters are the devices that are used to experimentally determine ΔH and ΔU of any reaction by measuring the temperature change in the water bath Hence , the experimatal data can be used for cross-checking theortical data, From the following theoretical data answer the question that follow:

Thermodynamic data:

$\Delta H_f^\circ\ Ch_4(g) = -15 kcal/\text{mole}, \Delta H_f^\circ\ CO_2(g) = -90 kcal/\text{mole},$

$\Delta H_f^\circ\ H_2O(l) = -60 Kcal/\text{mole}$

$S_m^\circ CH_4(g) = 40 cal/\text{mole Kelivn}$

$S_m^\circ O(g) = 45 cal/\text{mole Kelivn}$

$S_m^\circ H_2O(g) = 15 cal/\text{mole Kelivn}$

$S_m^\circ CO_2(g) = 50 cal/\text{mole Kelivn}$

Calorimeter data:

(1) Water equivlent of calorimaeter = 36 gm

(2) Sepcific heat capacity of water = $1 cal/gm.^{\circ}C$

(2) mass of water inthe water bath =164 gm

All data at 300 K, $R = 2cal/\text{mol } K$.

1. Calculate $\Delta U_{\text{combustion}}$ of $CH_4(g)$ at 300 K.

A. $-195 kcal/\text{mole}$

B. $-196.2 kcal/\text{mole}$

C. $-193.8 kcal/\text{mole}$

D. $-235 kcal/\text{mole}$

Answer: c

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2. Bomb calorimeters are the devices that are used to experimentally determine ΔH and ΔU of any reaction by measuring the temperature change in the water bath Hence , the experimatal data can be used for cross-checking theortical data, From the following theoretical data answer the question that follow:

Thermodynamic data:

$\Delta H_f^\circ\ Ch_4(g) = -15 kcal/\text{mole}, \Delta H_f^\circ\ CO_2(g) = -90 kcal/\text{mole},$

$\Delta H_f^\circ\ H_2O(l) = -60 Kcal/\text{mole}$

$S_m^\circ\ CH_4(g) = 40 cal/\text{mole Kelivn}$

$S_m^\circ\ O(g) = 45 cal/\text{mole Kelivn}$

$S_m^\circ\ H_2O(g) = 15 cal/\text{mole Kelivn}$

$S_m^\circ\ CO_2(g) = 50 cal/\text{mole Kelivn}$

Calorimeter data:

(1) Water equivlent of calorimaeter = 36 gm

(2) Sepcific heat capacity of water = $1 cal/gm.^\circ C$

(2) mass of water inthe water bath =164 gm

All data at 300 K, $R = 2 cal/\text{mol}\ \ K$.

Calculate rise in temperature of calorimeter if 0.01 moles of $CH_4(g)$ undergoes combustion in the above bonb calorimeter at 300 K .

A. $9.18K$

B. $9.696K$

C. $12K$

D. $8.8K$

Answer: b

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3. Bomb calorimeters are the devices that are used to experimentally determine ΔH and ΔU of any reaction by measuring the temperature change in the water bath Hence , the experimatal data can be used for cross-checking theortical data, From the following theoretical data answer the question that follow:

Thermodynamic data:

$\Delta H_f^{\circ} Ch_4(g) = -15kcal/\text{mole}, \Delta H_f^{\circ} CO_2(g) = -90kcal/\text{mole},$

$\Delta H_f^{\circ} H_2O(l) = -60Kcal/\text{mole}$

$S_m^{\circ} CH_4(g) = 40cal/\text{mole Kelivn}$

$S_m^{\circ} O(g) = 45cal/\text{mole Kelivn}$

$S_m^{\circ} H_2O(g) = 15cal/\text{mole Kelivn}$

$S_m^{\circ} CO_2(g) = 50cal/\text{mole Kelivn}$

Calorimeter data:

(1) Water equivlent of calorimaeter = 36 gm

(2) Sepcific heat capacity of water = $1cal/gm.^{\circ}C$

(2) mass of water inthe water bath =164 gm

All data at 300 K, $R = 2cal/\text{mol } K$.

If calorimeter is modified so as to convert chemical energy into electrical by ensuring that the reaction is occurring at constant pressure then how much electron work can be obtained by combustion of 0.1 mole of $CH_4(g)$?

A. $19.5kcal$

B. $18kcal$

C. $19.62kcal$

D. $18.12kcal$

Answer: b

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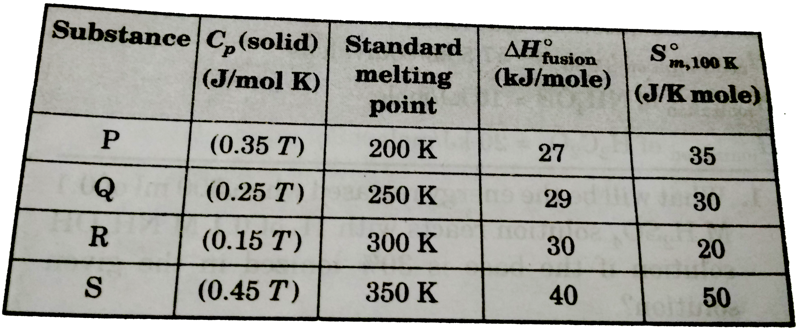
Comprehension #2 1

1. Out of different state parameters like E, H, G, A and S, only entropy(s) is the parameter whose absolute value can be determined, by using third law of thermodynamics. While perfect crystals hace zero entropy at $0K$, non-perfect crystals have some residual entropy at $0K$. From this info and the following data chart, answer the questions that follow :



Substance	C_p(solid) (J/mol K)	Standard melting point	$\Delta H^\circ_{\text{fusion}}$ (kJ/mole)	$S^\circ_{m,100\text{ K}}$ (J/K mole)
P	(0.35 T)	200 K	27	35
Q	(0.25 T)	250 K	29	30
R	(0.15 T)	300 K	30	20
S	(0.45 T)	350 K	40	50

Which of the substances will have residual entropy at $0K$

A. Only R

B. Only P

C. Q, R and S all three

D. Q and P only

Answer: c

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Comprehension #3 1

1. When acids an bases react they liberate some amount of energy which is represented as ΔH neutralization if one equivalent of acid and base reacts. The energy liberated depends on the concentration of acid and base and also on whether the acid is strong or weak. For strong acids and bases, the value is constant and for weaker acids as bases the magnitude is generally lesser.

Using this info and the date below answer the question that follow :

[Given data :

$\Delta_{\text{neutralization}} HCl/NaOH = -14 Kcal/eq$ (at infinite dil.)

$\Delta H_{\text{ionisation}} CH_3COOH = 2 kcal/mol$

$\Delta H_{\text{ionisation}} NH_4OH = 3 kcal/eq \Big]$

Which of the following option(s) is//are correct assuming weak acids/bases to be completely unionized ?

A. $\Delta H_{\text{neutralization}} H_2SO_4/NaOH = -28 kcal/\text{mole of } H_2SO_4$

B. $\Delta H_{\text{neutralization}} HCl/NH_4OH = -11 kcal/\text{mole of } HCl$

C. $\Delta H_{\text{neutralization}} CH_3COOH/NH_4OH = -9 kcal/\text{mole of } CH_3COOH$

D. $\Delta H_{\text{neutralization}} KOH/CH_3COOH = -11 kcal/\text{mole of } KOH$

Answer: a,b,c

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Comprehension #4 1

1. Fuel cells are the commercial cells which converts the chemical energy into electrical energy and differ from the normal batteries since fuel cells require constant source of fuel and oxygen to obtain electric current. However, they can be used to produce electricity as long as the supply of fuel and oxygen is maintained. All fuel cells consist of an anode and a cathode and an electrolyte which allows charges to move between the two sides of the fuel cell. Electrons are drawn from anode to cathode through an external circuit and hence produce direct current electricity.

Under practical cases, efficient of fuel cell is around $40 - 60\,\%$ and in some cases it may be as high as $85 - 90\,\%$

Some common examples of fuel cell are diect methanol fule cell (DMFC), Direct Borohydride fuel cell (DBFC), alkaline fuel cell (AFC) and others.While in DMFC the electrolyte is an ionomer (proton exchange monomer) in case of AFC and DBFC the electrolyte is an aqueous alkaline solution. Also, in case of DBFC the borohydride gets oxidised to metaborate, In all the above three cases, at cathode reduction of O_2(gas) occurs in a medium controlled by the electrolyte. Based on this information answer the electrolyte. Based on the information answer the question that follow :

Data

$\left(\Delta H_f^\circ\, CH_3OH(l) = -230 kJ/\text{mole}, , \Delta H_f^\circ\, CO_2\right.$=-390kJ//"mole"),

(Delta_(f)^(@)H_(2)O(l) = - 285 kJ//"mole",,S_(mH_(2)O(l))^(@)=130J//K "mole"),(S_(mCO_(2(g))) = 210 J//K "mole",S_(mH_(2)O(l))^(@) = 110 J//K "mol"),(S_(mO_(2(g)))=206J//K "mole",,S_(mH_(2(g))) = 130J//K "mole"),("All data at" 300 K.,1/F = 10^(-5)C^(-1)):}

$Whichofthefollow \in g \in f$ or $mationisc$ or $rectaboutDMFCat$300 K` if mathanol liquid is used as a fuel in DMFC ?

A. $\Delta H^{\circ}_{\text{reaction}} = -730kJ/moleof$O_(2)` consumed

B. $\Delta S^{\circ}_{\text{reaction}} = -9J/K$ mole of methonal consumed

C. $E^{\circ}_{\text{cell}} = 1.21$ volts approx.

D. $\Delta G^{\circ}_{\text{cell}} = -727.3kJ/\text{mole}$ of CO_2 produced.

Answer: b,c,d

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Comprehension #5 1

1. While analyzing driving forces for a chemical reaction it is observed that energy and entropy are true forces. The entropy is a typical state function owing to the possibility of calculation of its absolute value. The absolute values of entropies can be compared an calculating by knowing the residual entropies at $0K$ and by calculating the change due to change of state. Using the given information and data for a particular substance x answer the questions that follow :

Useful data :

(p) Standard melting point and boiling point of x is $200K$ and $400K$ respectively.

(q) $\Delta H^{\circ}_{\text{fusion}} = 10kcal/\text{mole}$ and $\Delta H^{\circ}_{vap} = 80kcal/\text{mole}$.

(r) $C_{p.m}(s)x = 0.1Tcal/\text{Kmole}, C_{p.m}(l)x = 0.05Tcal/Kmo \leq$

$S^{\circ}_{m.40K}s_{x} = 5cal/\text{mole}$

Which of the following statement is/are true ?

A. Substance x will be a perfect crystals.

B. S°_{m,N_2O_4} = two times $S^{\circ}_{m.N_2O_4}$

C. ΔS_{fusion} of x will be temperature dependent

D. $\Delta H^{\circ}_{\text{fusion},300K} <$ 10 kcal//"mole"`

Answer: c,d

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comprehensive6

1. It is observed that when acid and bases react, some energy is released due to neutralization reaction. While in case of strong acid and bases, the energy released in greater, in case of weaker acids of bases, energy released will be lesser. The difference is attributed to energy required for ionization. From the above information and data below answer the questions that follow:

$\Delta H_{\text{neutrization SA/SB}}$=-57.5 kJ/equivalent,

$\Delta H_{\text{ionization}} of NH_4OH$=10kJ/mole,

$\Delta H_{\text{ionization}}$ of $H_2C_2O_4$=20kJ/ mole.

What will be the energy released when 500ml of0.1 M H_2SO_4 solution reacts with 1L of 0.1 M NH_4OH solutioni if the base is 30% ionized in the given solution?

A. 5.75kJ

B. 4.75kJ

C. 5.05kJ

D. 5.45kJ

Answer: c

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comprehensive7

1. Cycloalkenes and alka- dienes are structural isomers and it is observed that the isomerisation reaction of cyclo-butene into 1,3, buta-diene follows 1st order kinetics with respect to cyclobutene. The rate constant of the reaction can be determined by hydrogenting (reaction with H_2 to remove unsaturation) the reaction mixture and different instant and measuring the amount of hydrogen required. In one such experiment two separate glass flasks of volume 1 litres. were added with same amount of cyclobutene and sealed. While one flask was broken after 138.6 min and the contents required 39.2 ml of H_2 gas at 1 atm pressure and 273K, where as other flask was broken after a very long time and the contents required 44.8 ml of H_2 gas at 1 tam pressure and 273K . From the information given above and given data, anwer the questions that follows:

ΔH_f° Cyclobutene=175kJ/mol

ΔH_f° Buta-1,3-diene =125kJ/mol

The average life of cyclobutene will be:

A. 100min

B. 69.3 min

C. 0.01 min

D. 1.386 min

Answer: a

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comprehensive8

1. Dissociation of $NH_3(g)$ over solid platinum follows zero order kinetics.

$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

The rate of reaction is $2 \times 10^{-3} M\sec^{-1}$. Also at 300K, thermodynamic data are:

$\Delta H_f^\circ\ NH_2$=-45kJ/mole $S_{N_2}^\circ$=190J/K mole

$S_{NH_3}^\circ$=200J/K mole, $S_{H_2}^\circ$=130J/K mole

From the above data and the assumption that $\Delta H_{\text{Rxn}}^\circ$ are independent of temperature, anwer the question that follows. [Take $R \times 300$kJ]

If initially $\left[NH_3\right]$=3M , then what will be its concentration after 100 sec if it is performed in rigid vessel as 300K:

A. 2.6M

B. 2.8M

C. 0.09 kJsec^{-1}

D. 3M

Answer: a

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comprehensive9

1. Entropy change for reversible phase transition at constant pressure P and temperature T is calculated by the formula $\Delta S = \frac{\Delta H}{T}$, where ΔH is the enthalpy change for phase transition. For irreversible phase transition $\Delta S > \frac{\Delta H}{T}$.

Consider a phase transition.

$Sn(\text{white, s}) \Leftrightarrow Sn(\text{grey,s})$

ΔH° at 1 atm and$300K = -2kJmol^{-1}$

The equilibrium temperature at 1 atm is 400 K.

Assume $C_{p,m}$ of Sn (white,s) and Sn(grey,s) are equal.

ΔS° for above phase transition at 1 atm and 300K is :

A. $-5JK^{-1}mol^{-1}$

B. $-\frac{20}{3}JK^{-1}mol^{-1}$

C. $-0.0055JK^{-1}mol^{-1}$

D. $-\frac{2000}{3}JK^{-1}mol^{-1}$

Answer: a

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comprehensive 10

1. The solubility on any substance in water may be classified as :

Molecular ability: AB(s/l/g) $\overset{aq}{\Leftrightarrow}$ AB(aq)

Ionic solubility : AB (s/l/g) $\overset{aq}{\Leftrightarrow} A^{+}(aq) + B^{-}(aq)$

For a substance AB(s) the following thermodynamic informations are available at 300K:

Molecular solubility: ΔH° =+20kcal/mol,

ΔS° =+40kcal/K-mole

Ionic solubility: ΔH° =-25 kcal/ mol,

ΔS° =-50 cal/K-mole

Which of the following statements is correct for the solubillity of AB(s) in water at 300K?

A. It undergoes molecular solubility.

B. It undergoes ionic solubility.

C. It undergoes ionic as well as molecular solubility.

D. It is almost completely insoluble in water.

Answer: b

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comprehensive 11

1. Equilibrium constant for a reaction can be obtained by kinetics approach or by thermodynamics approch. While from kinetics approach at equililbrium, the rate of forward and backward will be same, from thermodynamics approach Gibbs free energy will be minimized at equilibrium. Using this information and following thermodynamics values, answer the question that follow:

$\Delta G_f^{\circ} A(g)$=-200kcal/mole

$\Delta G_f^{\circ} B(g)$ =-320 kcal/mole

$\Delta G_f^{\circ} C(g)$=-300kcal/mole

$\Delta G_f^{\circ} D(l)$=-224.606 kcal/mole

$\Delta G_f^{\circ} D(g)$= -226.9.9 kcal/ mole, All values at 500K

Calculate rate constant of the backward reaction for the following reaction at 500K:

$A(g) + B(g) \Leftrightarrow C(g) + D(l)$ if $K_f = 10\text{bar}^{-1}\text{sec}^{-1}$

A. $10\text{bar}^{-1}\text{sec}^{-1}$

B. $0.1\text{bar}^{-1}\text{sec}^{-1}$

C. 0.1sec^{-1}

D. 10sec^{-1}

Answer: c

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comprehensive 12

1. A gaseous sample is generally allowed to do only expansion/compression type of work against its surroundings. The work done in case of an irreversible expansion (in the intermediate stages of expansion/ compression the states of gases are not defined). The work done can be calculated using

$$dw = -P_{ext}dV$$

while in case of reversible process the work done can be calculated using dw=-PdV where P is pressure of gas at some intermediate stages. Like for an isothermal reversible process, since

$P = \frac{nRT}{V}$,so,

$$w = \int dw = -\int_{V_i}^{V_f} \frac{nRT}{V} . dV = -nRT \ In\left(\frac{V_f}{V_i}\right)$$

Since,dw=PdV, so magnitude of work done can also be calculated by calculating the area under the PV curve of the reversible process in PV diagram.

An ideal gaseous sample at time state i$\left(P_0 V_0 T_0\right)$ is allowed to expand to volume $2V_0$ using two different processes, in the first process the equation of process is $PV^2 = K_1$ and in second process the equation of the process is $PV = K_2$. Then :

A. work done in the first process will be greater than work in second process (magnitude wise)

B. the order of values of work done cannot be compared unless we know the value of K_1 and K_2

C. value of work done (magnitude) in second process is greater in above expansion irrespective of the value of K_1 and K_2

D. 1st process is not possible

Answer: c

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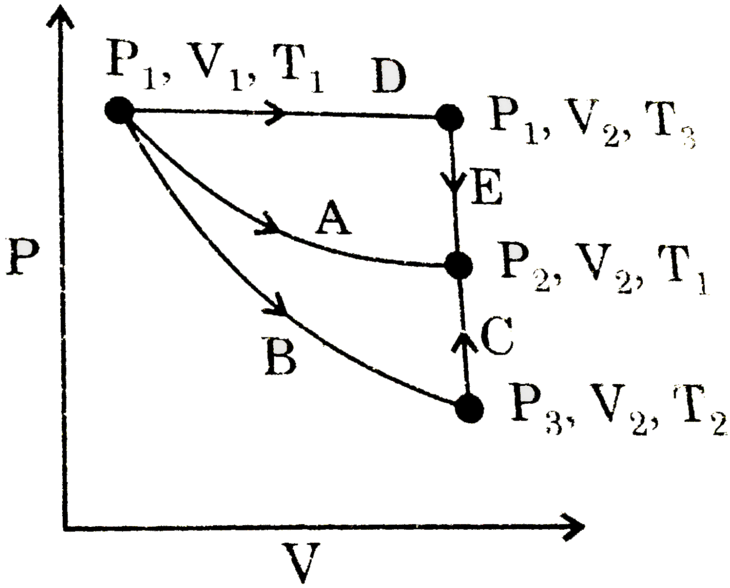
comprehensive 13

1. For an ideal monoatomic gas, an illustration of three different paths A, (B+C) and (D+E) from an initial state P_1, V_1, T_1 to a final state P_2, V_2, T_1 is shown in the given figure .



Path A represents a reversible isothermal from P_1V_1 to P_2, V_2, path (B+C) represent a reversible adiabatic expansion (B) from P_1, V_1, T_1 to P_3, V_2, T_2 followed by reversible heating of the gas at constant volume (C) from P_3, V_2, T_2 to P_2, V_2, T_1. Path (D+E) represents a reversible expansion at constant pressure $P_1(D)$ from P_1, V_1, T_1 to P_1, V_2, T_3 followed by a reversible cooling at constant volume $V_2(E)$ form P_1, V_2, T_3 to P_2, V_2, T_1

What is q_{rev} for path (A)?

A. zero

B. $-nR\ \text{In}\frac{V_2}{V_1}$

C. $-nRT_1 \ \text{In}\frac{V_2}{V_1}$

D. $nRT_1 \ \text{In}\frac{V_2}{V_1}$

Answer: d

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comprehensive 14

1. Entropy is a state function and its depends on two or three variable temperature (T), pressure(P) and volume (V). Entropy change for an ideal gas having number of moles (n) can be determined by the following equation:

$$\Delta S = 2.303nC_v \ \ \log\left(\frac{T_2}{T_1}\right) + 2.303nR \ \ \log\left(\frac{V_2}{V_1}\right)$$

$$\Delta S = 2.303nC_p \ \ \log\left(\frac{T_2}{T_1}\right) + 2.303nR \ \ \log\left(\frac{P_2}{P_1}\right)$$

Since free energy change for a process or a chemical equation is a deciding factor of spontaneity, which can be obtained by using entropy change (ΔS) according to the expression, $\Delta G = \Delta H - T\Delta S$ at a temperature T.

What would be the entropy change involved in thermodynamic expansion of 2 moles of a gas from a volume of 5 Lts to a volume of 50 Lts at $25\,^{\circ}C$? [Given R=8.3 J/mole-K]

A. 38.23J/K

B. 26.76J/K

C. 20J/K

D. 28.23J/K

Answer: a

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comprehensive 15

1. For a process top be spontaneous, at constant temperature and pressure, there must be decreases in free energy of the system in the direction of the process, i.e. $\Delta G_{P.T.} < 0. \Delta_{P.T.} = 0$ implies the equilibrium condition and $\Delta G_{P.T.} > 0$ corresponding to non-spontaneity.

Gibb's Helmholtz equation relates the free energy change to the enthalpy and entropy change of the process as :

$\Delta G_{P.T.} = \Delta H$ - $T\Delta S$......(i)

The magnitude of ΔH does not change much with the change in temperature but the entropy factor $T\Delta S$ changes appreciably. Thus, spontaneity of a process depends very much on temperature.

For edothermic proces, both $\Delta H \text{and } \Delta S$ are positive. The energy factor,the first factor of equation, opposes the spontaneity whereas entropy factor favours it . At low temperature, the favourable factor $T\Delta S$ will be small and may be less than $\Delta H, \Delta G$ will have positive value indicating the non-spontaneity of the process. On raising temperature, the factor $T\Delta S$ increases appreciably and when it exceeds $\Delta H, \Delta G$ would become negative and the process would be spontaneous.

For an exothermic process, both $\Delta H \text{ and } \Delta S$ would be negative. In this case, the first factor of equation(i) favours the spontaneity whereas the second factor opposes it. At high temperature, when $T\Delta S > \Delta H, \Delta G$ will have positive value, showing thereby the non-spontaneity of the process.

However, on decreasing temperature, the factore $T\Delta S < \Delta H$, ΔG becomes negative and the process occurs spontaneously. Thus, an exothermic process may be spontaneous at low temperature and non-spontaneous at high temperature.

When $CaCO_3$ is heated to a high temperature, it undergoes decomposition into CaO and CO_2 whereas it is quite stable at room temperature. The most likely explanation of it, is:

A. the enthalpy of reaction (ΔH) outweighs the term $T\Delta S$ at high temperature

B. the term $T\Delta S$ outweighs the enthalpy of reaction at high temperature

C. at high temperature, both enthalpy of reaction and entropy change become negative

D. none of the above

Answer: b

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Comprehension 16

1. Standard Gibbs energy of reaction $\left(\Delta_r G^\circ\right)$ at a certain temperature can be completed as $\Delta_r G^\circ = \Delta_r H^\circ - T\delta_r S^\circ$ and the change in the value of $\Delta_r H^\circ$ and $\Delta_r S^\circ$ for a reaction with temperature can be computed as follows:

$$\Delta_r H^\circ_{T_2} - \Delta_r C_p^\circ \left(T_2 - T_1\right)$$

$$\Delta_r S^\circ_{T_2} - \Delta_r S^\circ_{T_1} = \Delta_r C_p^\circ In\left(\frac{T_2}{T_2}\right)$$

$$\Delta_r G^\circ = \Delta_r H^\circ - T.\Delta_r S^\circ$$

$$\Delta_r^\circ G^\circ = -RTInK_{eq}$$

Consider the following reaction :

$$CO(g) + 2H_2(g) \rightarrow CH_3OH(g)$$

Given

$$\Delta_r H^\circ \left(CH_3Oh, g\right] = -201KJ/mol$$

$$\Delta_r H^\circ (CO, g) = -114KJ/mol$$

$$s^\circ \left(CH_3OH, g\right) = 240J/mol - k,$$

$$S^\circ \left(H_2 g\right) = 198J/mol - K$$

$C^{\circ}_{p.m}(h_2) = 28.8JK^{-1}mol^{-1}$

$C_{p.m(CO)} = 29.4J/mol\text{-}K$

$C^{\circ}_{p.m}(CH_{3_{\square}}OH) = 44J/mol\text{ - }K$

and $In\left(\frac{320}{300}\right) = 0.06$, all data at$300K$.

$\Delta_r S^{\circ}$ at 300 K for the reaction is :

A. 152.6J/K -mol

B. 181.6J?K-mol

C. $-16\frac{J}{K}\text{ - - }mol$

D. none of these

Answer: c

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Comprehension 17

1. Enthalpy of neutralzation is defined as the enthalpy change when 1 mole of acid$\overset{/}{-}$base is completely neutralized by base /acid in dilute solution .

For Strong acid and strong base neutralization net chemical change is

$H^{+}(aq) + OH^{-}(aq) \rightarrow H_2O(l)$

$\Delta_r H^{\circ} = -55.84 KJ/mol$

$\Delta H^{\circ}_{\text{ionization}}$ of aqueous solution of strong acid and strong base is zero .

when a dilute solution of weak acid or base is neutralized, the enthalpy of neutralization is somewhat less because of the absorption of heat in the ionzation of the because of the absorotion of heat in the ionization of the weak acid or base ,for weak acid /base

$\Delta H^{\circ}_{\text{neutrlzation}} = \Delta H^{\circ}_{\text{ionization}} + \Delta_r H^{\circ}\left(H^{+} + OH^{-} \rightarrow H_2O\right)$

If enthalpy of neutralization of CH_3COOH by NaOH is -49.86KJ/mol then enthalpy of ionization of CH_3COOH is:

A. 5.98KJ/mol

B. $-5.98 KJ/mol$

C. 105.7KJ/mol

D. none of these

Answer: a

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Comprehension 18

1. 9.0 gm ice $0^\circ C$ is mixed with 36 gm of water at $50^\circ C$ in a thermally insulated container.using the following data , Answer the qusestion that follow :

$C_p\left(H_2O\right) = 4.18Jg^{-1}k^{-1}, \Delta H_{\text{fusion}}\ (ice) = 335Jg^{-1}$

final temperature of water is :

A. 304.43K

B. 296.97K

C. 303.93K

D. 287K

Answer: b

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Comprehension 19

1. Liquid water freezes at 273K under external pressure of 1atm . The process is at eruilibrium

$H_2O(l) \rightarrow H_2O(S) at 273K$ and $1 atm$

however , it required to calculate the thermodynamic parameters of the fusion process occurring at same pressure and different temperature . Using the following dat ,answer the questions thaat follow:

$d_{ice} = 0.9gm/, d_{H_2O(l)} = 1gm/cc, 1L\text{ - }atm = 101.3J$

$C_p\left[H_2O(s)\right] = 36.4JK^{-1}mol^{-1}$

$C_p\left[H_2O(l)\right] = 75.3Jk^{-1}mol^{-1}$

$\Delta H_{\text{fusion}} = 6008.2mol^{-1}. Alldataat273K.$

the value of ΔH_{fusion} at 263 K and 1 atm will be :

A. $+6008.0K\text{mole}^{-1}$

B. $5619.2 J \text{mole}^{-1}$

C. $-5619.2 J \text{mole}^{-1}$

D. 6619.2mole^{-1}

Answer: b

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Comprehension 20

1. A mixture of hydrogen gas and theortical amount of air at 25° C and a total pressure of 1atm , is exploded in a closed right vessel . If the process ossurs under adiabatic conditions then using the given data anwer the question that follow :

Given :

$C_p(N_2)$ and $C_p(H_2O)$are8.3 and $11.3 cal deg^{-1} mol^{-1}$ not necessarily in the same order.

$\Delta H_f[H_2O(g)] = -57.8 kcal$

$\left[\text{take air as} 80\,\%\, N_2, 20\,\%\, O_2 \text{by volume.}\right]$

the value of $C_p of N_2$ and H_2O inthe order N_2, H_2O will be : (in cal $deg^{-1} mol^{-1}$

A. 8.3,8.3

B. 8.3,11.3

C. 11.3,11.3

D. 11.3,8.3

Answer: b

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Comprehension 21

1. The commercial production of 'Water gas' utilzes the endothermic reaction

$C(s) + H_2O(g) \rightarrow H_2(g) + CO(g)$

the heat required for this reaction is generated by combustion of coal to

CO_2 using stoichiometric amount of air (79% N_2 by volume and 21%O_2 by volume). the superheated steam undergoes 75% conversion . usingthe following data ,answer the question that follows :

$\Delta H_f[CO(g)] = -110.53 KJmol$

$\Delta H_f\left[H_2O(g)\right] = -241.81 KJ/mol$

$\Delta H_f\left[CO_2(g)\right] = -314.0 Kj/mol$

THe amount of heat liberated when one litre of product gases are burnt at 373 K and one atm is:

A. $\cong 3.36 KJ$

B. $\cong 3.9 KJ$

C. $\cong 4.43 KJ$

D. $\cong 5.34 Kj$

Answer: a

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Comprehension 22

1. If Weak acid or weak base are neutralised ,the heat relealised , the heat released during neutralisatiojn is somewhat lesser than -13.7 kcal or -57.27Kj .Heat of neutralistion is also referred to as heat of formation of water from H^+ and OH^- ionsi.e .,

$H^+OH^- \rightarrow H_2O, \Delta h = -13.7kcal$

Magnitude of heat of neutralistion of Hi and acetic acid respectively are (in kcal) buy strong base are:

A. $13.7, < 13.7$

B. > 13.7 for both

C. < 13.7 for both

D. $< 13.7, > 13.7$

Answer: a

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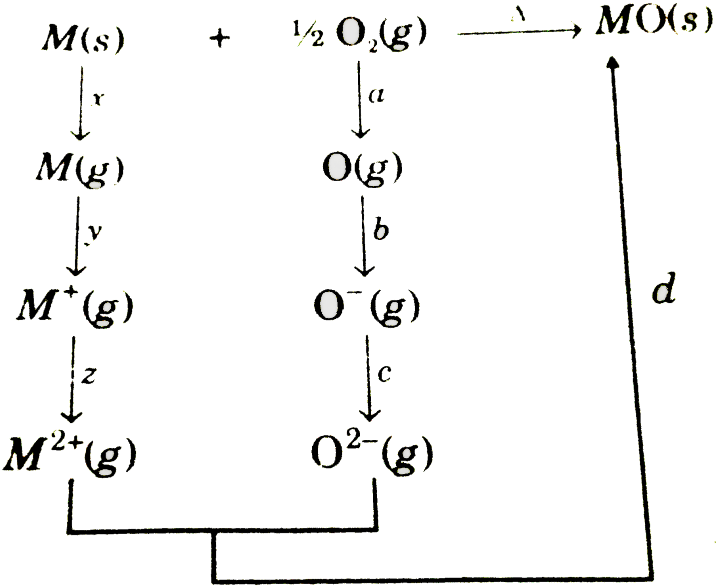
Comprehension #23

1. Born- Hyber cycle below respesents the energy changes occurring as 298 K, jwhen MO(s) is formed from its elements, wherx x, y,z, a, b,c and d are enthalpy change elements, for corresponding pro0cesses respectively



$\Delta H_{\text{sub}}\text{of}M = 180kJ/mol$

$I.\,E_1(M) = 218kJ/mol$

$I.\,E_2(M) = 384kJ/mol$

$\Delta H_{\text{atomisation}}\text{of}O_2 = 640kJ/mol$

$\Delta H\left(O \to O^-\right) = -142kJ/mol$

$\Delta H\left(O \to O^{-2}\right) = -844kJ/mol$

In terms of x,y,z,a,b, c and d enthalpy change for the reaction,

$2M(s) + O_2(g) \rightarrow 2MO(s)$,is:

A. $2x + 2y + 2z + 2a + 2b + 2c + 2d$

B. $x + y + z + a + b + c + d$

C. $2x + 2y + z + 2a + 2b + 2c + d$

D. $2x + 2y + 2z + 2a + 2b + 2c - 2d$

Answer: a

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Comprehension#25

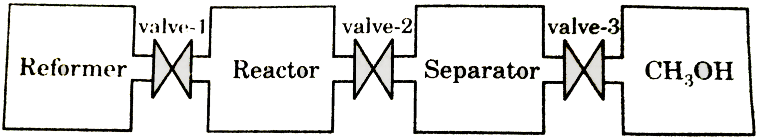
1. A factory, producing methanol, is based on the reaction :

$CO + 2H_2 \rightarrow CH_3OH$

Hydrogen and carbon monoxide are obtained by the reaction

$CH_4 + H_2O \rightarrow CO + 3H_2$

Three units of factory namely, the "reformer" for the H_2 and CO production, the "methanol reactor" for production of methonol adn a "separator" to separate CH_3OH form CO and H_2 are schematically shown in figure.



The flow of methonal from valve-3 is $10^3 mol/\sec$. The factory is so designed that $\frac{2}{3}$ of the CO is converted to CH_3OH. Assume that the feromer reaction goes to completion.

$CO + 2H_2 \rightarrow CH_3OH \Delta_r H = -100R$

What is the flow of CO and H_2 at valve-1?

A. $CO : 1500 mol/\sec, H_2 : 2000 mol/\sec$

B. $CO : 1500 mol/\sec, \ H_2 : 3000 mol/\sec$

C. $CO : 1000 mol/\sec, \ H_2 : 2000 mol/\sec$

D. $CO : 1500 mol/\sec, \ H_2 : 4500 mol/\sec$

Answer: d

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Comprecension#26

1. One mole of a monoatomic ideal gas was isobarically heated from 300 K to 600 K at constant pressure of one atm. Subsequently, it is subjected to reversible adiabatic expansion till the volume becomes $4\sqrt{2}$ of origingl (starting) value. After that it is subjected to isobaric cooling to original volume.

Select the correct statement :

A. Net work done in overall orocess is

$$\left[-\frac{450}{\sqrt{2}}R-75R\right]$$

B. Net work done in overall process is $\left[-450R-\frac{75}{\sqrt{2}}R\right]$

C. Temperature attained after adiabatic process is equal to initial temperature

D. Temperature attained finally is lesser than initial temperature

Answer: b,c,d

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Comprehension #27

1. Bond dissociation enthaply of the first H-S bond in hydrogen sulphide is $376\text{Kj}/\text{mole}$. The enthalpies of formatin of $H_2S(g)$ and $S(g)are - 20.0$ and $277.0\text{kj}/\text{mole}$ respectively. The enthalpy of formation of gaseous hydrogen atomis $218\text{Kj}/\text{mole}$. Using above information, answer following questions :

The enthalpy of formation of free radical HS is :

A. $138kJ/\text{mole}$

B. $276kJ/\text{mole}$

C. $-10kJ/\text{mole}$

D. $357kJ/\text{mole}$

Answer: a

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Comprehension#28

1. One mole of idea monoatomic gas at 300 K undergoes an adiabatic irrersible process due to which its interhnal energy decreases by 150 calories.

Calculate the final temperature of the gas.

A. 200 K

B. 250 K

C. 350 K

D. 400 K

Answer: b

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Comprehension#30

1. Photosyntesis is a bio process by which planets make energy rich molecules from low energy molecules with the help of energy. From sunlight. The photosynthesis of glucose can be represented as :

$6CO_2(g) + 6H_2O(g) + hv \rightarrow C_6H_{12}O(s) + 60_2(g)$

Electrochemical oxidation of glucoses to CO_2 and $H_2O.$ which is the reverse of photosyhnthesis, is an impottaint reaction and it can be used in the construction of a fuel cell. In a fule cell, a working substance celled fule is electrochemiclly oxidised by O_2

$C_6H_{12}O_6 + 6HO \rightarrow 24_e^- + 24H^+ + 6CO_2$

Heats of combustion of graphite and hydrogen at 300 K are $-400kJmol^{-1}$ respectively. If on combustion, 1 g of glucose releases 15 kJ of energy. calculate the heat of formation of glucose at 300 K.

A. -450 kJ

B. 1350 kJ

C. -1350kJ

D. 450 kJ

Answer: c

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Comprehension# 31

1. $N_2(g) + 20_2(g) \rightarrow 2NO_2(g) \Delta H_{\text{rxn}} > 0$ Which relationship is correat for this reaction at a pressure of 1 atm ?

A. $\Delta E_{rxn} > \Delta H_{rxn}$

B. $\Delta E_{rxn} < \Delta H_{rxn}$

C. $\Delta E_{rxn} = \Delta H_{rxn} + \Delta S_{rax}$

D. $\Delta E_{rxn} = \Delta H_{rxn} - \Delta S_{rax}$

Answer: a

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Comprehension # 32

1. Rubber bands comprise of loosely packed chains of atoms.When stretched, the chain of atoms get neatly lined up in rows and hens the entrops of system decreases whereas when contacted the chains get tangled up in a mess increasing entropy of system. Also on strectching rubber band, it is observed that any substance brought in its contact gets heated up. Based on this information, answer the following questions.

Which of the following statement (s) is/are true regarding the change

$\text{Rubber band}_{\text{streched}} \rightarrow \text{Rubberband}_{\text{unstreached}}$?

A. The change is spontaneous.

B. The process is endothrmic in nature.

C. Entropy of the rubber band is increasing in the process.

D. Entropy of surroundings is decreacing in the process.

Answer: a,b,c,d

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MATCH THE COLUMN TYPE1

1. When 1 mole of $C_2H_6(g) at 27^\circ C$ is burnt completely in some oxygen gas at $27^\circ C$ At constant pressure, $CO_2(g)$, $CO(g)$and $H_2O(g)$ are produce at $327^\circ C$. the surropundings. The standard enthaplies of formation of $C_2H_6(g)$. $CO(g)$ and $H_2O(g)$ are $-40, -90, -30$ and $-60 kcal/mol$ respectively. The molor heat capacities at constant pressure of $CO_2(g), CO(g)$ and $H_2O(g)$ are $7.0, 6.0$ and $9.0 cal/K mol$, respectively. The molar hear capacities at constnt pressure of $CO_2(g), CO(g)$ and $H_2O(g)$ are $7.0, 6.0$ and $9.0 cal/K\text{-}mol$ respectively. On the basis of these informations, math teh valuesof column-I with the quantities represented in column-II Assume $\Delta_r H$ independent of temperature.

$(, \text{Column-I}, , \text{Column-II}), \Big((a), 1.0, (p), \Delta_r H \text{of reaction}: 2C_2H_6(g) + 7O_2(g) \rightarrow 4C$

$(, \text{Column-I}, , \text{Column-II}), ((a), 1.0, (p), \Delta_r H \text{of reaction}: 2C_2H_6(g) + 7O_2$

$\Big((b), -200\text{kcal}, (q), \Delta_r H \text{of reactIon}: C_2H_6(g) + \frac{5}{2}O_2(g) \rightarrow 2CO(g) + 3.$

$((d), -640 kcal, (s), \text{Moles of CO\_(2)formed is}), (, , (t), \text{Work done by the}$

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SUBJECTIVE TYPE

1. A picece of zinc of mass 5.0 g is dropped into a beaker of dilute hydrochloric acid. Calculate the work done by the system (mangnitude only in J) as a result of the reaction. The atmospheric pressure is 1.1 atm and temperture 23° C.

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Others

1. For a van der Waal's gas with a = 0.2463 atm $lit^2 mol^{-1}$ and b=0.01 lit mol^{-1} subjected to adiabatic free exapansion at an initial temperature of 650 K will show which of the following characterstics?

A. $q=0, w=0, \Delta T=0$

B. $q=0, w=0, \Delta T>0$

C. $q=0, w=0, \Delta T<0$

D. $q \neq 0, w = 0, \Delta T = 0$

Answer: B

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2. 1 mole of argon is expanded isothermiocally and irreversably (not against vaccum) from 10L to 100L. Which of the following is incorrect the process ?

A. $\Delta U = 0$

B. $\Delta H = 0$

C. Heat supplied(q)=0

D. $\Delta T = 0$

Answer: C

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3. A vessel contains 100 litres of liquid X. Heat is suppplied to the liquid in such a fashion that, Heat given = change in ethalpy. The volume of the liquid is incresed by 2 litres. If the external pressure is one atm, and 202.6joules of heat were supplied then, [U= total internal energy] :

A. $\Delta U = 0, \Delta H = 0$

B. $\Delta U = +202.6J, \Delta H = +202.6J$

C. $\Delta U = -202.6J, \Delta H = -202.6J$

D. $\Delta U = 0, \Delta H = +202.6J$

Answer: D

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4. 2 mole of ideal gas expands isothermically and reversibally from 1 L to 10 L at 300 K. then ΔH is :

A. 4.98 kJ

B. 11.47 kJ

C. $-11.47kJ$

D. zero

Answer: D

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5. Select the correct set of $\text{statement}/s$:

(P) Work done by the surroundings in case of infinite stage expansion is more than single stage expansion.

(Q) Irreversible work is always greater than reversible work.

(R) In an ideal gas in case of single stage expansion and compression, system as well as surroundings are restored back to their orginal states.

(S) If gas in thermodynamics is equilibrium is taken from state A to state B, by four successive single stage expansion. Then we can plot four points on the $P-V$ indicator diagram.

A. Only Q

B. P,Q,R,S

C. Q,S

D. P,Q,S

Answer: A

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6. A typical adults needs 33 kcal per kg body weight per day. Assuming an energy balance, calculate the' power' of an 80 kg individual

A. 217 W

B. 128 W

C. 712 W

D. 172 W

Answer: B

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7. A sample of gas is compressed from an initial volume of $2V_0 \text{to} V_0$ using three different processes.

First: Using reversing isothermal

Second : Using reversible adiabatic

Third : Using irreversible adiabatic under a constant external pressure ,than :

A. Final temerature of gas will be highest at the end of third process.

B. Final temperature of gas will be highest at the end of second process

C. Enthalpy change of sample will be highest in isothermal process. (magnitude wise)

D. Final pressure of gas will be highest at the end of second process.

Answer: A

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8. In an isothermical expansion of a gaseous sample the correct relation is (consider w (work) with sign according to IUPAC convention)

[The reversible and irreversible procss are carried out between same initial and final states.]

A. $w_{rev} > w_{irrev}$

B. $w_{irev} > w_{rev}$

C. $q_{rev} > q_{irrev}$

D. cannot be predicted

Answer: B

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9. a monoatomic gas $\left(Cv = \frac{3}{2}R\right)$ is allowed to expand adiabaticaly and reversibly from initial volume of 8 L to 300 K to a volume V_2 at 250 K. V_2 is

:

A. 10.5 L

B. 23 L

C. 8.5 L

D. 50.5 L

Answer: A

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10. An ideal gas with $C_v = 3R$ expands adiabatically into a vaccum thus doubling its volume. The final temeperature is given by :

A. $T_2 = T_1\left[2^{-1/3}\right]$

B. $T_2 = T_1$

C. $T_2 = 2T_1$

D. $T_2 = \frac{T_1}{2}$

Answer: B

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11. The enthalapy of vaporization of water at 100° C is 40.63 kJ mol^{-1}. The value of ΔU° for this process would be :

A. 37.53 kj mol^{-1}

B. 39.08 kJ mol^{-1}

C. 42.19 kJ mol^{-1}

D. 43.73 kJ mol^{-1}

Answer: A

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12. What is the work done against the atmosphere when 25 grams of water vapourizes at 373 K against a constant external pressure of 1 atm ? Assume that steam obeys perfect gas laws. Given that the molar enthalpy of vaporization is $9.72kcal/\text{mole}$, what is the change of enternal energy in the above process? [Take R =$2cal/mol/K$]

A. 1294.0 cals, 11247 cals

B. 921.4 cals, 11074 cals

C. 1036.1 cals, 12464 cals

D. 1129.3 cals, 10207 cals

Answer: C

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13. The magnitude of enthalpy changes for irreversible adiabatic expansion of a gas from 1 L to 2L is ΔH_1 and for reversible adiabatic expansion for the same expansion is ΔH_2. Then :

A. $\Delta H_1 > \Delta H_2$

B. $\Delta H_1 < \Delta H_2$

C. $\Delta H_1 < \Delta H_2$, enthalapy being a state function

D. $\Delta H_1 = \Delta E_1$, and $\Delta H_2 = \Delta E_2$ Where $\Delta E_1 \text{and} \Delta E_2$ are magnitudes changes in internal energy of gas in three expansions respectively .

Answer: B

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14. A certain mass of gas expanded from (1L, 10 atm) to (4 L, 5 atm) against a constant external pressure of 1 atm. If initial temperature of gas is 300 K and the heat capacity of process is $50J/{}^{\circ}C$. Then the enthalpy change during the process is :

$(1\text{Latm} \simeq 100J)$

A. $\Delta H = 15kJ$

B. $\Delta H = 15.7kJ$

C. $\Delta H = 14.4kJ$

D. $\Delta H = 14.7kJ$

Answer: D

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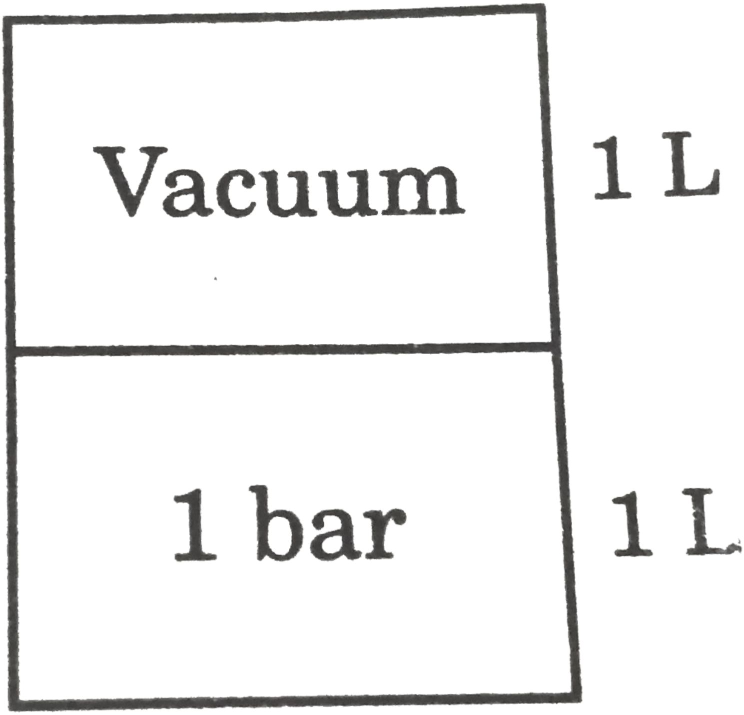
15. A container of volume 2L is seperated into equal compartments. In one compartment, one mole of an ideal monoatomic gas is filled at 1 bar pressure and the other compartment is completely evacuated. A pihole is made in the seperator so gas expands to occupy full 2 L and heat is supplied to gas so that finally pressure of gas equals 1 bar. Then :



A. $\Delta E = \Delta H = 150J$

B. $\Delta H = 250J$

C. $\Delta E = 100J$

D. $\Delta E = \Delta H = 0$

Answer: D

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16. Which of the following options is not correct w.r.t. van der Waal's gas subjected to isothermal process?

A. $|w|$ for 2 moles in a reversible process will not be double of $|w|$ for one mol.

B. Heat exchange :

$$q = \mathrm{nRTln}\frac{V_2 - nb}{V_1 - nb} + an^2\left[\frac{1}{V_2} - \frac{1}{V_1}\right]$$

C. Kinetic energy of molecules will remain constant.

D. Potential energy of moecules will change

Answer: B

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17. 5 moles of an ideal monoatomic gas absorbes x joule when heated from 25° C to 30° C at a constant volume. The amount of heat absorbed when 2 moles of the same gas is heated from 25° C to 30° C at constant pressure, is :

A. $\frac{3}{5}xJ$

B. $\frac{5}{3}xJ$

C. $\frac{2}{3}xJ$

D. $\frac{25}{6}xJ$

Answer: C

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18. The only incorrect statement for the value of γ for NH_3 gas is :

(Assume ideal gas behaviour)

A. $\gamma = \frac{7}{5}$ at moderate temperature

B. $\gamma = \frac{5}{9}$ at very low temperature

C. $\gamma = \frac{10}{9}$ at very high temperature

D. $\gamma = \frac{7}{6}$ considering only 50% contribution of vibrational energy.

Answer: A

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19. For a gaseous reaction,

$2SO_2 + O_2 \rightarrow 2SO_3, \Delta H = -440 kJ/\text{mole}$

at a temperature of 300 K. Calculate ΔU when 1 mole of SO_2 is completely reacted with 1 mole of O_2 in a 10 litre rigid vessel at an initial pressure of 50 bar which decreases to 20 bar.

A. $-190kJ$

B. $-250kJ$

C. $-410kJ$

D. $-470kJ$

Answer: A

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20. Select the option in which all the parametres are intensive :

A. pH, volume, Electrodes potential.

B. Molar enthalpy, Heat capacity, Resistivity.

C. Temperature,Molality, Electromotive force.

D. Mass, Pressure, Molar entropy.

Answer: C

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21. For which of the following process $|\Delta H| < |\Delta E|$:

A. Vaporisation of liquid bromine at constant pressure

B. Dissociation of $NH_3(g)$ to give $N_2(g)$ and $H_2(g)$ at constant pressure

C. Adiabatic free expansion of ideal gas

D. Conversion of graphite to diamond occuring at constant pressure condition

Answer: D

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22. For a fixed amouunt of an ideal gas $\left(\gamma = \frac{11}{9}\right)$, the change in internal energy of the gas when pressure changes from 10 bar to 20 bar in rigid vessel of volume 5 L is given by :

A. 225 J

B. 22.5 kJ

C. 15 kJ

D. 36 kJ

Answer: B

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23. Calculate change in enthalpy when 2 moles of liquid water at 1 bar and 100° C is coverted into steam at 2 bar and 300°. Assume H_2O vapoures to behave ideally.

[Latent heat of vaporisation of $H_2O(l)$ at 1 bar and 100° C id=s 10.8 kcal per mole]

[R=$2cal/\text{mol}K$]

A. 21.6 kcal

B. 11.8 kcal

C. 24.8 kcal

D. 23.6 kcal

Answer: C

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24. Which of the following statement is incorrect regarding adiabatic and isothermal processes for an ideal gas, starting from same initial state to same final volume?

A. In expansion, more work is done by the gas in isothermal processs.

B. In compression, less work will be done on the gas in isothermal process.

C. The slope of adiabatic P - V graph is negative.

D. In expansion, final temperature of adiabatic will be mor as compared to isothermal.

Answer: D

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25. Calculate work involved in compression of 2 moles of H_2 gas reversibly and isothermically from 1.2 L to 0.6 L at 300 K, if critical volume of H_2 gas is $0.3L/\text{mol}$.

Given : R=$2cal/mol$,in10=2.3,log4=0.6,log5=0.7,log11=1.2]

A. 1.104 kcal

B. 1.38 kcal

C. 2 kcal

D. 3.9 kcal

Answer: A

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26. Which of the following options is correct w.r.t. ideal gas

A. $\left(\frac{\partial H}{\partial T}\right)_P - \left(\frac{\partial H}{\partial T}\right)_V = R$

B. $\left(\frac{\partial H}{\partial T}\right)_P < \left(\frac{\partial H}{\partial T}\right)_V$

C. $\frac{\left(\frac{\partial H}{\partial T}\right)_P}{\left(\frac{\partial U}{\partial T}\right)_V} = \gamma(\text{Poisson's ratio})$

D. $\left(\frac{\partial U}{\partial T}\right)_P - \left(\frac{\partial H}{\partial T}\right)_p = R$

Answer: C

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27. Caalculate $\Delta H$when 2 moles of solid benzoic acid undergo complete combustion at 300 K if

$$C_6H_5COOH(s) + \frac{15}{2}O_2(g) \rightarrow 7CO_2(g) + 3H_2O(l)$$

$$\Delta U_{reaction} = -750kJ/\text{mole}$$

A. $-751.247kJ$

B. $-752.494kJ$

C. $-1501.247kJ$

D. $-1502.494kJ$

Answer: D

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28. For the combustion of CH_4 at 1 atm pressure and 300 K, which of the following options is correct?

A. $\Delta H = \Delta U$

B. $\Delta H > \Delta U$

C. $\Delta H < \Delta U$

D. $\Delta H = 0$

Answer: C

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29. A certain mass of a gas is expended from [2 L, 20 atm, 300 K] to [5 L, 10 atm, 320 K] against a constant external pressure of 5 atm. If heat capacity of the gas is $100 J / {}^{\circ} C$ then enthalapy change of the process will be : [1 atm lit. = 100 J]

A. 2 kJ

B. 0.5 kJ

C. 1.5 kJ

D. 1 kJ

Answer: C

30. Calculate heat capacity of a diatomic ideal gas (Molar mass=$11 gm / mol$) if it is subJected to a process such that pressure exerted is directly proportional to cube of the volume.[R=$2 cal / molK$]

A. $5 cal / molK$

B. $11 cal / gmK$

C. $0.5 cal / gmK$

D. $0.5 cal / molK$

Answer: C

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31. The value of $\Delta H - \Delta U$ when 2 moles of solid benzoic acid undergoes combustion at 300 K is given by :

A. $-1.247 kJ$

B. $-2.494 kJ$

C. $+2.494 kJ$

D. $+1.247 kJ$

Answer: B

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32. For a reaction

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g), \Delta H =$ - 24 kcal at 700 K and 10 atm pressure, calculate magnitude of change in internal energy if 1.68 kg of $N_2(g)$ and 0.3 kg of H_2 are mixed and reaction undergoes 60% completion :

A. 21.2 kcal

B. 636 kcal

C. 1200 kcal

D. 1090 kcal

Answer: D

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33. What will be the value of maximum work one by the gas when pressure of 20 gm H_2 is reduced from 20 to 2 atm at constant tempreature of 300 k, assuming gas to behave ideally?

A. 57.44 kJ

B. 114.88 J

C. 224.478 kJ

D. 22.4478 kJ

Answer: A

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34. An ideal gas is subjected to two different reversible expansion process, $PV^3 = K_1$ and $PV^{5/2} = K_2$ from same initial state to same final volume. Which of the follwing statements is correct regarding the two process :

A. The work done by the gas in second process is more as compared to first process.

B. The magnitude of work done can be compared only by knowing value of $K_1 \text{and} K_2$.

C. Heat capacity of the gas for the two process is same

D. Final state for the two process will be same

Answer: A

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35. A real gas is subjected to an adibatic process causing in a change of state from (3 bar, 50 L, 500 K) to (5 bar, 40 L, 600 K) against a constant pressure of 4 bar. The magnitude of enthalpy change for the process is :

A. 4000 J

B. 5000 J

C. 9000 J

D. 1000 J

Answer: C

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36. Which of the following options consist of only intensive parametres?

A. pH of solution, Temperature and volume.

B. Δp, Specific heat capacity, Molar internal energy, E.M.F.

C. Resistence, Molar mass, Vapour density

D. Density, Mass and temperature.

Answer: B

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37. A real gas follows PV=nRT at a temperature of 30° C. Which of the following statements is true when it is subjected to adiabatic free expansion at a temperature of 70°.

A. It will not undergo any change in temperature

B. It will not undergo increase in the temperature

C. It will not undergo decrease in the temperature

D. It will undergo first increase and then decrease in temperature

Answer: C

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38. Identify the options in which $\Delta H > \Delta U$. [Assume gases to behave as ideal].

A. Polymerisation of ethene (g) into polyethene (g) .

B. $H_2O(g) \rightarrow H_2(g) + O_2(g)$

C. $HCl(g) \rightarrow H_2(g) + Cl_2(g)$

D. $CH_4(g) \rightarrow O_2(g) + CO_2(g) + H_2O(l)$

Answer: B

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39. In which of the following processes involving ideal gas magnitude of heat exchange will be maximum for same change in temperture and same moles.[P

is in atm and V in litre]:

A. $PV^3 = 20$

B. Isochoric procees

C. Isobaric process

D. $PV^{1/2} = 10$

Answer: D

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40. Four sample of ideal gas containig same moles and intially at same temperature and prcessure are subjected to four difference processes :

(A) Isothermal reversible expansion

(B) Isothermal irrversible expansion against final pressure

(C) Adiabatic reversible expansion

(D) Adiabatic irreversible expansion against final pressure

If in all the cases , final pressue is same then what will be the order of final temperture in the above cases.

A. $T_a = T_b > T_c = T_d$

B. $T_a > T_b > T_c > T_d$

C. $T_a = T_b < T_c < T_d$

D. $T_a = T_b > T_d > T_c$

Answer: D

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41. An ideal gas is expanded irrversibly against 10 bar pressure from 20 litre to 30 litre . Calculate if processure is isoenthalpic :

A. 0

B. $+100J$

C. $-100J$

D. $+10kJ$

Answer: D

42. The volume of gas is reduced to half from its original volume. The specific heat will be

A. reduced to half

B. be doubled

C. remain constant

D. increase four times

Answer: C

43. For a real gas having $a = 4.105 atm - L^2/\text{mole}$ and $b = \frac{1}{5.4} L/\text{mole}$ .If it is at an initial temperture of 300 k, then which of the following process can cause liquifaction of the gas ?

A. Isothermally decrease of pressure

B. Isothermally increase of pressure

C. Adiatbatic decrease of pressure

D. both (b) and (c)

Answer: C

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44. What is the change internal energy when a gas contracts from 377 mL to 177 mL under a constant pressure of 1520 torr, while at the same time being cooled by removing 124 J heat ?

$[Take: (1 Latm) = 100 J)]$

A. $-24J$

B. $-84J$

C. $-164J$

D. $-248J$

Answer: B

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45. The heat capactiy of liquid water is $75.6J/molK$, while the enthalpy of fusion of ice is $6.0kj/mol$. What is the smallest number of ice cubes at 0° C, each containing 9.0 g of the of water, needed to cool 500 g of liquid water from 20° C to 0° C ?

A. 1

B. 7

C. 14

D. None of these

Answer: C

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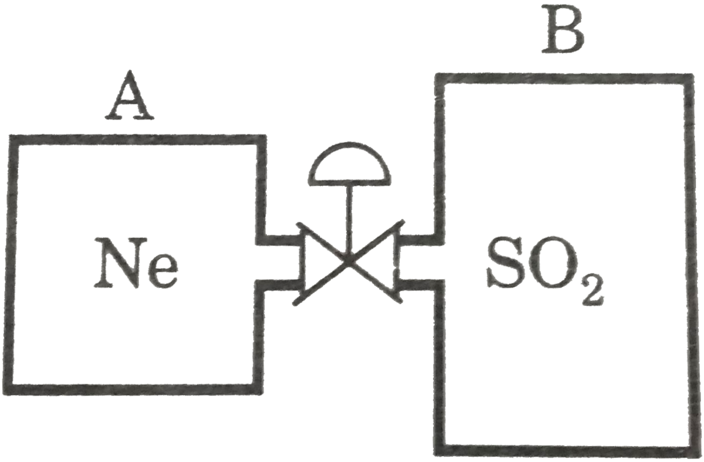
46. Two rigid adiabatic vessel A and B which initially ,contain two gases at different temperature are connected by pipe line with value of negligible volume .The vessel A contain 2 moles Ne gas $\left(C_{p.m}=\frac{5}{2}R\right)$ at 300 K, vessel B contain 3 moles of $SO_2gas\left(C_{p.m}=4R\right)$ at 400 K .

The volume of the A and B vessel is 4 and 6 litre repectively .

The final total pressue (in atm) when valve is opened and 12 kcal heat supplied throught it to vessels .

[Use :$R=2cal/\text{mole}K\text{and}R=0.08L.\,atm/\text{mole}$ K as per desire]



A. $3.5atm$

B. $7atm$

C. $35atm$

D. $70atm$

Answer: C

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47. A system contains 1 mole of a monoatomic ideal gas . Now 1 mole of a diatomic non-reacting ideal gas is added into the system at constant volume and temperature. Due to addition diatomic gas ,Choose the incorrect statement , regarding the new

system :

A. Enthalpy of system will increase

B. Adiabatic coefficient $\left(\lambda = C_p / C_V\right)$ of the system

will decrease

C. Internal energy of the system remains constant .

D. Pressure energy system will increase .

Answer: C

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48. Warming ammonium chloride with sodium hydroxide in a test tube is an example of :

A. closed system

B. isolated system

C. open system

D. None of these

Answer: C

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49. Out of boiling point (P), entropy (Q), pH (R) and e.m.f. of cell (S), intensive properties are:

A. P, Q

B. P, Q, R

C. P, R, S

D. All of these

Answer: C

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50. Ice-water mass ratio is maintntained as $1:1$ in a given system containing water in equilibrium with ice at constant pressue . If C_p (ice) = C_p (water) =4.18 J $mol^{-1}K^{-1}$ molar heat capacity of such a system is :

A. Zero

B. infinity

C. $4.182JK^{-1}mol^{-1}$

D. $75.48JK^{-1}mol^{-1}$

Answer: B

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51. A piece of zinc at a tempreature of 20.0° C weighing 63.38 g is drooped into 180 g boiling water $\left(T = 100^{\circ}C\right)$. The specific heat of zinc is $0.400Jg^{-1} ° C$ and that of water is $4.20Jg^{1} ° C$. What is the finial comman temperature reached by both the zinc and water ?

A. $97.3 °$C

B. $33.4 °$C

C. $80.1 °$C

D. $60.0 °$C

Answer: A

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52. Two mole of an ideal gas is heated at constant pressure of one atmosphere from $27 ° C$ to $127 ° C$. If $C_{v,m} = 20 + 10^{-2}\text{T JK}^{-1}. mol^{-1}$, then q and ΔU for the process are respectively:

A. $6362.8J, 4700J$

B. $3037.2J, 4700J$

C. $7062.8, 5400J$

D. none of these

Answer: A

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53. Determine which of the following reactions at constant pressure represent surrounding that do work on the system environment :

(P) $4NH_3(g) + 7O_2(g) \rightarrow 4NO_2 + 6H_2O(g)$

(Q) $CO.\ O(g) + 2H_2(g) \rightarrow CH_3OH(l)$

(R) $C(\text{s,graphite}) + H_2O(g) \rightarrow CO(g) + H_2(g)$

(S) $H_2O(s) \rightarrow H_2O(l)$

A. R,S

B. Q and R

C. Q,S

D. P,Q and S

Answer: D

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54. A sample of liquid in a thermally insulated constant (a calorimetre) is stirred for 2 hr. by a mechancal linkage to motor in the surrounding ,for this procees :

A. $w < 0, q = 0, \Delta U = 0$

B. $w > 0, q = 0, \Delta U > 0$

C. $w < 0, q > 0, \Delta U = 0$

D. $w > 0, q = 0, \Delta U > 0$

Answer: D

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55. 10 mole of ideal gas expand isothermally and reversibly from a pressure of $10atm$ to $1atm$ at $300K$. What is the largest mass which can lifted through a height of 100 meter?

A. $31842kg$

B. $58.55kg$

C. $342.58kg$

D. None of these

Answer: B

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56. A gas expands adiabatically at constant pressure such that $T \propto V^{-1/2}$.

Thre Value of $\gamma\left(C_{p,m}/C_{v,m}\right)$ of the gas will be :

A. 1.3

B. 1.5

C. 1.7

D. 2

Answer: B

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57. Which has maximum internal energy at $290K$?

A. Neon gas

B. Nitrogen gas

C. Ozone gas

D. Equal for (a),(b),(c)

Answer: C

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58. 1 mole of NH_3 gas at 27° C is expanded under reversible adiabatic conditions to make volume 8 times $(\gamma = 1.33)$. Final temperature and work done respectively are :

A. 150 K, 900 cal

B. 150 K, 400 cal

C. 250 K, 1000 cal

D. 200 K, 800 cal

Answer: A

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59. 1 mole of an ideal gas A($C_{v,m} = 3R$) and 2 mole of an ideal gas B are $\left(C_{v,m} = \frac{3}{2}R\right)$ taken in a container and expended reversibly and adiabatically from 1 litre to 4 litre starting from initial temperature of 320 K. $\Delta E \text{or} \Delta U$ for the process is :

A. -$240R$

B. $+240R$

C. 480 R

D. -$960R$

Answer: D

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60. One mole of an ideal gas $\left(C_{v,m}=\frac{5}{2}R\right)$ at 300 K and 5 atm is expanded adiabatically to a final pressure of 2 atm against a constant pressure of 2 atm. Final temperature of the gas :

A. 270 K

B. 273 K

C. 248.5 K

D. 200 K

Answer: C

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61. The work done in adiabatic compression of 2 mole of an ideal monoatomic gas by constant external pressure of 2 atm starting from initial pressure of 1 atm and initial tempreature of 1 atm and initial temperature of 300 K.

(R=$2cal/mol$ - $degree$)

A. 360 cal

B. 720 cal

C. 800 cal

D. 1000 cal

Answer: B

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62. One mole of a non-ideal gas undergoes a change of state (1.0 atm,3.0 L,200 K) to (4.0 atm,5.0 L,250 K) with a change in internal energy (ΔU)=40 L-atm. The change in enthalpy of the process in L-atm :

A. 43

B. 57

C. 42

D. None of these

Answer: B

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63. 0.5 mole each of two ideal gases A$\left(C_{v,m}=\frac{5}{2}R\right)$ and B$\left(C_{v,m}=3R\right)$ are taken in a container and expanded reversibely and adibatically , during this process, temperature of gaseous mixture decreased from 350 K and 250 K. Find ΔH (in cal/mol) for the process :

A. $-100R$

B. $-137.5R$

C. $-375R$

D. None of these

Answer: C

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64. $100mL$ of a liquid is contained in an insulated container at a pressure of 1bar. The pressure is steeply increased to 100bar. The volume of the liquid is decreased by $1mL$ at this constant pressure. Find ΔH and ΔU.

A. 1 L atm

B. 5 L atm

C. 500 L atm

D. 50 L atm

Answer: A

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65. Consider the reaction at 300 K

$H_2(g) + Cl_2(g) \rightarrow 2HCl(g), \Delta H^\circ = -185 kJ$

If 2 mole of H_2 compeletely react with 2 mole of Cl_2 to form HCl. What is ΔU° for this reaction ?

A. 0

B. $-185kJ$

C. 370 kj

D. $-370kJ$

Answer: D

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66. For the real gases reaction,

$2CO(g) + O_2(g) \rightarrow 2CO_2(g), \Delta H = -560kJ$. In 10 litre rigid vessel at 500 K the initial pressure is 70 bar and after the reaction it becomes 40 bar. The change in internal energy is :

A. $-557kJ$

B. $-530kJ$

C. $-563kJ$

D. None of these

Answer: B

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67. Correct statements about samples of ice and liquid water at 0° C include which of the following ? (P) Molecules in ice and liquid water have the same kinetic energy.

(Q) Liquid water has a greater entropy than ice. (R) Liquid water has a greater potential energy than ice

A. P and Q only

B. P and R only

C. Q and R only

D. P,Q and R

Answer: D

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68. A heating coil is immersed in a 100 g sample of H_2O (l) at a 1 atm and 100° C in a closed vessel. In this heating process , 60% of the liquid is converted to the gaseous form at constant pressure of 1 atm . The densities of liquid and gas under these conditions are 1000 kg/m^3 and 0.60 kg/m^3 respectively . Magnitude of the work done forthe process is : (Take : 1L-atm= 100J)`

A. 4997 J

B. 4970 J

C. 9996 J

D. none of these

Answer: C

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69. 10 itres of monoatomic gas at 0° C and 10 atm pressure is suddenly released to 1 atm pressure and the gas expands adibatically against the constant pressure. The final temperature and the volume of the gas respectively are :

A. T= 174.7 K, V= 64.00 liitres

B. T= 153 K, V= 57 liitres

C. T= 165.4 K, V= 78.8 liitres

D. T= 161.2 K, V= 68.3 liitres

Answer: A

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70. Consider a classroom that is roughly $5m \times 10m \times 3m$. Initially $T = 27^\circ$ C and p=1 atm. There are 50 people in a insulated class losing energy to the room at the average rate of 150 Watt per person. How long can they remain in class if the body temperature is 42° C and person feels uncomfortable above this temperature. Heat capacity of air=$(7/2)R$

A. 4.34 minutes

B. 5.91 minutes

C. 6.86 minutes

D. 7.79 minutes

Answer: B

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71. The increase in internal energy of 1 kg of water at 100° C when it is converted into steam at the same temperature and 1 atm (100 kPa) will be :

[The density of water and steam are $1000kg/m^3$and$0.6kg/m^3$ respectively. The latent heat of vapourisation of water is $2.25\times10^6 J/kg$.]

A. $2.08 \times 10^6 J$

B. $4 \times 10^7 J$

C. $3.27 \times 10^8 J$

D. $5 \times 10^9 J$

Answer: A

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72. At 5×10^4 bar pressure density of diamond and graphite are $3g/cc$ and $2g/cc$ respectively, at certain temperature $'T'$.Find the value of $\Delta U - \Delta H$ for the conversion of 1 mole of graphite to 1 mole of diamond at temperature $'T'$:

A. $100kJ/mol$

B. $50kJ/mol$

C. $-100kJ/mol$

D. None of these

Answer: A

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73. A new flourocarbon of molar mass 102 g mol^{-1} was placed in an electricity heated vessel. Whwn the pressure was 650 torr, the liquid boiled at 77 ° C. After the boiling point had been reached , it was found that a current of 0.25 A from a 12.0 volt supply passed for 600 sec vaporises 1.8g of the sample. The molar enthalpy and enternal energy of vaporisation of new flourocarbon will be :

A. $\Delta H = 102kJ/mol, \Delta E = 99.1kJ/mol$

B. $\Delta H = 95kJ/mol, \Delta E = 100.3kJ/mol$

C. $\Delta H = 107kJ/mol, \Delta E = 105.1kJ/mol$

D. $\Delta H = 92.7kJ/mol, \Delta E = 97.4kJ/mol$

Answer: A

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74. A sample of argon gas at 1 atm pressure and 27° C expand reversibly and adibatically from $1.25dm^3$ to $2.50dm^3$. The enthalpy change in this process will be $C_{v.m.}$ for argon is $12.48JK^{-1}mol^{-1}$.

A. 114.52 J

B. $-117.14J$

C. $-57.26J$

D. 57.26 J

Answer: D

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75. In thermo dynamics a process is called reversible when :

A. surroundings and system change into each other

B. there is no boundary between system and surroundings

C. the surroundings are always in equilibrium with system

D. the system chnges into surrounding spontanously

Answer: C

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76. Which one of the following statement is false :

A. work is a state function

B. temperetaue is a state function

C. change in the state is completely defined when the initial and final states are specified.

D. work appears at the boundary of the system.

Answer: A

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77. One mole of a non-ideal gas undergoes a change of state $(2.0 atm, 3.0 L, 95 K) \rightarrow (4.0 atm, 5.0 L, 245 K)$ with a change in internal energy , ΔU =30.0 L atm. The change in enthalapy (ΔH) of the process in L atm is :

A. 40

B. 42.3

C. 44

D. not defined, because pressure is not constant

Answer: C

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78. The molar heat capacity, C_v of helium gas is $3/2$ R and is independent of temperature. For hydrogen gas, C_v approaches $3/2$ R at a very low temperature, equals $5/2$ R at moderate temperature and is higher than

5/2 R at high temperature. Choose the correct reason for the temperature dependence of C_v in case of hydrogen :

A. Hydrogen is diatomic so at high temperature rotational and vibrational motion also counts

B. Hydrogen is monoatomic so at high temperature rotational and vibrational motion also counts

C. Hydrogen is diatomic so at high temperature rotational and vibrational motion are not counted

D. can't be defined

Answer: A

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79. 2 moles of an ideal gas is expanded isothermically and revrsibly from 1 litre to 10 litre. Find the enthalapy change in kJ mol^{-1}.

A. 0

B. 11.7

C. -11.7

D. 25

Answer: A

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80. There is 1 mol liquid (molar volume 100 ml) in an adiabatic container initial, pressure being 1 bar. Now the pressure is steeply increased to 100 bar ,and the volume decreased by 1 mL under constant pressure of 100 bar. Calculate $\Delta H \text{and} \Delta E$.

[Given 1 bar = $10^5 N/m^2$]

A. $\Delta E = 0J, \Delta H \neq 0J$

B. $\Delta H = 990J, \Delta E = 10J$

C. $\Delta E = 20J, \Delta H = 890J$

D. $\Delta E = 0J, \Delta H = 10J$

Answer: B

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81. One mole of an ideal monoatomic gas at temperature T and volume 1 L expands to 2 L against a constant external pressure of one atm under adibatic conditions, then final temperature of gas will be :

A. $T + \frac{2}{3 \times 0.0821}$

B. $T - \frac{2}{3 \times 0.0821}$

C. $\frac{T}{2^{5/3-1}}$

D. $\frac{T}{2^{5/3+1}}$

Answer: B

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82. The ratio of P to V at any instant is constant and is equal to 1. for a monoatomic ideal gas undergoing a process. What is the molar heat capacity of the gas?

A. $\frac{3R}{2}$

B. $\frac{4R}{2}$

C. $\frac{5R}{2}$

D. 0

Answer: B

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83. An ideal gas expands from $1 \times 10^{-3} m^3$ to $1 \times 10^{-2} m^3$ at $300K$ againts a constant pressure of $1 \times 10^5 Nm^{-2}$. The work done is :

A. $-900J$

B. $-900kJ$

C. 270 kJ

D. $+900kJ$

Answer: A

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84. Consider the reaction: $N_2 + 3H_2 \Leftrightarrow 2NH_3$ carried out at constant pressure and temperature. If ΔH and ΔU are change in enthalpy and change in internal energy respectively, then:

A. $\Delta H = 0$

B. $\Delta H = \Delta U$

C. $\Delta H < \Delta U$

D. $\Delta H > \Delta U$

Answer: C

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85. An ideal gas is allowed to expand both reversible and irreversibly in an isolated system. If T_i is the initial temperature and T_f is the final temperature, which of the following statements is correct:

A. $T_f > T_i$ for reversible process but $T_f = T_i$ for irreversible process

B. $\left(T_f\right)_{rev} = \left(T_f\right)_{irrev}$

C. $T_f = T_i$ for both reversible and irreversible process

D. $\left(T_f\right)_{irrev} > \left(T_f\right)_{rev}$

Answer: D

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86. $(\Delta H - \Delta U)$ for the formation of carbon monoxide (CO) from its elements at 298 K is :

(R=8.314 $JK^{-1}mol^{-1}$)

A. 1238.78 J mol^{-1}

B. $-2477.57 Jmol^{-1}$

C. 2477.57 J mol^{-1}

D. $-1238.78 mol^{-1}$

Answer: A

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87. Assuming that water vapour in an ideal gas, the internal energy change (ΔU) when 1 mol of water is vaporised at 1 bar of pressure and 100° C, (Given : Molar enthalpy of vapourization of water at 1 bar and 373 K = 41 kJ mol^{-1} and R=8.3 J $mol^{-1}K^{-1}$) will be :

A. 37.904 kJ mol^{-1}

B. 41.00 kJ mol^{-1}

C. 4.100 kJ mol^{-1}

D. 3.7904 kJ mol^{-1}

Answer: A

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88. A substance is expanded in adiabatic process from 2 L to 5 L against constant pressure of 1 bar then internal energy change will be :

A. 3 bar-L

B. $-3\text{bar} - L$

C. 6 bar-L

D. $-6\text{bar} - L$

Answer: B

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89. What is the change in enthalapy (kcal) when 1 mole of ideal monoatomic gas is expended reversibly and adibatically from initial volume of 1 L and initial temperature 300 K to final volume of 8 L :

A. -1.125

B. $+1.125$

C. 2.25

D. -2.250

Answer: A

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90. One mole of a monoatomic ideal gas initially at a pressure of 2.00 bar and a temperature of 273 K is taken to a final pressure of 4.00 bar by a reversible path defined by P/V=constant, the value of $\Delta U/w$ for this process is :

A. -3.0

B. -1.5

C. $+1.5$

D. $+3.0$

Answer: A

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91. The temperature of a definite amount of an ideal monoatomic gas becomes four times in a reversible process for which heat exchange is zero. Which of the following is correct relation between the final and initial parameteres of gas?

A. $V_f = 8V_i$

B. $P_f = 32P_i$

C. $V_f = 16V_i$

D. $P_f = \frac{1}{16}P_i$

Answer: B

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92. Calculate the work done on the system in Joules when 2.0 moles of N_2 reactes with 6.0 moles H_2, to form NH_3 against a pressure of 1 .0 atm at 27 ° C. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

(Given : R= $8J/molK$)

A. $+4.8 \times 10^3$

B. -9.6×10^3

C. -4.8×10^3

D. $+9.6 \times 10^3$

Answer: D

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93. A certain mass of an ideal gas absorbes 80 kJ heat and gas is expended from 2 L to 10 L at constant pressure of 25 bar. What is ΔU for gas in the process ? (1 bar-L= 100 J)

A. 280 kJ

B. - $120kJ$

C. 60 kJ

D. 100 kJ

Answer: C

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94. For which of the following change $\Delta H \neq \Delta E$?

A. $H_2(g) + I_2(g) \rightarrow 2HI(g)$

B. $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$

C. $C(s) + O_2(g) \rightarrow CO_2(g)$

D. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

Answer: D

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95. Select the correct formula for isothermal irreversible process for an ideal gas :

A. $W = nRT\ln.\ \frac{P_2}{P_1}$

B. $W = P_{ext}\left(\frac{nRT}{P_2} - \frac{nRT}{P_1}\right)$

C. $Q = P_{ext}\left(\frac{nRT}{P_2} - \frac{nRT}{P_1}\right)$

D. $Q = nRT\ln\left(\frac{P_2}{P_1}\right)$

Answer: C

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96. When 1 mol of real gas absorbes 100 kJ heat at constant pressure of 1 bar, it's volume changes from 2 L to 2.5 L. What is the enthalapy for the gas?

A. 150 kJ

B. 50 kJ

C. 100 kJ

D. $-50J$

Answer: C

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97. 418.4 J of heat is added to a $4 \times 10^{-3} m^3$ rigid container containing a diatomic gas atm and 273 K. Calculate the pressure of the gas assuming ideal behaviour. The vibrational contributions may be neglected : (R=8.314 J $mol^{-1} K^{-1}$)

A. $3.48 \times 10^5 N/m^2$

B. $7.27 \times 10^7 N/m^2$

C. $1.43 \times 10^5 N/m^2$

D. $9.2 \times 10^7 N/m^2$

Answer: C

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98. Given at $25^\circ C$

$4NH_3(g) + 5O_2(g) \Leftrightarrow 6H_2O(l) + 4NO(g)$,

$\Delta H^\circ = -1169kJmol^{-1}$

The value of ΔU° for this reaction at $25^\circ C$ will be about :

A. $-1181.4kJmol$

B. $-1194.8kJmol^{-1}$

C. $-1156.6kJmol^{-1}$

D. $-1144.2kJmol^{-1}$

Answer: D

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99. Given at 300 K

$NH_3(g) \Leftrightarrow \frac{1}{2}N_2(g) + \frac{3}{2}H_2(g),$

$\Delta_r H^\circ = 193.27 kJmol^{-1}$

The value of $\Delta_r U$ for this reaction would be :

A. 190.78 kJmol^{-1}

B. 19.576 kJmol^{-1}

C. 188.29 kJmol^{-1}

D. 198.27 kJmol^{-1}

Answer: A

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100. One mole of diatomic ideal gas undergoing a process in which absolute temperature is directely proportional to cube of volume, then, heat capacity of process is :

A. $\frac{10}{3}R$

B. $\frac{11}{6}R$

C. $\frac{17}{6}R$

D. 3R

Answer: C

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101. Calculate ΔU for a gas, if enthalpy change is 40 atm-L for the state change (5 atm, 10 L) to (3 atm,15 L) :

A. 45 atm-L

B. 35 atm-L

C. 30 atm-L

D. 40 atm-L

Answer: A

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102. Maximum heat absorbed during isothermal expansion of an ideal gas from (10 atm, 1 L) to (1 atm, 10 L) is :

A. 90 atm-L

B. 10 atm-L

C. 9 atm-L

D. 23.03 atm-L

Answer: D

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103. 1 mole of an ideal gas expands from $5dm^3$ to$25dm^3$ isothermally and irreversibly at 27° C. Find work done in the process [R=8.3 $J/mol/K$]

A. - $1.99kJ$

B. $+1.99kJ$

C. $-7.46kJ$

D. $+7.46kJ$

Answer: A

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104. Which of the following statements is correct ?

A. The presence of reacting species in a covered beaker is an example of open system.

B. There is an exchange of energy as well as matter between the system and the surounding in a closed system

C. The presence of rectants in aclose vessel made up of copper is an exampleof a closed system

D. The presence of reactants in a thermose flask or any other closed insulated vessel is an example of a closed system

Answer: C

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105. Thermodynamics is not concerned about....

A. energy changes involved in a chemical reaction

B. the extent to which a chemical reaction proccedes

C. the rate at which a reaction proceedes

D. the feasibility of a chemical reaction

Answer: C

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106. The volume of gas is reduced to half from its original volume. The specific heat will be

A. reduce to half

B. be doubled

C. remains constant

D. increases four times

Answer: C

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107. During an experiment an ideal gas is found to be obey an additional law PV^3= Constant. The initial temperature of gas is 600 K, what will be the final temperature, if gas expands to double it's volume :

A. 1200 K

B. 2400 K

C. 300 K

D. 150 K

Answer: D

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108. A gas expands slowely against a variable pressure given by $p = \frac{10}{V}$ bar, where V is the volume of gas at each stage of expansion. During expansion from volume 10 L to 100 L the gas undergoes an increase in internal energy of 400 J. How much heat is absorbed by gas during expansion ?

A. 1900 J

B. 2300 J

C. 2700 J

D. 423 J

Answer: C

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109. A system is provided 50 J of heat and work can be done on the system is 10 J. The change in internal energy during the process is:

A. 40 J

B. 60 J

C. 80 J

D. 50 J

Answer: B

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110. Temperature of $1 mol$ of a gas is increased by 1° at constant pressure. The work done is

A. $-R$

B. $-2R$

C. $-\frac{R}{2}$

D. $-3R$

Answer: A

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111. In an adibatic process, no transfer of heat takes place between system and surroundings. Choose the correct option for free expansion of an ideal gas under adiabatic conditions from the following :

A. $q = 0, \Delta T \neq 0, w = 0$

B. $q \neq 0, \Delta T = 0, w = 0$

C. $q = 0, \Delta T = 0, w = 0$

D. $q = 0, \Delta T < 0, w \neq 0$

Answer: C

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112. The pressure-volume work for an ideal gas can be calculated by using the expression $\omega = - \int_{\upsilon_1}^{\upsilon_1} P_{ex} dV$. The work can also be calculated form the Pv, plot by using the area under the curve within the specified limits. When an ideal gas is compressed (a) reversiblity or (b) irrevesibly form volume $V_i \text{to} V_f$ choose the correct option:

A. $\omega(\text{reversible}) = \omega(\text{irreversible})$

B. $\omega(\text{reversible}) < \omega(\text{irreversible})$

C. $\omega(\text{reversible}) > \omega(\text{irrversible})$

D. $\omega(\text{reversible}) = \omega(\text{irrversible})$

Answer: B

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113. Work done by a sample of an ideal gas in a process A is double the work done in another process B. The temperature rises through the same amount in the two process. If C_A and C_B be the molar heat capacitites for the two processes:

A. $C_A = C_B$

B. $C_A > C_B$

C. $C_A < C_B$

D. None of these

Answer: D

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114. One mole of a real gas is subjective to a process form $(2\text{bar}, 30lit, 300k)$ to $(2\text{bar}, 50lit, 400k)$ Given $C_v = 40J/mol/K, C_P = 50J/mol/K$ Calculate $\triangle U$.

A. $4000J$

B. $2000J$

C. $1000J$

D. $5000J$

Answer: C

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115. An ideal gaseous sample at intial state $i(P_0, V_0, T_0)$ is allowed to expand to volume $2V_0$ using two different process, in the first process, thje equation of process is $2PV^2 = K_1$ and in the second process the equation of the process is $PV = K_2$. Then:

A. Work done in the first process will be greater than work in second process (magnitude wise).

B. The order of value of work done cannot be compared unless we know the value of K_1 and K_2

C. Value of work done (magnitude) in second process is greater in above expansion irrespective value of K_1 and K_2

D. Ist process is not possible.

Answer: C

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116. A balloon is 1m in diameter and contain air at $25^{\circ}C$ and 1 bar pressure. It is filled with air isothermally and reversibly until the pressure reaches 5bar. Assume pressure is propotional to diameter of ballon. Calulate work done by air $\left(atm, m^3\right)$

A. 78π

B. 156π

C. 624π

D. 625π

Answer: A

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117. During an adiabatic process, the pressure of a gas is found to be proportional to cube of its absolute temperature. The poision's ratio of gas is:

A. $\frac{3}{2}$

B. $\frac{7}{2}$

C. $\frac{5}{3}$

D. $\frac{9}{7}$

Answer: A

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118. Calulate the work done (in cal.). When 1.0 mole of N_2H_4 decomposes completely against a pressure of 1.0 atm at $27^\circ C$ $(GivenR = 2cal/mol/K)$

$N_2H_4(l) \rightarrow NH_3(g) + N_2(g)$

A. $-1000cal$

B. $1000cal$

C. $-3000cal$

D. $3000cal$

Answer: A

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119. The average degree of freedom per molecule for a gas is 6. The gas performs $25J$ of work when it expands at constant pressure. Find the heat absorbed by the gas:

A. $25J$

B. $50J$

C. $75J$

D. $100J$

Answer: D

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120. In which of the following chemical reactions, $\delta H > \delta U$?

A. $H_2(g) + I_2(g) \rightarrow 2HI(g)$

B. $N_2(g) + 3H_2(g) \rightarrow NH_3(g)$

C. $2H_2O_2(g) \rightarrow 2H_2O(g) + O_2(g)$

D. $C_s(g) + O_2(g) \rightarrow CO_2(g)$

Answer: C

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121. In a constant pressure process, for 5mole of an ideal monoatomic gas, the temperature of gas increased form $300K \rightarrow 500k$. Which of the following is incorrect reagarding the process?

A. $\delta H_{sys} = 2500R$

B. $\delta U_{sys} = 1500R$

C. $Q = 3500R$

D. $\omega = -1000R$

Answer: C

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122. $\delta_f U^{\ominus}$ of formation of $CH_4(g)$ at a certain temperature is $-393Jmol^{-1}$. The value of $\delta H^{\ominus} is:$

A. zero

B. $< \delta_f U^{\ominus}$

C. $> \delta_f U^{\ominus}$

D. equal to$\delta_f U^{\ominus}$

Answer: B

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123. What is correcto for an ideal gas undergoing reversible adiabatic expansion reagarding temperture?

A. Remains same

B. Increases

C. Decreases

D. May increase or decrease

Answer: C

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124. An ideal gas taken in an insulated chamber is relased into interstellar space. The statement that is nearly trure for this pupose is :

A. $Q=0, W \ne 0$

B. $W=0, Q \ne 0$

C. $\delta U=0, Q \ne 0$

D. $Q=W=\delta U=0$

Answer: D

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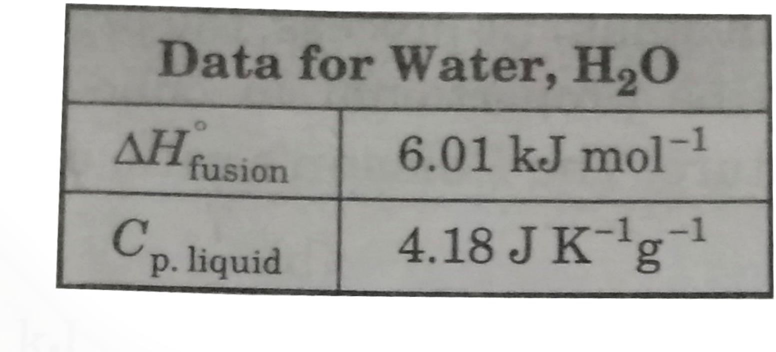
125. How much energy must be supplied to change $36g$ of ice at $36g$ of ice at $0^\circ C$ water at room temperture , $25^\circ C$?



Data for Water, H_2O	
$\Delta H^{\circ}_{fusion}$	6.01 kJ mol^{-1}
$C_{p.\,liquid}$	4.18 J $K^{-1}g^{-1}$

A. $12kJ$

B. $16kJ$

C. -$210kJ$

D. $22kJ$

Answer: B

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126. A certain reaction is exothermic by $220kJ$ and does $10kJ$ of work. What is the change is the internal energy of the system at constant temperture?

A. $+230kJ$

B. $+210kJ$

C. $-210kJ$

D. $-230kJ$

Answer: D

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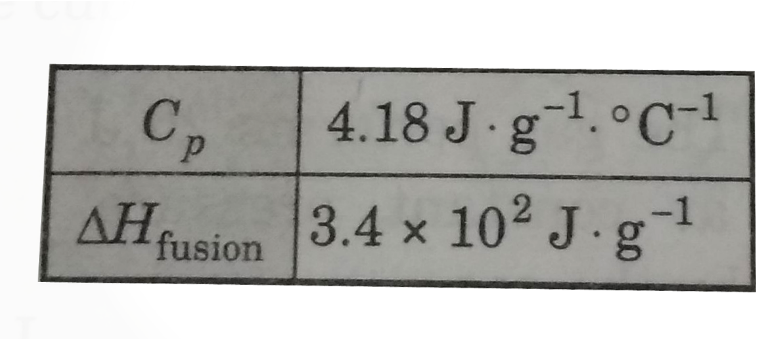
127. Calculate the amount the energy necessary to heat a $2.5g$ ice cube form $0\,^\circ C to 23\,^\circ C$:



C_p	$4.18\ J\cdot g^{-1}\cdot {}^\circ C^{-1}$
ΔH_{fusion}	$3.4\times 10^2\ J\cdot g^{-1}$

A. 240J

B. $850J$

C. $1090J$

D. $3700J$

Answer: C

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128. δE° is measured at constant volume and δH° is measured at constant pressure. For the reaction ,

$2C(s) + O_2(g) \rightarrow 2CO(g)$ " " $\delta H^{\circ} < 0kJ$

How do the δE° and δH° compare for this reaction ?

A. $\delta E^{\circ} < \delta H^{\circ}$

B. $\delta E^{\circ} > \delta H^{\circ}$

C. $\delta E^{\circ} = \delta H^{\circ}$

D. Impossible to tell form this infromation.

Answer: A

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129. An ice cube at $0.00\ ^{\circ}C$ is placed is 200g of distilled water at $25\ ^{\circ}C$. The final temperature after ithe ice is completely metled is $5.00\ ^{\circ}C$. What is the mass of the ice cube?

$\delta H_{fus} = 340 J.\ g^{-1}, C_p = 4.18 J.\ g^{-1}..\ ^{\circ}C^{-1}$

A. $23.6g$

B. $46.3g$

C. $50.0g$

D. $800g$

Answer: B

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130. For which reaction is δH (enthalpy change) most nearly equal to δE (internal energy change)?

A. $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g)$

B. $Cl_2(g) + F_2(g) \rightarrow 2ClF(g)$

C. $H_2O(l) \rightarrow H_2O(g)$

D. $2SO_3(g) \rightarrow 2SO_2(g) + O_2(g)$

Answer: B

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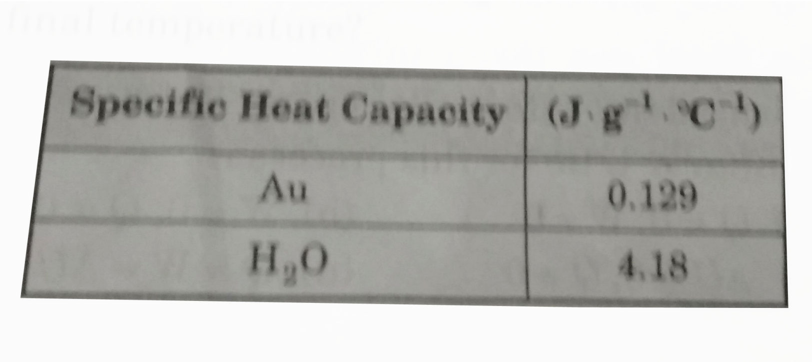
131. A gold ring that weighting 3.81g is heated to $84^\circ C$ and placed in 50.0g of H_2O at $22.1^\circ C$. What is the final temperature?



Specific Heat Capacity	$(J \cdot g^{-1} \cdot {}^\circ C^{-1})$
Au	0.129
H_2O	4.18

A. $22.2^\circ C$

B. $24.0\,^\circ C$

C. $26.5\,^\circ C$

D. $53.1\,^\circ C$

Answer: A

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132. For which exothermic reaction is δE more negative than δH?

A. $Br_2(l) \rightarrow Br_2(g)$

B. $2C(s) + O_2(g) \rightarrow 2CO(g)$

C. $H_2(g) + F_2(g) \rightarrow 2HF(g)$

D. $2SO_2(g) + O_2(g) \rightarrow 2SO_2(g)$

Answer: B

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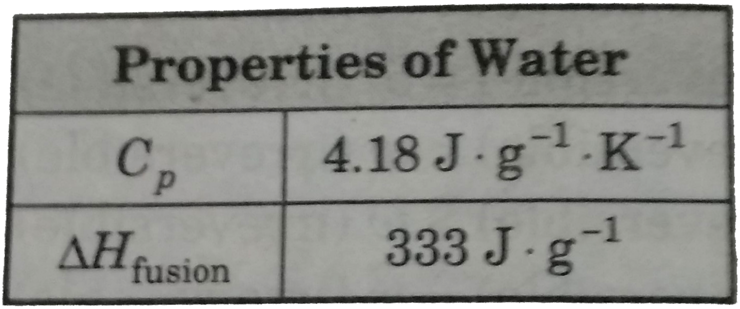
133. An ice cube of unknown mass at $0^{\circ}C$ is added to 265g of H_2O at $25.00^{\circ}C$ in a calorimeter. If the final temperature of the resulting H_2O is $21.70^{\circ}C$, what is the mass of the ice cube?



Properties of Water	
C_p	$4.18\ J\cdot g^{-1}\cdot K^{-1}$
ΔH_{fusion}	$333\ J\cdot g^{-1}$

A. $2.47g$

B. $8.63g$

C. $10.3g$

D. $11.0g$

Answer: B

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134. What is the specific heat capacity of mercury $\left(\text{in} J \times g^{-1} \times C^{-1}\right)$ if a $25.0g$ a sample requires $19.3J$ to raise its temperature from $24.5\,^{\circ}C \text{to} 30.0\,^{\circ}C$?

A. 0.026

B. 0.032

C. 0.14

D. 7.0

Answer: C

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135. For reactions conducted at constant pressure, under that what conditions are δE and $\delta Hequal$?

(A) Constant number of moles

(b) Constant temperature

(C) Constant volume

A. P only

B. Q only

C. R only

D. P and Q only

Answer: C

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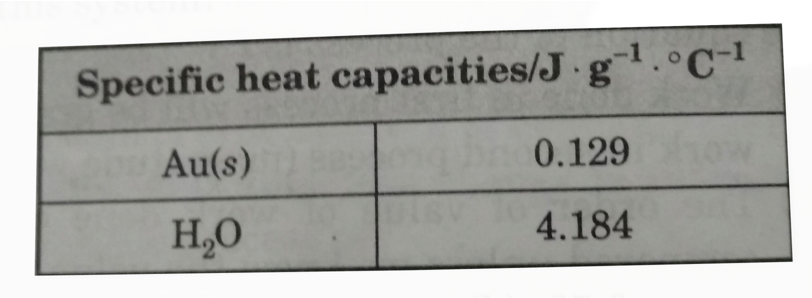
136. $84.12g$of gold at$120.1^\circ C$. Is placed in $106.4g$ of H_2Og at $21.4^\circ C$. What is the final temperature of this system?



Specific heat capacities/$J \cdot g^{-1} \cdot {}^\circ C^{-1}$	
Au(s)	0.129
H_2O	4.184

A. 70.8

B. 65.0

C. 27.8

D. 23.7

Answer: D

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137. A 10.00g piece of metal is heated to $80.00\,^{\circ}C$ and placed in 100.0g of water at $23.00\,^{\circ}C$. When the system has reached eqvillibrium the temperature of the water and metal are $23.50\,^{\circ}C$. What is the identify of the metal?

Specify heat capacity of$H_2O = 4.184J/g\overset{\circ}{C}$

A. $Ag\left(C_p0.236J/g\overset{\circ}{C}\right)$

B. $Cu\left(C_p0.385J/g\overset{\circ}{C}\right)$

C. $Fe\left(C_p0.385J/g\overset{\circ}{C}\right)$

D. $Al\left(C_p 0.385 J/g\overset{\circ}{C}\right)$

Answer: B

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138. When MgO reacts with H_2O at $25^\circ C$ and 1 atm, the volume change is $-4.6 mL.\ mol^{-1}$.

$MgO(s) + H_2O(l) \rightarrow Mg(OH)_2(s)$

What is the value of $\delta H - \delta E$ for this reaction?

A. $-4.7 \times 10^{-1} J.\ mol^{-1}$

B. $-4.7 \times 10^{-2} J.\ mol^{-1}$

C. $4.7 \times 10^{-2} J.\ mol^{-1}$

D. $4.7 \times 10^{-1} J.\ mol^{-1}$

Answer: A

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139. An ice cube at an unknown temperature is added to $25.0g$ of liquid H_2O at $40.0^\circ C$. The final temperature of the $29.3g$ equilibrated mixture of the ice cube?

$C_p\left(J/g \times .^\circ C\right) water = 4.184, ice = 2.06, \delta H_{fusion} = 333 J/g^\circ$

A. -$6.5^\circ C$

B. -$13.1^\circ C$

C. -$35.3^\circ C$

D. -$56.8^\circ C$

Answer: B

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140. Which is (are) state properties?

(P) enthalpy (Q) heat (C) Volume

A. P only

B. Q only

C. P and R only

D. Q and R only

Answer: C

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141. How much work is done by the gas when $1.00g$ of sodium azide, NaN_3 $(M = 65.01g \times mol^{-1})$, decomposes in a container of changeable volume (e.g. and airbag in a car) against a constant pressure of 1.00 atm at 298K?

$2NaN_3(s) \rightarrow 2Na(s) + 3N_2(g)$

A. $+114J$

B. $+57.2J$

C. $-114J$

D. $-57.2J$

Answer: D

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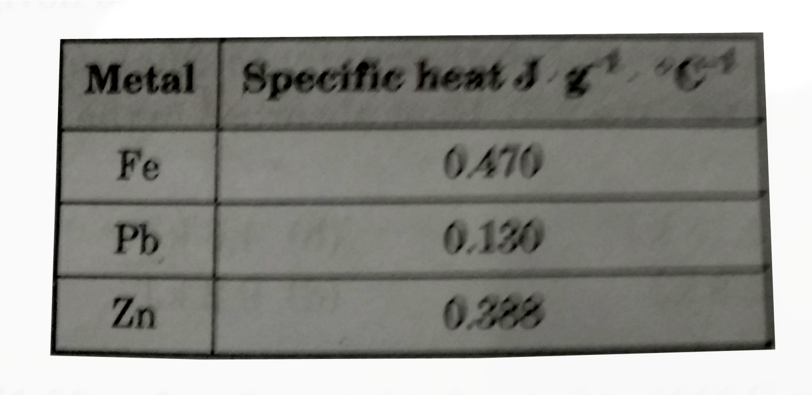
142. The specific heat capacities of three metals are given below.



Metal	Specific heat $J g^{-1} {}^\circ C^{-1}$
Fe	0.470
Pb	0.130
Zn	0.388

If 1.00g of each metal is heated to $100^\circ C$ and added to $10.0 g$ of H_2O at $25.0^\circ C$, what is the order of the temperatures of the final mixtures form the lowest to the highest?

A. $Fe < Zn < Pb$

B. $Pb < Zn < Fe$

C. $Zn < Pb < Fe$

D. $Zn < Fe < Pb$

Answer: B

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143. A system consists of a gas contined in a thin ballon. If the ballon deflates as the temperature of the gas changes from $90^\circ C \text{to} 25^\circ C$, then:

A. Heat is transferred out of the system and work is done on the system.

B. Heat is transferred out of the system and work is done by the system.

C. Heat is transferred into the system and work is done by the system.

D. Heat is transferred into the system and work is done the system

Answer: A

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144. Which of the following is a mathatical statement of the first law of theromodynamics?

A. $\delta V = \frac{nR}{P}\delta T$

B. $\delta E = q + w$

C. $\partial aH = \delta E + P\delta V$

D. $\delta G = \delta H + T\delta S$

Answer: B

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145. 7 g of $N_2 g$ at $27\,^{\circ}C$ is expanded slowly and isothermally form pressuure of $0.5MPa$ to a final pressure $0.1Mpa$. Determine approximate work done $\left[In5 = 1.6, R = 8.3Jmol^{-1}K^{-1}\right]$

A. $-996J$

B. $+125J$

C. $-95J$

D. $+200J$

Answer: A

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146. An ideal gas involved in a reversible adiabatic process follow the law $T\alpha P^{1/3}$ then what will be the value of C_p/C_v?

A. 1

B. $\frac{4}{3}$

C. 1.5

D. 1.333

Answer: C

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147. One mole of $H_2 at 25^\circ C$ undergo combustion in the presence of excess O_2 in a closed rigid adibatic container:

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l), \quad \Delta H = -240kJ/\text{mole}$$

Choose the incorrect option :

A. $q = 0$

B. $w = 0$

C. $\delta U = 0$

D. $\delta T = 0$

Answer: D

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148. $2(Ag) \rightarrow B(g), \delta H = -20kcal/mol$. In a closed rigid container, 0.2mole of $A(g)$ at constant temperature $727^\circ C$ convert into B(g) then, change in heat energy in the process will be:

$(R = 2cal/\text{mole} - K)$

A. $-12kcal$

B. $-1.8kacl$

C. $-2.4kcal$

D. $0.24kcal$

Answer: B

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149. A real gas is subjective to an adiabatic process form $(2\text{bar}, 40L, 300K)$ to $(4\text{bar}, 30L, 300K)$ against a constant pressure of 4 bar. The enthalpy change for the process is $(1\text{bar} - litre = 100J)$:

A. zero

B. 6000J

C. 8000J

D. 10000J

Answer: C

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150. Calculate magnitude of work involved when $100g$ of calcite form of $CaCO_3$ is converted into it's aragonite form of $CaCO_3$ at 100 bar pressure. Given density of calcite=$2g/$ density of arogonite =$2.5g/$

A. $0.2kJ$

B. $0kJ$

C. $0.1kJ$

D. $0.5kJ$

Answer: C

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151. Select the incorrec option:

A. Specific volume and molar heat capacity are intensive properties:

B. Change in internal energy for an ideal gas for and isobaric process is expected as $nC_v(T_2 - T_1)$.

C. Thermodyamics can predict rate at which process will take place.

D. Free expansion is an irreversible process.

Answer: C

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152. For an isothernal free expansion of an ideal gas correct question option is:

A. $q = 0, w = 0, \delta H \neq 0$

B. $q = 0, w = 0, \delta H = 0$

C. $q \neq 0, w \neq 0, \delta H \neq 0$

D. $q = 0, w = 0, \delta H = 0$

Answer: D

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153. For the reaction:

$5A(g) + 3B(g) + 7C(g) \rightarrow 5D(g) + 4E(l)$

$\Delta H = -56 kcal/\text{mole}$

Find heat exchanged when 2 moles of A, 1.5 moles of B and 2.1 moles of C react in a closed rigid container to 300K:

A. $-62kcal$

B. $-15kcal$

C. $-18.6kcal$

D. $-50kcal$

Answer: B

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154. 7.5 Kj of heat is added to a closed system and its internal system decreases by 12kJ, then how much energy is transferred as work?

A. $19.5kJ$

B. $-19.5kJ$

C. $4.5kJ$

D. $-4.5kJ$

Answer: B

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155. 10 litre of an ideal gas at 25 atm and $27^{\circ}C$ is expanded isothermally to 1 atm against a constant external pressure of 760 torr. Calualate work done by the gas in litre-atm:

A. 240

B. 250

C. 800

D. 400

Answer: A

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156. 50g of an ideal gas is undergoing a process for which heat capacity is $50cal/mo \leq \ -K$. If rise in temperature during the process is $100\ ^\circ C$ then calculate work involved in process (given molar mass of gas $=10g/\text{mole}$, $C_pofgas = 5R\big)$

A. $-29kcal$

B. $-21kcal$

C. $29kcal$

D. $21kcal$

Answer: B

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157. As per the first law of theromdyamics, which of the following statements would be appropriate?

A. Energy of system remains constant

B. Energy of surrounding remains constant

C. Energy of universe remains constant

D. Energy of universe always increases

Answer: C

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158. Ration of $C_p/C_v \text{for} NH_3$ gas(assuming ideal behaviour) when vibrational degree of freedom are active :

A. $\frac{10}{9}$

B. $\frac{4}{3}$

C. $\frac{11}{8}$

D. $\frac{12}{10}$

Answer: A

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159. Temperature of 1.5 mole of gas is increased by $10^{\circ}C$ at constant pressure. Magnitude if work involved is:

A. $15R$

B. $10R$

C. $10R$

D. $20R$

Answer: A

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160. Which of the following expression expressions is true for an ideal gas?

A. $\left(\frac{\partial V}{\partial T}\right)_p = 0$

B. $\left(\frac{\partial P}{\partial T}\right)_V = 0$

C. $\left(\frac{\partial U}{\partial P}\right)_T = 0$

D. $\left(\frac{\partial U}{\partial T}\right)_T = 0$

Answer: C

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161. For the real gas reaction,

$2A(g) + B(g) \rightarrow 2C(g) \delta H = -440 kJ/mol$

If the reaction is carried out in 10 litre rigid vessol, the initial pressure is

50bar bar which decreses to 20bar in the course of reactioin. The change in internal energy for the reaction is:

A. $-434kJ$

B. $-140kJ$

C. $-443kJ$

D. $-470kJ$

Answer: B

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162. Which of the following is true

A. $C_P - C_v = R$ is applicable for all gases

B. For an ideal gas undergoing adiabatic process, temperature will not always change under normal conditions.

C. If $\delta T = 0$, process must be isothermal

D. If isothermal reversible and irreversible process are started from same initial state to same final pressure then both process ends at same date.

Answer: D

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163. $1dm^3$ of an ideal gas at a pressure of 10bar expands reversibly and isothermally to final volume of 10 litre .(In 10=2.3). Heat absorbed in the process will be:

A. $1.15kJ$

B. $4.6J$

C. $2.3kJ$

D. $9.2kJ$

Answer: C

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164. With what pressure must a given volume of oxygen, originally at 300K and 1 bar pressure be adiabatically and irreversibly compored in order to raise its temperture to 600K $(\gamma = 7/5)$

A. 4.5bar

B. 9bar

C. 2.25bar

D. 6.75bar

Answer: A

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165. Pressure of a liquid is linear function of volume $P = a + bV$. Calculate work done for change in state form $(1\text{bar}, 2L)$ to $(2\text{bar}, 5L)$:

A. $+810J$

B. $-450J$

C. $-810J$

D. $+450J$

Answer: C

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166. For reaction

$2A(g)+3B(g)\rightarrow 4C(g)+D(s)$ Calulate work involved during system reaction if reaction occurs at constant pressure and 300K:

A. $600kal$

B. $300kcal$

C. $150cal$

D. $1200kacl$

Answer: A

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167. An ideal gas was subjected to following process:

$\left(n_1 = 2\text{mole}, T_1 = 400K, P_1 = 1\text{atm}\right)$
$\xrightarrow{\text{Reversible Isobarically}} \left(n_2 - 2\text{mole}, T_2 = 300K, P_2 = 1\text{atm}\right)$

The work done by the gas is:

A. $+831kJ$

B. $+1662.8J$

C. $-1662.8J$

D. $-831.4J$

Answer: B

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168. Consider the following statements and arrange in the order of true/false as given in the codes.

S_1: Change in state function between two states is a definite quantity and does not depend on path.

S_2: Intensive properties can't be algebraically added or subtracted.

S_3: Ration of two extensive properties always result into a parameter that depends on amount of substance.

S_4: Molar heat capacity is a path function.

The correct order of True//false of the above statement is :

A. FTFT

B. FFFT

C. TTFT

D. TTFT

Answer: C

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169. One mole of an ideal gas is subjected to adiabatic expansion form initail state of $(10\text{atm}, 300K)$ to final pressure of 1 atm against constant external pressure. Which of the following option contain correct change in thermodynamic parameters for the above process. $\left(Given : \gamma = \frac{4}{3}\right)$

A. $\delta U = 270R$

B. $\delta S = RIn10$

C. $\delta H = 230R$

D. $\omega = \text{ - } 202.5R$

Answer: D

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170. One mole of an ideal gas is subjected to adiabatic expansion form initail state of 16atm, 200K to final pressure of 1 atm against constant external pressure. Select the incorrect optioin if $\gamma = \frac{4}{3}$ for the gas

A. $\delta U = 0$

B. $\delta S = 1 \times RIn16$

C. $\delta S_{\text{surrounding}} = 0$

D. $\delta V_{\text{final}} = 8.21 litre$

Answer: D

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171. A substance has a normal boiling point of 400K. Which of the following options correct set of thermodynamic parameters for the reaction:

$(l)(1atm.400K) \rightarrow A(g)(1atm, 400K)$

A. $q > 0, \delta G = 0, W > 0$

B. $\delta H = 0M, \delta G = 0, \delta S = 0$

C. $\delta G = 0M, \delta H > 0, \delta S > 0$

D. $\delta G < 0, \delta H > 0, \delta S > 0$

Answer: C

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172. Which of the following parameters correctly represent conditions for a spontaneous process with no non P-V work involved?

(P) $(dH)_{S,P} < 0$ (Q) $(dU)_{S,P} < 0$

(R) $(dG)_{T,P} < 0$ (S) $(dH)_{P,T} > 0$

(T) $(d, S)_{universe} > 0$ (U) $(dS)_{U,V} > 0$

A. Options (Q),(R) and (T) are correct

B. Options (P),(T) and (U) are correct

C. Options (P),(R) and (T) are incorrect

D. Options (Q) and (R) are incorrect

Answer: B

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173. A reaction has an equillibrium constant of 0.98 at 300K and 1.2 at 400K. Select the incorrect option:

A. The reaction in endothermic.

B. At standard conditions, reaction will be non spontaneous at 300K and spontaneous at 400K.

C. Enthaply change of reaction,

$$\delta H_R^{\circ} = 1200R \times In\left(\frac{1.2}{0.98}\right)$$

D. $\delta S_R^{\circ} = 3RIn\frac{1.2}{0.98}$ [Assuming δH° and δS° to be temperature independent]

Answer: B

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174. The gibbs free energy of formation of MO and CO at temperature $1000^{\circ}C$ and $1900^{\circ}C$ are given below :

This reactioin is feasible at temperature:

$$2M + O_2 \rightarrow 2MO \quad \Delta G_{1000^\circ C} = -921 kJ/mol$$

$$\Delta G_{1900^\circ C} = -300 kJ/\text{mol}$$

$$2C + O_2 \rightarrow 2CO \quad \Delta G_{1000^\circ C} = -432 kJ/mol$$

$$\Delta G_{1900^\circ C} = -624\text{kJ}/\text{mol}$$

$$MO + C \overset{\Delta}{\rightarrow} M + CO \uparrow$$

A. $1900^\circ C$

B. $1000^\circ C$

C. $900^\circ C$

D. $12000^\circ C$

Answer: A

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175. When water in a beaker freezes to form ice, then which of the following will be correct statement:

A. S_{system} decreases whereas $S_{\text{surrounding}}$ increases

B. S_{system} and $S_{\text{surrounding}}$ both increases

C. S_{system}increases whereas $S_{\text{surrounding}}$ decreases

D. S_{system} and $S_{\text{surrounding}}$ both increases

Answer: A

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176. Identify the option which correctly represents set of true (T) false (F) statements:

Statement :1 In an adiabatic free expansion, entropy of system remains constant.

Statement-2: For every isothermal process, internal energy of the system remains contant. Statement-3: Molar enthalpy is an intensive parameter.

Statement-4: For every reversible cyclic process, final state of surroundings is same as that of initial state of surroundings.

A. TTFT

B. FFTF

C. FFTT

D. TFTF

Answer: C

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177. The entropy change when 2 moles of an ideal monoatomic gas us subjective to change in state from $(1atm, 10L)$ to $(2atm, 5L)$ will be : $(In2 = 0.7)$

A. $-2.8cal/K$

B. $2.8J/K$

C. $-1.4cal/K$

D. $5.6cal/K$

Answer: A

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178. In order to solve a complex physical chemistry, problem, brain requires some "netural energives " which are electical in nature. Each problem on an average requires 21 Joules of netral energy. Calculate minimum amount of glucose required to solve 10 such problem if all electrical energy is obtained for oxidation of glucose:

$\left[Given: \delta H^{\circ}_{combustion} \text{of glucose} = -2800 k/J\text{mole} \right.$

$\delta S^{\circ}_{combustion} \text{of glucose} = -\frac{1000}{3} J/mol/K,$ Temperature=300K]

A. 14g

B. 14mg

C. 20g

D. 120mg

Answer: B

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179. For an allotropic change:

$A(s) \rightarrow B(s), \delta G^{\circ}_{400} = 20kJ/\text{mole}$

If molar volume A and B are $12mL/\text{mole}$ and $10mL/\text{mole}$ respectively then calculate approximate pressure at which the two allotropes will be at equillibrium at 400K:

A. $10^5 Pa$

B. $2 \times 10^4 Pa$

C. $100 Pa$

D. $10^{10} Pa$

Answer: D

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180. Which of the following options correctly represent trure//false nature of statements?

Statement-I: $\delta H = \delta U + P\delta V$for all processes

Statements-II: For a reaction involving only ideakl gas, $\Delta H_{reaction}$ will be independent of the pressure at which reactants and products are taken.

Statements-III: Heat taken from a thermal reservoir can be completely converted at work without liberating some heat at lower temperature.

Statement-IV: For a chemical reaction, G at equillibrium will be zero.

A. All the statement are true

B. Only statement-II are true

C. All the statements are false

D. Only statement-I and III are false

Answer: B

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181. Which of the following parameters is correct reagarding adsorption of gases over solid?

A. $\delta S_{system} > 0$

B. $\delta S_{\text{surrounding}} > 0$

C. $\delta G > 0$

D. $\delta H > 0$

Answer: B

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182. A substance has latent heat of vaporisation (at its boiling point 300K) $=3kJ/g$. If molar mass of substance is 40, the molar entropy change for condensation process will be:

A. $10J/K$

B. $400J/K$

C. $-400J/K$

D. $-10J/K$

Answer: C

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183. For a reaction: $2A(g) + 4B(g) \rightarrow 5C(g) + 2D(l)\Delta E^{\circ} = 40kcal/\text{mole}$ and $\Delta S^{\circ} = +200cal/K\text{mol}$

The value of ΔG°_{200} will be.

A. 0

B. $+0.4kcal/\text{mole}$

C. $-0.4kcal/\text{mole}$

D. $-360kcal/\text{mole}$

Answer: C

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184. A heat engine takes up heat at 100K and liberates heat at 200K. Which of the following in an impossible amount of heat rejected by the engine if 1000J of heat is absorbed:

A. 60J

B. 80J

C. 90J

D. 15J

Answer: D

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185. Which of the reaction is expectd to be spontaneous at low temperatures and non-spontaneous at high temperatures:

A. Dissociation of PCl_5 to give PCl_3 and Cl_2

B. Formation of H_2O from $H_2(g)$ and $O_2(g)$

C. Melting of ice

D. Vaporisation of any volatile liquid

Answer: B

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186. Which of the following statements is incorrect?

A. $\Delta H^2_{vap} H_2O(l) > 21 \times 373 cal$

B. $\oint \frac{dq}{T} = 0$for all cyclic processes.

C. Adiabatic reversible process is isoentropic.

D. Heat exchange at constant volume condition will be independent of path.

Answer: B

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187. Which of the following partical derivations are incorrect for one mole of an ideal gas?

A. $\frac{\partial S}{\partial T})_V = \frac{C_{v,m}}{T}$

B. $\frac{\partial S}{\partial V})_T = \frac{nR}{T}$

C. $\frac{\partial G}{\partial P})_T = V$

D. $\frac{\partial H}{\partial P})_T = 0$

Answer: B

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188. For a substance A, vapour pressure of liquid and solid state at temperature 400K is 0.1bar and 0.16bar respectively. What will be Gibbs free energy change for the following process.

$A(s)[0.1\text{bar}, 400K, n = 1] \rightarrow A(l)$

$[0.16\text{bar}, 400K, n = 1]$

A. 0

B. $400RIn1.6$

C. $400RIn\frac{1}{1.6}$

D. $400R[0.16 - 01]$

Answer: C

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189. Which of the following options correctly reagarding the following statements?

Statements-1: $\Delta S_f^{\circ}\ NH_3(g)$ and $\Delta S_f^{\circ}\ PCl_5(g) < O$

Statement-2: On heating a metal , entorpy of metal increases.

Statement-3: $\Delta S_f^{\circ}\ NH_2(l) = 0$

A. All the statement are incorrect

B. Only statement-3 are incorrect

C. only statement-1 is correct

D. All the statement are incorrect

Answer: B

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190. In which of the following cases, entropy of the system is increasing.

A. $\Delta S_f^{\circ} NH_2(l) = 0$

B. $C_{\text{graphite}} \rightarrow C(\text{diamond})$

C. Ideal monotomic gas subjected to change on state from

$1\text{atm}300K \rightarrow 2\text{atm}600K$

D. Dimerisation of acetic acid

Answer: C

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191. An ideal gas $(\gamma = 1.4)$ is used in a carnot cycle as a working substance . Substance. The efficency of the cycle, if as a result of an adiabatic expansion, the gas volume increases $2.75 \times$ is $\left[(1.5)^{2.5} = 2.75\right]$

A. $\dfrac{100}{3}\%$

B. $\dfrac{200}{3}\%$

C. 50 %

D. 25 %

Answer: A

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192. Caculate $\Delta G(kJ/\text{mole})$for the reaction at 300K

$N_2(g) + O_2(g) \Leftrightarrow 2NO(g)$

at constant where partical pressure of N_2, O_2 and $NO are 10^{-1}\text{bar}, 10^{-3}\text{bar}.$

$\Delta H_f^\circ\ NO(g) at 300K = 90.5 kJ/\text{mole}$ and $\Delta S_f^\circ, NO(g) at 300K = 12.5 J/K\text{mole}$ and

$[2.303 \times R \times 300 = 5750 J/\text{mole}]$

A. $173.5 kJ/\text{mole}$

B. $185 kJ/\text{mole}$

C. $162 Kj/\text{mole}$

D. $84.5 kJ/\text{mole}$

Answer: C

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193. Identify the option which is correct :

A. for an adiabatic process, entropy, of system must remains constant is always.

B. for porcess to be spontaneous Gibbs free energy should decreses.

C. for any substance heat required for melting will always be more than heat required for vaporisation since solids will have stronger interaction.

D. $\Delta S_f^{\circ} of H_2O(l) is < 0.$

Answer: D

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194. For a reaction: $2A(g) + B(g) \rightarrow C(g), \Delta U^\circ = 30 kcal / \text{mole}, \Delta S^\circ = 100 cal / K\text{mole}$. What will be t

$[R = 2 cal / K\text{mole}]$ $\left[\Delta C_{p_{reaction}} = 0\right]$

A. 0

B. $-1.2 kacl$

C. $-11.2 kcal$

D. $-10 kcal$

Answer: C

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195. What is the free energy for the process

$H_2O\left(l, -10^\circ C, 0.28 Pa, 1\text{mole}\right) \rightarrow H_2O$

$\left(s, -10^\circ C, 0.26 Pa, 1\text{mole}\right)$

Given that vapor pressure of water and ice at $-10^\circ C$ is 0.28and0.26Pa respectively

A. $R \times 263 \times In\frac{14}{13}$

B. $R \times 263 \times In\frac{13}{14}$

C. $-R \times 10 \times In\frac{13}{14}$

D. zero

Answer: B

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196. Which of the following options represents correct sequence of True (T) or False(T) statements:

Statements-I: No Gibbs for energy changes occurs for vaporisation at triple point.

Statement:II: Entrophy driven process are spontaneous at hight temperature.

Statement-III: ΔG° of a reaction will increases with increses in temperature if the reaction is endothermic.

A. TTT

B. TTF

C. FTF

D. TFF

Answer: B

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197. A reaction has an equillibrium constant of 0.98 at 300K and 1.2 at 400K. Select the incorrect option:

A. The reaction in endothermic.

B. At standard conditions, reaction will be non spontaneous at 300K and spontaneous at 400K.

C. Enthaply change of reaction,

$$\Delta H_R^{\circ} = 1200R \times In\left(\frac{1.2}{0.98}\right)$$

D. $\Delta S_R^{\circ} = 3RIn\frac{1.2}{0.98}$

Answer: D

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198. For a reaction : $3A(g) + B(g) \rightarrow 2C(g) + 4D(l)$

$\Delta U^{\circ} = 50 kcal / \text{mole and } \Delta S^{\circ} = -400 cal / \text{mol-K}.$

Calculate $\Delta G^{\circ} at 200 K$:

A. 129.2kcal

B. 130kcal

C. 130.8kcal

D. $-30 kcal$

Answer: A

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199. A substance P has a standard boiling point of 450K. Which of the following options contain correct set of thermodynamic parameters for the following reactions?

$P(l)(1atm, 420K) \rightarrow P(g)(1atm, 420K)$

A. $\Delta G < 0, \Delta H > 0, \Delta S > 0$

B. $q > 0, W > 0, \Delta U > 0$

C. $\Delta H = 0, \Delta U = 0, q > 0$

D. $\Delta G > 0, q > 0, \Delta U > 0$

Answer: D

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200. For a reaction $A(s) \rightarrow B(s), \Delta G^{\circ}_{300} = -2kJ/\text{mole}$ Where A and B ar allotropic forms. At what external pressure will the reaction attain equillbrium at 300K, if specific volume of A and B are 10mL//g and 15mL//g respectively and molar mass of A is 40g:

A. $100Pa$

B. 100bar

C. $101Pa$

D. 101bar

Answer: D

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201. Select the correct option with respect to reversible process:

A. ΔG will always be zero for isobaric process.

B. ΔS_{system} wil always be greater than zero for a closed system.

C. $\Delta S_{universe}$ will always be zero for a closed system.

D. Both A and C option are correct

Answer: C

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202. For the process,

$H_2O(l, T, K, P\text{bar}) \rightarrow H_2O(g, TK, P\text{bar})$

Identify the option which is not correct.

A. $\Delta G = 0 \quad \text{if} \quad P, representvapourpressureof$H_(2)O` at TK.

B. $\Delta G < 0 \quad \text{if} \quad Prepresentvapourpressureof$H_(2)O` at temperature greater than TK.

C. $\Delta G > 0$ if P is greater than vapour pressure of H_2O TK.

D. Only A and C are correct.

Answer: B

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203. One mole of an ideal monoatomic gas expands isothermally against constant external pressure of 1 atm from initial volume of 1L to a state where its final pressure becomes equal to external pressure. If initial temperature of gas is 300K then total entropy change of system in the above process is:

$\left[R = 0.082Latmmol^{-1}K^{-1} \equiv 8.3Jmol^{-1}K^{-1}\right]$

A. 0

B. $RIn(24.6)$

C. $RIn(2490)$

D. $\frac{3}{2}RIn(24.6)$

Answer: B

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204. For a perfectly crystalline solid $C_{p.m.} = aT^3$, where ais constant. If $C_{p.m.}$ is 0.42.J//K-"mol" at 10K, molar entropy at 10K is:

A. $0.42J/K$ - mol

B. $0.14J/K$ - mol

C. $4.2J/K$ - mol

D. zero

Answer: B

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205. Predict which of the following reaction (s) has a positive entropy change?

$I . Ag^{+}(aq) + Cl^{-}(aq) \rightarrow AgCl(s)$

$II . NH_4Cl(s) \rightarrow NH_3(g) + HCl(g)$

$III . 2NH_3(g) \rightarrow N_2 + 3H_2(g)$

A. P and Q

B. R

C. Q and R

D. Q

Answer: C

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206. Which of the following reactions is asssociated with the most negative change in entropy?

A. $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

B. $C_2H_2(g) + H_2(g) \rightarrow C_2H_4(g)$

C. $C(s, \text{graphite}) + O_2(g) \rightarrow CO_2(g)$

D. $3C_2H_2(g) \rightarrow C_6H_6(l)$

Answer: D

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207. When two moles of an ideal gas $\left(C_{p.m.} = \frac{5}{2}R\right)$ heated form 300K to 600K at constant pressure, the change in entropy of gas (ΔS) is:

A. $\frac{3}{2}RIn2$

B. - $\frac{3}{2}RIn2$

C. $5RIn2$

D. - $\frac{5}{2}RIn2$

Answer: C

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208. In a previous problem, calculate ΔS_{gas} If process is carried out at constant volume:

A. $5RIn2$

B. $\frac{3}{2}RIn2$

C. Value of work done (magnitude) in second process is greater in above expansion irrespective value of K_1 and K_2

D. - $3RIn2$

Answer: C

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209. When one mole of an ideal gas is compressed to half of its initial volume and simultaneously heated to twice its initial temperature, the change in entropy of gas $(DelataS)$ is:

A. $C_{p.m.}In2$

B. $C_{v.m.}In2$

C. $RIn2$

D. $\left(C_{v.m.} - R\right)In2$

Answer: D

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210. The entropy change when two of ideal monoatomic gas is heated form $200 \rightarrow 300^{\circ} C$ reversiblity and isochorically?

A. $\frac{3}{2}RIn\frac{300}{200}$

B. $\frac{5}{2}RIn\frac{573}{273}$

C. $3RIn\frac{573}{473}$

D. $\frac{3}{2}RIn\frac{573}{473}$

Answer: C

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211. If one mole of an ideal gas $\left(C_{p.m.} = \frac{5}{2}R\right)$ is expanded isothermally at 300K until it's volume is tripled, then change in entropy of gas is:

A. zero

B. infinity

C. $\frac{5}{2}RIn3$

D. $RIn3$

Answer: D

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212. In previous problem, if expansion is carried out freely $\left(P_{ext} = 0\right), then\Delta Sis:$

A. zero

B. infinity

C. $RIn3$

D. None of these

Answer: C

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213. Two moles of an ideal gas is expanded irreversibly and isothermally at $37^\circ C$ until its volume is doubled and $3.41KJ$ heat is absorbed from surrounding. $\Delta S_{\text{total}}(\text{system +surrounding})$ is:

A. $-0.52J/K$

B. $0.52J/K$

C. $22.52J/K$

D. 0

Answer: B

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214. $1mol$ of an ideal gas at $25^{\circ}C$ is subjected to expand reversibly 10 times of its initial volume. Calculate the change in entropy of expansions.

A. 19.15

B. -19.15

C. 4.7

D. zero

Answer: D

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215. One mole of an ideal diatomic gas $\left(C_v = 5cal\right)$ was transformed form initial $25^\circ C$ and $1L$ to the state when the temperature is $100^\circ C$ and volume 10L. The entropy change of the process can be express as: $(R = 2cal/mol/K)$

A. $3In\frac{298}{373} + 2In10$

B. $5In\frac{373}{298} + 2In10$

C. $7In\frac{373}{298} + 2In\frac{1}{10}$

D. $5In\frac{373}{298} + 2In\frac{1}{10}$

Answer: B

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216. What is the change in entropy when 2.5 mole of water is heated from $27^\circ C$ to $87^\circ C$?

Assume that the heat capacity is constant $\left(\left(C_p\right)_m\left(H_2O\right) = 4.2J/g = k, \ln(1.2) = 0.18\right)$

A. $16.6J/K$

B. $9J/K$

C. $34.46J/K$

D. $1.89J/K$

Answer: C

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217. For a perfectly crystalline solid $C_{p.m.} = aT^3 + bT$,where a and b constant . If $C_{p.m.} is 0.40J/Kmol$ at 10K and $0.92J/K\text{mol} at 20K$ then molar entropy at 20k is:

A. $0.92J..\text{Kmol}$

B. $8.66J/K\text{mol}$

C. $85 \times 1.5 J / K^{-1}$

D. None of these

Answer: C

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218. The entropy if vaporisation of benzene is $85 JK^{-1} mol^{-1}$. When 117g benzene vaporizes at its's normal boiling point, the entropy change in surrounding is:

A. $-85 JK^{-1}$

B. $-85 \times 1.5 JK^{-1}$

C. $85 \times 1.5 J / K^{-1}$

D. None of these

Answer: B

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219. Calculate the total entropy change for the transition at 368K of 1mol of sulphur from the monoclinic to the rhombic solid state, if $\Delta H = -401.7J, mol^{-1}$ "for the transition". Assume the surroundings tio be an ice-water bath at $0\,^{\circ}C$:

A. $-1.09JK^{-1}$

B. $1.47JK^{-1}$

C. $0.38JK^{-1}$

D. None of these

Answer: C

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220. Which of the following statement (s) is correct?

Statement-I: The entropy of isolated system with P-V work only, is always maximized at equillibrium.

Statement-2: It is possible for the entropy of closed system to decrease substantialy in an irreversible process.

Statemet-3: Entropy can be crearted but not destroyed.

Statement-4 ΔS_{system} is zero for reversible process in an isolated system.

A. Statement 1,2,3

B. Statement 2,4

C. Statemetn 1,2,4

D. All of these

Answer: D

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221. Calculate the entropy change $(J/molK)$ of the given reaction. The molar entropies $(J/K\text{-}mol)$ are given in brackets after each substance:

$2PbS(s)[19.2] + 3O_2(g)[205.1]$

$\rightarrow 2PbO(s)[66.5] + 2O_2(g)[248.2]$

A. -113.5

B. -168.3

C. $+72.5$

D. -149.2

Answer: B

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222. Given $\Delta_r S^\circ = -266$ and the listed $\left[S_m^\circ value\right]$ Calculate $S^\circ \text{ for} Fe_3O_4(s)$

$4Fe_3O_4(s)[\ldots] + O_2(g)[205] \rightarrow 6Fe_2O_3(s)[87]$

A. $+111.1$

B. $+122.4$

C. 145.75

D. 248.25

Answer: C

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223. Which of the following conditions reagarding a chemical process ensures its spontaneity at all temperature?

A. $\Delta H > 0, \Delta G < 0,$

B. $\Delta H < 0, \Delta S > 0,$

C. $\Delta H < 0, \Delta S < 0,$

D. $\Delta H > 0, \Delta S < 0,$

Answer: B

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224. For isothermal expansion in case of an ideal gas :

A. $\Delta G = \Delta S$

B. $\Delta G = \Delta H$

C. $\Delta G = -\Delta T.\Delta S$

D. None of these

Answer: C

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225. When reaction is at standard state at equilibrium, then

A. $\Delta H^{\circ} = 0$

B. $\Delta S^{\circ} = 0$

C. equillibrium constant$K = 0$

D. equillibrium constant$K = 1$

Answer: D

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226. For the gas-phase decomposition,

$PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$

A. $\Delta H < \Delta S < 0$

B. $\Delta H > \Delta S > 0$

C. $\Delta H > \Delta S < 0$

D. $\Delta H < \Delta S > 0$

Answer: B

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227. What is the free energy change (ΔG) when 1.0mole of water at $100^\circ C$ and atm pressure is converted into steam at $100^\circ C$ and 1 atm pressure?

A. 80 cal

B. 540 cal

C. 620 cal

D. zero

Answer: D

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228. The enthalpy change for a given reaction at $298K$ is $-x cal mol^{-1}$. If the reaction occurs spontaneously at $298K$, the entropy change at that temperature

A. can be negative but numerically larger than x/298.

B. can be negative but numerically smaller than x/298.

C. cannot be negative

D. cannot be positve

Answer: B

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229. A reaction has $\Delta H = -33kJ$ and $\Delta S = -58J/K$. This reaction would be:

A. spontaneous at all temperature.

B. non-spontaneous at all temperatures.

C. spontaneous above a certain temperature.

D. spontaneous below a certain temperature.

Answer: D

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230. For a certain $A(g) \rightarrow B(g)$ at equillibrium . The parital pressure of B is found to be one fourth of the partial pressure of A. The value of ΔG° of the reaction $A \rightarrow B$ is:

A. $RTIn4$

B. $-RTIn4$

C. $RT\log 4$

D. $-RT\log 4$

Answer: A

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231. During winters, moisture condness in the form of dew and can be seen on plant leaves and grass. The entropy of the system in such cases decreases as liquids posses lesser disorder compared to gases. With prefrence to the second law, which statement is correct, for the above proces?

A. The randomnes of the unierse decreases.

B. The randomnesof the surroundings decreases.

C. Increases is randomne of surrroundings equals the decreases in randomnes of system.

D. The increase in randomnes of the surrounding is greater as compared to the decrease in randomnes of the system.

Answer: D

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232. For the hypothetical reaction

$A_2(g) + B_2(g) \rightarrow 2AB_g$

ΔG_r° and ΔS_r° are $20KJ/mol$ and $-20JK^{-1}mol^{-1}$respectively at$200K$

$\Delta_r C_r$ is JK^{-1} then ΔH_r° at$400K is$

A. $20KJ/mol$

B. $7.98KJ/mol$

C. $28kj/mol$

D. None of these

Answer: A

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233. Following reaction occurs at $25\,^{\circ}C$

$2NO\left(g, 1\times10^{-5}atm\right) + Cl_2\left(g, 1\times10^{-2}atm\right)$

$2NOCl\left(g, 1\times10^{-2}atm\right)\Delta G^{\circ}\ is\ R = 8J/\text{mole}K$

A. $-43.92kJ$

B. $-25.53kJ$

C. $28kj$

D. $-57.06kJ$

Answer: A

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234. Find ΔG° and ΔH° for the reaction

$CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g) at 300K$

when the standard entropy is $-0.094 kJ mol^{-1} K^{-1}$. The standard Gibbs free energiers fo formation for CO_2 and CO are -394.4 and $-137.2 kJ mol^{-1}$ respectively.

A. $\Delta G^\circ = 257.2 kJ/mol, \Delta H^\circ = 285.4 kJ/mol$

B. $\Delta G^\circ = 514.4 kJ/mol, \Delta H^\circ = -570.8 kJ/mol$

C. $\Delta G^\circ = 514.4 kJ/mol, \Delta H^\circ = -570.8 kJ/mol$

D. $\Delta G^\circ = -257.2 kJ/mol, \Delta H^\circ = -285.4 kJ/mol$

Answer: D

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235. $\Delta H = 30 kJ mol^{-1}, \Delta S = 75 J/K/mol$. find boiling temperature at $1 atm$:

A. $400K$

B. $300K$

C. $150K$

D. $425K$

Answer: A

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236. The direct conversion of A to B is difficult, hence is carried out by the following shown path:

$\Delta(A \rightarrow C) = 50, \Delta S(C \rightarrow D) = 30, \Delta S(B \rightarrow D) = 20$ The entropy change for the process $A \rightarrow B$ is :

A. 100

B. -60

C. -100

D. $+60$

Answer: D

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237. The value of $\log_{10}K$ for a reaction $A \Leftrightarrow B$ is (Given:

$\Delta_f H^{\Theta}_{298K} = -54.07 kJmol^{-1}$,

$\Delta_r S^{\Theta}_{298K} = 10JK^{=1}mol^{-1}$, and $R = 8.314JK^{-1}mol^{-1}$

A. 5

B. 10

C. 95

D. 100

Answer: B

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238. For the process $H_2O(l)(1\text{bar}, 373K) \rightarrow H_2O(g)(1\text{bar}, 373K)$ the correct set of thermodynamic parameters is

A. $\Delta G = 0, \Delta S = +ve$

B. $\Delta G = 0, \Delta S = -ve$

C. $\Delta G = +ve, \Delta S = 0$

D. $\Delta G = -ve, \Delta S = +ve$

Answer: A

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239. Identify the correct statement regarding a spontaneous process :

A. Exothermic process are always spontaneous.

B. Lowering of energy in the reaction process is the only criterion for spontaneity.

C. For a spontaneous process in an isolated system, the change in entropy is positive.

D. Endothermic process are never spontaneous.

Answer: C

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240. In conversation of lime-stone ti lime, $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)7$ the value of ΔH° and ΔS° are $+179.1KJmol^{-1}$and $160.2J/K$ respectively at 298K and 1 bar. Assuming that ΔH and ΔS do not change with temperature, temperature above which coversation of lime-stone to lime will be just spontaneous is:

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241. Predict which of the following reactions(s) has a positive entropy change?

A. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

B. $HCl(g) + NH_3(g) \rightarrow 2NH_4Cl(g)$

C. $\text{Graphite(s)} \rightarrow \text{diamonds(s)}$

D. $F_2(g) \rightarrow 2F(g)$

Answer: D

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242. Select correct statements:

A. $\int \frac{dq}{T}$ is always independent of path followed between two points.

B. Entropy of universe is conserved.

C. For a process in isolated system, entropy either increases or remains contant

D. Enrtropy decreases with increase in temperature at constant V.

Answer: C

243. In which of the following reactions do you except to have a decrease in entropy?

A. $Fe(s) \rightarrow Fe(l)$

B. $Fe(s) + \frac{3}{2}O_2(g) \rightarrow Fe_2O_3(s)$

C. $Fe(l) \rightarrow Fe(g)$

D. $2H_2O_2(l) \rightarrow 2H_2(l) + O_2(g)$

Answer: B

244. In which of the following process (involving ideal gas) entropy of system remain constant?

A. reversible isothermal expansion

B. irreversible adiabatic expansion

C. reversible adiabatic expansion

D. free expansion

Answer: C

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245. During melting of an ice slab at 273K at 1atm pressure:

A. Negative work is done on the ice-water system by the atmosphere

B. Positive work is done by the ice-water system on the atmosphere

C. The entropy of the ice-water system decrease

D. The internal energy of the ice-water system increases

Answer: D

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246. Which of the following reactions is spontaneous only at reletively low temperature?

A. $NH_4Br(s) + 188kJ \rightarrow NH_3(g) + Br_2(l)$

B. $NH_3(g) + HCl(g) \rightarrow NH_4Cl(s) + 176kJ$

C. $2H_2O_2(l) \rightarrow 2H_2(l) + O_2(g) + 196kJ$

D. Both A and C

Answer: B

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247. Two samples of same substance A and B are at 300K and 500 K respectively. When A and B are bought in thermal contact in reversible manner, which of the following options are correct?

A. $\Delta S_A < \Delta S_B$

B. $\Delta S_A > \Delta S_B$

C. $|\Delta S| < \left|\Delta S_B\right|$

D. Can't be determine

Answer: B

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248. What are the signs for $\Delta H, \Delta S$ and ΔG for the freezing of liquid water at $-10^\circ C$?

A. $\begin{array}{ccc} \Delta H & \Delta S & \Delta G \\ + & - & + \end{array}$

B. $\begin{array}{ccc} \Delta H & \Delta S & \Delta G \\ - & - & 0 \end{array}$

C. $\begin{array}{ccc} \Delta H & \Delta S & \Delta G \\ - & + & - \end{array}$

D. $\begin{array}{ccc} \Delta H & \Delta S & \Delta G \\ - & - & - \end{array}$

Answer: D

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249. For the reaction between CO_2 and graphite:

$CO_2(g) + C(s) \rightarrow 2CO(g),$

$\Delta = 170kJ$ and $\Delta S = 170.\ JK^{-1}$. The reaction will be spontaneous at :

A. 300K

B. 500K

C. 900K

D. 1100K

Answer: D

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250. The combustion reaction occuring in an automobile is $2C_8H_{18} + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(g)$ This reaction is accompanied with:

A. $\Delta H = \text{- } ve, \Delta S = + ve, \Delta G = + ve$

B. $\Delta H = + ve, \Delta S = \text{- } ve, \Delta G = + ve$

C. $\Delta H = \text{- } ve, \Delta S = \text{- } ve, \Delta G = + ve$

D. $\Delta H = + ve, \Delta S = + ve, \Delta G = \text{- } ve$

Answer: C

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251. In which of the following entropy is creasing?

A. $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

B. $Ca^{2+}(aq.) + 2F^{-}(aq) \rightarrow CaF_2(s)$

C. $N_2(g, 1atm, 300K) \rightarrow N_2, (g, 2atm, 300K)$

D. $O_2(g, 1L, 300K) \rightarrow O_2, (g, 2L, 300K)$

Answer: D

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252. $A(s) \rightarrow A(l), \Delta H^\circ = 3Kl/g$

If at 200K above changes become reversible then ΔS Will be :

(Molecular weight of A=50 g//mole)

A. $0.75 J/mol - K$

B. $750 J/mol - K$

C. $1500 J/mol - k$

D. $75 J/mol - K$

Answer: B

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253. For reaction at $1000k$:

$A(g) \Leftrightarrow B(g), \Delta G_f^\circ (A, g) = -5.2 kcal/\text{mole}^{-1}$,

$\Delta G_f^\circ (B, g) = -3.814 kcal/\text{mole}^{-1}$

Equillibrium constant of reaction is:

A. 1

B. 0.5

C. 2

D. 4

Answer: B

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254. A process must be spontaneous (feasible) if:

A. Entropy of system increases

B. Energy of system decreases

C. Gibbs free energy decreases

D. Entropy of univese increases

Answer: D

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255. Which of the following statement is incorrect when a system consisting of ideal gas undergoes change of state?

A. In reversible change, $\Delta S_{univ} = 0$

B. In an irreversible change, $\Delta S_{univ} \neq 0$

C. In an adiabatic process always $\Delta S_{univ} = 0$

D. In an ischoric process, $\Delta S_{syst} = nC_v In\left(\frac{T_2}{T_1}\right)$

Answer: C

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256. Solid $KCIO_3$ is taken in a container maintained at constant pressure of 1 atm. Upon heating, following equiibria is set:

$2KCIO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$

$If \Delta H^\circ = 25 kcal/mol$ and $\Delta S^\circ = 50 cal/K$, temperature equillibrium will be established in the container?

A. 298K

B. 500K

C. 5000K

D. Data insufficient

Answer: B

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257. ΔG for the conversation of 2 mol of $C_6H_6(l)$ at $80^\circ C$ (normal boiling point) to vapour at the same temperature and a pressure of 0.2 atm is:

A. $-9.44 kcal/mol$

B. $-2.27 kcal/mol$

C. $-1.135 kcal/mol$

D. zero

Answer: B

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258. For the given reaction at 1 atm,

$H_2(g) + S(s) \rightarrow H_2S(g), \qquad \Delta H_r = 100 kJ/mol$ and $\Delta S_r = 400 J/mol/K$

Temperature at which following reactions occurs reversibly is: AssumingΔH_r and $\Delta S_r$are independent of temperature)

A. 200K

B. 250K

C. 400K

D. None of these

Answer: B

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259. What are the signs of ΔH_r and ΔS_r for the reaction

$2C(s) + O_2(g) \rightarrow 2CO(g)$

A. $\begin{array}{cc} \Delta H & \Delta S \\ - & - \end{array}$

B. $\begin{array}{cc} \Delta H & \Delta S \\ - & + \end{array}$

C. $\begin{array}{cc} \Delta H & \Delta S \\ + & + \end{array}$

D. $\begin{array}{cc} \Delta H & \Delta S \\ + & - \end{array}$

Answer: B

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260. One mole of ice is melted at $0\,^{\circ}C$ and then is heated to $100\,^{\circ}C$. What is the difference in entropies of the steam and ice? The heats of vaporisation and fusion are $540 cal g^{-1}$ and $80 cal g^{-1}$ respectively. Use the average heat capacity of liquid water as 1cal $g^{-1} degree^{-1}$

A. $18\left(\frac{80}{373} + \frac{540}{273} + In\frac{373}{273}\right)$

B. $18\left(\frac{80}{373}+\frac{540}{373}+In\frac{373}{273}\right)$

C. $\left(\frac{80}{273}+\frac{540}{373}+In\frac{373}{373}\right)$

D. $\left(\frac{80}{273}+\frac{540}{373}+100\right)$

Answer: B

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261. One mole of diatomic ideal gas undergoes change such that pressure drops to 4 times and volume increases to 2 times. Then, calculate the entropy change in system during the process:

A. - $\frac{0.693}{K}$

B. - $2.1cal/K$

C. $1.386cal/K$

D. - $1.386cal/K$

Answer: B

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262. which of the following statement(s) is/are incorrect?

Statement (a) : Reversible isothermal compression of an ideal gas represents the limiting minimum value of the work done ($|\omega|$) by the surrounding on the system .

Statement (b) : For thermodynamic changes in adiabatic process

$T\left(\frac{C_{p.m}}{R}\right)$.P = constant

Statement (c): ΔS_{system} is zero for reversible adiabatic expansion of an ideal gas.

A. Statement b

B. Statement a,b,c

C. statement a,b

D. Statement a

Answer: A

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263. The entropy change can be calculated by using the expression ΔS - $\frac{q_{rev}}{T}$. When water freezes in a glass beaker, choose the correct statement amongst the following:

A. $\Delta S(system)$ decreases but ΔS (surroundings) remains the same.

B. $\Delta S(system)$ increases but ΔS (surroundings) decreases.

C. $\Delta S(system)$ decreases but ΔS (surroundings) increases .

D. $\Delta S(system)$ decreases but ΔS (surroundings) also decreases.

Answer: C

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264. Which of the following is not correct?

A. ΔG is zero for a reversible reaction

B. ΔG is positive for a spontaneous reaction

C. ΔG is neagative for a spontaneous reaction

D. ΔG is positive for a non-spontaneous reaction

Answer: B

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265. Select the option which is correct regarding true//false of the given stateements:

Statements-1: Thermal decomposition of solid $CaCO_3$ is expected to be spontaneous as high temperature and non-spontaneous at low temperatures. Statements-2: If the rate law for an acid catalysed reaction is $r = K(Reactant)^{1}[Catalyst]^{\circ}$ then rate will be independent of presence / absence of catalyst.

Statement-3: When water freezes in a glass beaker, volumes of the system increases at constant temperature and hence entropy will also increses.

A. All statement are correct

B. Only statemen-3 is incorrect

C. only statement-1 is correct

D. Only statement-2 is incorrect

Answer: C

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266. 4g of he gas is expanded isothermally at 300K from litre to 10L. The molar change in entropy is:

A. $2cal$

B. $600cal$

C. $1380cal$

D. $4.6cal$

Answer: D

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267. Which of the following thermodynamic condition at constant pressure and temperature is necessary for the spontaneity of a process?

A. $d(E - TS + PV) > 0$

B. $d(E - TS + PV) < 0$

C. $d(E - TS + PV) = 0$

D. $d(E + TS + PV) < 0$

Answer: B

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268. For the given reaction:

$H_2(g) + Cl_2(g) \rightarrow 2H^+(aq) + 2Cl^-(aq)$

$\Delta G^\circ = -262.4kJ$

The value of Gibbs free energy of formation $\left(\Delta G_r^\circ\right)$ for the ion $Cl^-(aq)$ is:

A. $-131.2kJmol^{-1}$

B. $+131.2kJmol^{-1}$

C. $-262.4kJmol^{-1}$

D. $+262.4kJmol^{-1}$

Answer: A

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269. Which of the following options will be correct for the stage of half competiton of the reaction $A \rightarrow B$?

A. $\Delta G^{\circ} = 0$

B. $\Delta G^{\circ} > 0$

C. $\Delta G^{\circ} < 0$

D. $\Delta G^{\circ} = -RTIn2$

Answer: A

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270. For which of the following process would ΔS be expected to be most positive?

A. $C_6H_{12}O_6(g) \rightarrow 6CO_2(g) + 6H_2O(g)$

B. $CO_2(g) \rightarrow CO_2(s)$

C. $Na^+(aq) + Cl^-(aq) \rightarrow NaCl(s)$

D. $Cl_2(g) + H_2(g) \rightarrow 2HCl(g)$

Answer: A

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271. The normal boiling point of a liquid A is 300K. Which of the following statement is false about the process: $A(l) \rightarrow A(g)$?

A. at 300K and 1 atm pressure $\Delta G = 0$

B. at 300K and 2atm pressure $\Delta G = \ + ve$

C. at 300K and 0.1 atm pressure $\Delta G = \ - ve$

D. at 310K and 1 atm pressure $\Delta G = \ + ve$

Answer: D

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272. For the transformation, $H_2O(l, 1atm) \rightarrow H_2O$ $(g, 1atm)$, $\Delta H_{vap} = 40.668 kJmol^{-}$ The change in entropy $\left(JK^{-}mol^{-}\right)is:$

A. 19.14

B. 89.89

C. 109.03

D. 128.17

Answer: D

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273. For which process will ΔH and ΔG° be expected to be most similar?

A. $2Al(s) + Fe_2O_3(s) \rightarrow 2Fe(s) + Al_2O_3(s)$

B. $2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2O(g)$

C. $2NO_2(g) \rightarrow N_2O_4(g)$

D. $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$

Answer: A

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274. For a particular reaction, $\Delta H = -38.3kJ$ and $\Delta S^\circ = -113J \times K^{-1}$.

This reaction is:

A. spontaneous at all temperature.

B. non-spotaneous at all temperatures.

C. spontaneous at temperature below $66^\circ C$.

D. spontaneous at temperature above $66\,^{\circ}C$.

Answer: C

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275. What is ΔG° for the reaction?

$$\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \rightarrow NH_3(g)\ K_p = 4.42 \times 10^4 at 25\,^{\circ}C.$$

A. $-26.5kJ.\,mol^{-1}$

B. $-11.5kJ.\,mol^{-1}$

C. $-2.2kJ.\,mol^{-1}$

D. $-0.97kJ.\,mol^{-1}$

Answer: A

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276. The ΔH° and ΔS° value for a particular reaction are $-60.0kJ$ and $-0.200kJ.\ K^{-1}$ respectively, Under what reaction spontaneous?

A. all conditions

B. $T < 300K$

C. $T = 300K$

D. $T > 300K$

Answer: B

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277. What are the signs of ΔH° and ΔS° for a reaction that is spontaneous at all temperature?

A. $\begin{array}{cc} \Delta H^\circ & \Delta S^\circ \\ + & + \end{array}$

B. $\begin{array}{cc} \Delta H^\circ & \Delta S^\circ \\ + & - \end{array}$

C. ΔH° ΔS°
- +

D. ΔH° ΔS°
- -

Answer: C

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278. For a process that is both endothermic and spontaneous:

A. $\Delta H < 0$

B. $\Delta H > 0$

C. $\Delta E = 0$

D. $\Delta S > 0$

Answer: D

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279. Consider the values of $\Delta H\left(\text{in} kJmol^{-}\right)$ and for $\Delta S\left(\text{in} mol^{-}K^{-1}\right)$ given for four different reactions. For which reaction will ΔG increases the most (becoming more positive) when the temperature is increased form $0\,^{\circ}C\text{to}25\,^{\circ}C$?

A. $\Delta H^{\circ}C = 50, \Delta S^{\circ} = 50$

B. $\Delta H^{\circ}C = 90, \Delta S^{\circ} = 20$

C. $\Delta H^{\circ}C = -90, \Delta S^{\circ} = -50$

D. $\Delta H^{\circ}C = -90, \Delta S^{\circ} = -20$

Answer: C

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280. A large positive value of $\Delta G^{\ominus}$ corresponds to which of these?

A. small positive K

B. small positive J

C. large positive K

D. large negative K

Answer: A

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281. Which of the following occurs with an increase in entropy?

A. $2C(s) + O_2(g) \rightarrow 2CO(g)$

B. $2H_2S(s) + SO_2(g) \rightarrow 3S(s) + 2H_2O(g)$

C. $2Fe(s) + 3O_2(g) \rightarrow Fe_2O_3(s)$

D. $CO(g) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$

Answer: A

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282. For the reaction

$PCl_3(g) + Cl(g) \rightarrow PCl_5(g), \Delta H = -86kJ.$

Under what temperature is this reaction expected to be spontaneous?

A. no temperature

B. high temperatures only

C. all temperature

D. low temperature only

Answer: D

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283. Which statement is correct?

A. In a coffe-cup calorimeter, $q = \Delta H$

B. In a coffe-cup calorimeter, $w = 0$

C. In bomb calorimeter, $q = \Delta S$

D. In bomb calorimeter, $w > 0$

Answer: A

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284. For which substance and conditions can $\Delta S = 0$?

(P) elements at 0 K (Q) compounds at 0 K

(R) gases at 298K

A. P only

B. R ONLY

C. P AND Q ONLY

D. P AND R ONLY

Answer: C

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285. Which reaction occurs with a decrease in entropy?

A. $N_2(g) + O_2(g) \rightarrow 2NO(g)$

B. $N_2O_4(g) \rightarrow 2NO_2(g)$

C. $2CO(g) \rightarrow C(s) + CO_2(g)$

D. $HCl(aq) + Ag_2CO_3(s)$

$\rightarrow 2AgCl(s) + CO_2(g) + H_2O(l)$

Answer: C

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286. ΔG° for a reaction $25^\circ Cis 3.5 kJ \times mol^{-1}$. What is the value of K?

A. 2.2×10^5

B. 1.1

C. 0.86

D. 4.5×10^{-6}

Answer: D

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287. when the substance below are arranged in order oif increasing entropy value, $S^{\circ}, at 25^{\circ} C$ which is the correct order?

A. $CO_2(s) < CO_2(aq) < CO_2(g)$

B. $CO_2(g) < CO_2(aq) < CO_2(s)$

C. $CO_2(s) < CO_2(g) < CO_2(aq)$

D. $CO_2(g) < CO_2(s) < CO_2(aq)$

Answer: A

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288. For the reaction: $2NO_2(g) \rightarrow N_2O_4(g) : \Delta H < 0$. What predictions can be made about the sign of ΔS and the temperature conditions under which the reaction would be spontaneous?

	ΔS_{rxn}	Temperature Condition
(a)	negative	low temperature
(b)	negative	high temperature
(c)	positive	high temperature
(d)	postive	low temperature

A.

ΔS_{rxn}	Temperature Condition
negative	low temperature

B.

ΔS_{rxn}	Temperature Condition
negative	high temperature

C.

ΔS_{rxn}	Temperature Condition
positive	high temperature

D.

ΔS_{rxn}	Temperature Condition
positive	low temperature

Answer: A

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289. Which reaction occurs with a decrease in entropy?

A. $2H_2O(l) \rightarrow 2H_2 + O_2(g)$

B. $2NO(g) \rightarrow N_2(g) + O_2(g)$

C. $C(s)+O_2(g) \rightarrow CO_2(g)$

D. $Br_2(g)+Cl_2(g) \rightarrow 2BrCl(g)$

Answer: A

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290. For a substance with the value of ΔH_{vap} and ΔS_{vap} given below, what is its normal boiling point in $.^{\circ}C\left(\Delta H_{vap}=59.0kJmol^{-1}, \Delta S_{vap}=93.65Jmol^{-1}\right)$

A. 357

B. 630

C. 1314

D. 1587

Answer: A

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291. Which of best describtion of the relationship between the absolute entropies, S° of solid water at 100K and at 200K?

A. S°_{200k} is smaller because entropy decreases as temperature increases.

B. S°_{200k} is smaller because the surroundings are more disordered at high temperatures.

C. $S^{\circ}_{100k} = S^{\circ}_{200k}$ = because water is in the solid phase at high temperatures.

D. S°_{200k} is larger because the vibration of the molecules increases as temperature increases.

Answer: D

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292. Which applies to any endothermic reaction?

A. $\Delta H < 0$

B. $\Delta H > 0$

C. $\Delta G < 0$

D. $\Delta G > 0$

Answer: B

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293. Which phase change for water has positive values for both ΔH° and ΔG°?

A. $(l) \rightarrow (s) at 250 K$

B. $(l) \rightarrow (s) at 350 K$

C. $(l) \rightarrow (g) at 350 K$

D. $(l) \rightarrow (g) at 450 K$

Answer: C

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294. When solid $CuSO_4$ dissolves in water to make a 1 M solution, the temperature of the system increases When solid NH_4NP_3 dissolves in water to make a 1M solution, the temperature of the system decreases. Which statement(s) mus be correct for these dissolving processes?

(P) ΔH° value for both processes have the same sign.

(Q) ΔG° values for both processes have the same sign.

A. P only

B. Q only

C. Both P and Q

D. Neither P nor Q

Answer: B

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295. which reaction proceeds with the greates increases in entropy

A. $H_2(g) + O_2(g) \rightarrow H_2O_2(l)$

B. $Br_2(l) + F_2(g) \rightarrow 2BrF(g)$

C. $Cu^{2+}(aq) + Zn(s) \rightarrow Cu(s) + Zn^{2+}(aq)$

D. $4NH_3(g) + 7O_2(g) \rightarrow 4NO_2(g) + 6H_2O(g)$

Answer: B

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296. For the reaction,

$N_2H_4(l) \rightarrow N_2(g) + 2H_2(g) \Delta H^\circ = -50.6kJ.$

This reaction is:

A. spontaneous at all temperature.

B. non-spotaneous at all temperatures.

C. spontaneous only at low temperatures.

D. spontaneous only at high temperatures.

Answer: A

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297. Diethyl ether has a normal boiling point of $35.0^{\circ}C$ and has an entropy of vaporization of $84.4J/molK$. What is its enthalpy of vaporization?

A. $0.274J/mol$

B. $2.41J/mol$

C. $3.65J/mol$

D. $26.0Kj/mol$

Answer: D

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298. For a reaction that is exothermic an non-spontaneous at $25\,^{\circ}C$, which quantity must be positive?

A. ΔE°

B. ΔG°

C. ΔH°

D. ΔS°

Answer: B

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299. Bromine boils at $59\,^{\circ}C$ with $\Delta H^{\circ}_{vap} = 29.6 kJmol^{-1}$ What is the value of $\Delta S^{\circ}_{vap} \text{in} 29.6 Jmol^{-1}K^{-1}$

A. 11.2

B. 89.2

C. 50.1

D. 1750

Answer: B

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300. A chemical reaction is carried out twice with the same quantity of reactants to forms the same products but the pressure is different for the two experiments. Which value does not change?

A. k_p

B. Heat released

C. $\Delta T_{\text{surroundings}}$

D. Work done

Answer: A

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301. Which reactions is spontaneous at all temperature at standard pressure and concentration?

A. exothermic reaction with a decrease in entropy

B. exothermic reaction with an increase in entropy

C. endothermic reaction with a decrease in entropy

D. endothermic reaction with a increase in entropy

Answer: B

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302. Which has the highest standard molar entropy?

A. $O_2(g)$

B. $SO_2(g)$

C. $H_2O(l)$

D. $PbO_2(s)$

Answer: B

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303. Which always true for a specific system during a spontaneous reaction?

A. $\Delta H < 0$

B. $\Delta H \geq 0$

C. $\Delta G < 0$

D. $\Delta S > 0$

Answer: C

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304. The boiling point of diethyl ether is $34.6^\circ C$. Which is true for the vaporization of diethyl ether at $25.0^\circ C$?

A. $\Delta G^\circ_{vap} > 0$

B. $\Delta H^\circ_{vap} < 0$

C. $K_{vap} = 1$

D. $\Delta S^\circ_{vap} < 0$

Answer: A

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305. when the substance $Na(s), Br_2(g), Br_2(l), NaBr(s)$ are arranged in order of increasing molar entropy at $25^\circ C$, which order is correct?

A. $Br_2(g), Br_2(l), , Na(s), NaBr(s)$

B. $Na(s), Br_2(g), Br_2(l), NaBr(s)$

C. $Na(s), NaBr(s), Br_2(l), Br_2(g)$

D. $NaBr(s), Br_2(g), Br_2(l), Na(s)$

Answer: C

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306. The reaction,

$4Ag(s) + O_2(g) \rightarrow 2Ag_2O(s)$, is exothermic

Which statement about the reaction is correct?

A. It is spontaneous at all temperature

B. It is spontaneous only at low temperatures

C. It is spontaneous only at high temperatures.

D. It is non-spontaneous at all temperatures.

Answer: B

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307. Which reaction has a positive $\Delta S^{\circ}_{reaction}$?

A. $Ag^{+}(aq) + Br^{-}(aq) \rightarrow AgBr(s)$

B. $2C_2H_6(g) + 3O_2(g) \rightarrow 4CO_2(g) + 6H_2O(l)$

C. $N_2(g) + 2H_2(g) \rightarrow N_2H_4(g)$

D. $2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$

Answer: D

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308. For a reaction at $25\%(\circ)C, \Delta G^{\circ} = -33.3kJ$ and $\Delta S = -198kJ \times K^{-1}$. What is the value of $\Delta H\%(\circ)$?

A. $-92.3kJ$

B. $-38.3kJ$

C. $-28.8kJ$

D. $25.7kJ$

Answer: A

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309. Which statement is always true for a spontaneous reaction?

A. The entropy change for the system is neagative.

B. The enthalpyt change for the system is negative.

C. The entropy change for the universe is positive.

D. The free energy change for the system is positive.

Answer: C

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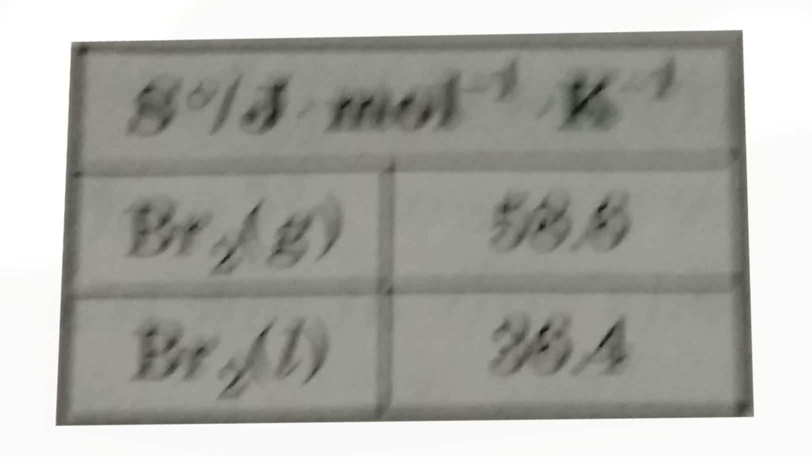
310. Liquid bromine boils at $332.7. K$ Estimate the enthalpy of formation of $Br_2(g) \in Kj. Mol^{-1}$



$S^\circ/J\ mol^{-1}\ K^{-1}$	
$Br_2(g)$	58.6
$Br_2(l)$	36.4

A. 7.4

B. 12.1

C. 19.5

D. 22.2

Answer: A

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311. Which change(s) is(are) accompanied by an increase in entropy of the system?

(P) Conversion of $O_2(g) \text{to} O_3(g)$

(Q) Freezing of water

(R) Sublimation of iodine

A. P only

B. R ONLY

C. P AND Q ONLY

D. Q and R only

Answer: B

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312. Which choice represents the signes for ΔS and ΔH for the sublimatioon of a compound that is occuring at constant temperature?

A. $\Delta S < 0, \Delta H < 0$

B. $\Delta S < 0, \Delta H > 0$

C. $\Delta S > 0, \Delta H > 0$

D. $\Delta S > 0, \Delta H < 0$

Answer: C

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313. A reaction has $\Delta H^\circ > 0$ and $\Delta G^\circ > 0$ $25^\circ C$. This reaction:

A. is at equillibruim at $25^\circ C$.

B. could not be spontaneous under standard conditions at any temperature.

C. could be spontaneous under standard conditions at temperatures above $25^\circ C$

D. could be spontaneous under standard conditions at temperature below $25^\circ C$.

Answer: C

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314. An ionic compound ha a solublity increases as the temperature is raised. What are the signs of ΔH° and ΔS° for the dissolving process?

A. $\begin{array}{cc} \Delta H^\circ & \Delta S^\circ \\ + & + \end{array}$

B. $\begin{array}{cc} \Delta H^\circ & \Delta S^\circ \\ + & - \end{array}$

C. $\begin{array}{cc} \Delta H^\circ & \Delta S^\circ \\ - & + \end{array}$

D. $\begin{array}{cc} \Delta H^\circ & \Delta S^\circ \\ - & - \end{array}$

Answer: A

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315. The enthalpy of fusion for $NaF(s)$ at its melting point $\left(992\,^{\circ}C\right) is 29.3 kJ \times mol^{-1}$. What is the value of $\Delta S^{\circ}_{fusion}$ in $J \times mol^{-1} \times K^{-1}$?

A. 43.2

B. 33.9

C. 29.5

D. 23.2

Answer: D

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316. For the reaction at $25\,^{\circ}C$,

$C_2H_4(g) + H_2(g) \Leftrightarrow C_2H_6(g), K_p = 308.08$

What is ΔG° for this reaction in $kJ \times mol^{-1}$?

A. 0.436

B. -3.71

C. - 19.2

D. - 14.2

Answer: D

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317. Which reaction has the most positive entropy change understandard conditions?

A. $H_2O(g) + CO(g) \rightarrow H_2(g) + CO(g)$

B. $CaCO_3(s) \rightarrow CaO(s) \rightarrow + CO_2(g)$

C. $NH_3(g) \rightarrow NH_3(aq)$

D. $C_8H_{18}(g) \rightarrow C_8H_{18}(s)$

Answer: B

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318. What are the sign of ΔH and ΔS for a reaction that is spontaneous only at low temperatures?

A. ΔH is positve, ΔS is positive

B. ΔH is positve, ΔS is negative

C. ΔH is negative, ΔS is negative

D. ΔH is negative, ΔS is positive

Answer: C

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319. For a reaction at constant pressure to be spontaneous, which relationship is correct

A. $\Delta H_{rxn} < 0$

B. $\Delta G_{rxn} < 0$

C. $\Delta S_{rxn} < 0$

D. $\Delta S_{uni} < 0$

Answer: B

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320. Tungsten is obtained commercially by the reduction of WO_3 with H_2 according to the equation:

$WO_3(s) + 3H_2(g) \rightarrow W(s) + 3H_2O(g)$

The following data related to this reaction at $25\,^{\circ}C$ are available

The temperature at which this reaction is at equillibrium at 1 atm is closest which of the following?

A. 124K

B. 231K

C. 928K

D. 2810K

Answer: C

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321. The gases compound $NOBr$ decomposses accordings to the equation

$NOBr(g) \Leftrightarrow NO(g) + \frac{1}{2}Br(g)$

At 350K, the equillibrium constant, K_p is 0.15. What is the value ΔG° ?

A. $-5.5 \times 10^3 J/mol$

B. $-2.4 \times 10^3 J/mol$

C. $2.4 \times 10^3 J/mol$

D. $5.5 \times 10^3 J/mol$

Answer: D

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322. At the triple point of water how do the entropies of solid, liquid, and gas compare?

A. $S^{\circ}_{\text{solid}} < S^{\circ}_{\text{liquid}} < S^{\circ}_{\text{gas}}$

B. $S^{\circ}_{\text{solid}} = S^{\circ}_{\text{liquid}} < S^{\circ}_{\text{gas}}$

C. $S^{\circ}_{\text{gas}} < S^{\circ}_{\text{solid}} < S^{\circ}_{\text{liquid}}$

D. $S^{\circ}_{\text{solid}} = S^{\circ}_{\text{liquid}} = S^{\circ}_{\text{gas}}$

Answer: A

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323. "A perfect crystalline substance has an entropy of zero at absolute zero" is a statement of

A. Hess' Law.

B. The First Law of Thermodynamics.

C. The SecondLaw of Thermodynamics.

D. The Third Law of Thermodynamics.

Answer: D

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324. Which of the following sets of conditions would result in a reaction that is spontaneous at high temperature but non-spontaneous at low temperature?

A. $\Delta H > 0, \Delta S > 0$

B. $\Delta H > 0, \Delta S < 0$

C. $\Delta H < 0, \Delta S < 0$

D. $\Delta H < 0, \Delta S > 0$

Answer: A

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325. Spontaneous reactions always:

A. go to completion.

B. are fast. Involve phase changes.

C. involve phase changes.

D. release energy and/or show an increase in the system's entropy.

Answer: D

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326. Which is a statement of the second law of Thermodynamics?

A. The energy of the universe is conserved .

B. The energy of the universe is decreasing .

C. The entropy of the universe is unconserved .

D. The entropy of the universe is conserved .

Answer: D

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327. For the reaction, $2H(g) \rightarrow H_2(g)$, what are the signs of ΔH and ΔS ?

A. $\Delta H^\circ < 0, \Delta S^\circ < 0$

B. $\Delta H^\circ < 0, \Delta S^\circ > 0$

C. $\Delta H^\circ > 0, \Delta S^\circ > 0$

D. $\Delta H^\circ > 0, \Delta S^\circ < 0$

Answer: A

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328. Which substance has the greatest molar entropy at 298K?

A. $NO_2(g)$

B. $NO_2O_4(l)$

C. $NO_2O_4(g)$

D. $NO_2O_5(l)$

Answer: C

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329. For the process, $CH_3OH(l) \rightarrow CH_3OH_g, \Delta G^\circ = 4.30 kJ/mol at 25^\circ C$.

What is the vapour pressure of $Ch_3OH(l) at 25^\circ C$ in mm Hg

A. 0.176mm Hg

B. 14.0mm Hg

C. 134mm Hg

D. 759mm Hg

Answer: C

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330. Which reaction has the greatest positive change in entropy, ΔS?

A. $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$

B. $2C_2H_2(g) + 5O_2(g) \rightarrow 4CO_2(g) + 2H_2O(l)$

C. $2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$

D. $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

Answer: C

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331. Which statement is correct for the reaction represented below?

$2NOCl(g) \rightarrow 2NO(g) + Cl_2(g), \Delta H^{\circ}_{reaction} > 0$

The reaction is

A. spontanous at all temperatures

B. spontanous only at high temperatures

C. spontonous only at low temperatures

D. non-spontanous at any temperature

Answer: B

Watch Video Solution

332. What is the temperature at which the reaction below is at equillibirium ?

$2NO(g) + O_2(g) \rightarrow 2No_2(g)$

$\Delta H^{\circ}_{reaction} = -113kJ \cdot mol^{-1}$

$\Delta S^{\circ}_{reaction} = -145kJ \cdot mol^{-1} \times K^{-1}$

A. -195° C

B. 77.9° C

C. 506° C

D. 779° C

Answer: C

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333. The atmospheric pressure on the summit of Mt. Everest is 0.333 atmospheres. At what tempperature (in $^\circ \text{C}$) does H_2O boil there?

$\left(\Delta H_{vap} H_2O = 40.7kJ \times mol^{-1}\right)$

A. 71° C

B. 87° C

C. 96° C

D. 98° C

Answer: A

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334. Which isomer of C_4H_8 has the lowest entropy at 25° C?

A. 1-butane

B. cis-2-butane

C. trans-2-butane

D. cyclobutane

Answer: D

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335. Consider the following reactions :

(P) $2NO_2(g) \rightarrow N_2(g) + 2O_2(g)$

(Q) $2IBr(g) \rightarrow I_2(s) + Br_2(l)$

For which reaction is $\Delta S^\circ < 0$?

A. P only

B. Q only

C. Both P and Q

D. Neither P and q

Answer: B

Watch Video Solution

336. Liquid water is injected into an oven at 400 k. What are the signs for $\Delta G, \Delta H, \Delta S$ for the physical transformation that occurs ?

A. $\begin{array}{ccc} \Delta G & \Delta H & \Delta S \\ + & - & - \end{array}$

B. $\begin{array}{ccc} \Delta G & \Delta H & \Delta S \\ + & - & 0 \end{array}$

C. $\begin{array}{ccc} \Delta G & \Delta H & \Delta S \\ - & + & + \end{array}$

D. $\begin{array}{ccc} \Delta G & \Delta H & \Delta S \\ - & + & 0 \end{array}$

Answer: C

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337. Which halogen has the highest standerd entropy, S° ?

A. $F_2(g)$

B. $Cl_2(g)$

C. $Br_2(l)$

D. $I_2(s)$

Answer: B

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338. A chemical reaction has $K_{eq} = 1 \times 10^{-5}$ at 25° C, and the value of K_{eq} increases with incresing tempreature. From these statements, what may one conclude?

A. $\Delta H^{\circ} > 0$ and $\Delta S^{\circ} > 0$

B. $\Delta H^{\circ} < 0$ and $\Delta S^{\circ} < 0$

C. $\Delta H^{\circ} < 0$ and $\Delta S^{\circ} > 0$

D. $\Delta H^{\circ} < 0$ and no conclusion may be drawn about the sign of ΔS°

Answer: D

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339. Which of these reaction has $\Delta S^{\circ} > 0$?

A. $S_8(l) \rightarrow S_8$(s,monoclinic)

B. $H_2(g) + O_2(g) \rightarrow H_2O_2(aq)$

C. $H_2(g) + 2Ag^{+}(aq) \rightarrow 2H^{+}(aq) + 2Ag(s)$

D. $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$

Answer: D

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340. Standard emtropy of X_2, Y_2 and X_2Y_3 are 60, 40 and 150 in J/K mol

$$X_2 + \frac{3}{2}Y_2 \rightarrow X_2Y_3, \Delta H = +30kJ$$

The temperature at which reaction will attain equilibrium is :

A. 250 K

B. 1000 K

C. 750 K

D. 200 K

Answer: B

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341. A reaction at 400 K with approximate $\Delta G^{\circ} = 3207 J/\text{mole}$, consists of 4 mole of substance A, 2 mole of substance B and 3 mole of substance C at equilibrium in 1 litre container, then which of the following is correctly balanced reaction ?

[Take : log 3 =0.48, log 2= 0.3

in x =2.30 log x

R=8.3 $J/\text{mole}/K$]

A. $2A(g) \Leftrightarrow B(g) + C(g)$

B. $A(g) \Leftrightarrow B(g) + C(g)$

C. $A(g) + B(g) \Leftrightarrow 2C(g)$

D. $A(g) + C(g) \Leftrightarrow 2B(g)$

Answer: A

Watch Video Solution

342. At $500K$, for an isobaric pracess.

$\Delta S_{system} = -10\dfrac{KJ}{molK}$ and $\Delta S_{surr} = 12\dfrac{KJ}{molK}$

Therefore, ΔG for the entire process is

A. $-500kJ/mol$

B. $-1000kJ/mol$

C. $-600kJ/mol$

D. $-1100kJ/mol$

Answer: B

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343. 1 mole of an ideal gas, initially present in a 1 litre insulated cylinder at 300 K is allowed to expand against vaccum from 1 litre to 8 litre. Determine ΔG : [in 2=0.7, R=8.3 $J/\text{mole - }K$]

A. $-5229 J/\text{mole}$

B. $-1500 J/K$

C. $-3456 J/K$

D. $-600 J/K$

Answer: A

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344. Which of the following decreases with increasing tempreature ?

A. The volume of an ideal gas in an adiabatic process

B. Internal energy of a system

C. The pressure of an ideal gas in a fixed volume

D. Entropy of a pure substance

Answer: A

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345. At what temperature the following process would not be spontanous ?

$4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$

$\Delta H = -1648 kJ/\text{mole}$

$\Delta S = -560 J/\text{mole}$

A. 2000 K

B. 3000 K

C. 2900 K

D. 2500 K

Answer: B

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346. What will be change in molar Gibbs free energy of $H_2O(l)$ at 300 K constant temperature if it is compressed from 10 bar to 20 bar : [1 bar L=100 J]

A. $36J/mol\text{-}K$

B. $28J/mol\text{-}K$

C. $18J/mol\text{-}K$

D. $10J/mol\text{-}K$

Answer: C

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347. From a source of infinite heat capacity 300 kcal heat is extracted at 727° C temperature then change in its entropy $(\text{cal}/\text{kelvin})$ will be ?

A. $-300\ln2$

B. -300

C. -500

D. $-500\ln 2$

Answer: B

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348. One mole He gas at 300K, 10 atm is heated through a process in which its pressure is directly propotional to square of its absolute temperature becomes 600 K. The change in entropy of He is :

A. $\frac{5}{2}R\text{in}2$

B. $\frac{1}{2}R\text{in}2$

C. $\frac{3}{2}R\text{in}2$

D. $\frac{9}{2}R\text{in}2$

Answer: B

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349. Predict in which of the following entropy of the system increses/ decreases:

(P) A liquid crystalizes into a solid

(Q) Temperature of a crystalline solid is raised

(R) $2NaHCO_3(s) \rightarrow Na_2CO_3(s) + H_2O(g) + CO_2(g)$

(S) $H_2(g) \rightarrow 2H(g)$

A. increases in all

B. decreases in (P) and (Q)

C. Decreases in (P) only

D. Increases in (P),(S) only

Answer: C

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350. Consider an ideal gas reaction

$A(g) \rightarrow B(g), \Delta G$=76.5 joule

ΔH=276.5 joules at 300 K, then, equilibium temperature of reaction will be :

A. 298 K

B. 141.75 K

C. 596 K

D. 207.25 K

Answer: B

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351. The change in entropy of the system moles of a diatomic ideal gas is heated from 400 K to 800 K under constant pressure:

A. 3 R in 2

B. 7 R in 2

C. 5 R in 2

D. R in 2

Answer: B

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352. Which one of the following statement is false ?

A. For a fixed amount of substance, entropy of a substance in agaseous phase

B. spontanous process always occur very rapidly

C. for a fixed amount of a solid ,ΔS sublimation of a solid may balways be positive

D. If $\Delta G < 0$ then it is not necessary that process will be spontaneous always

Answer: B

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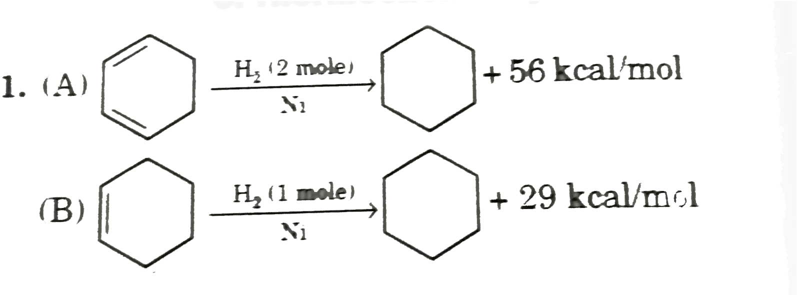
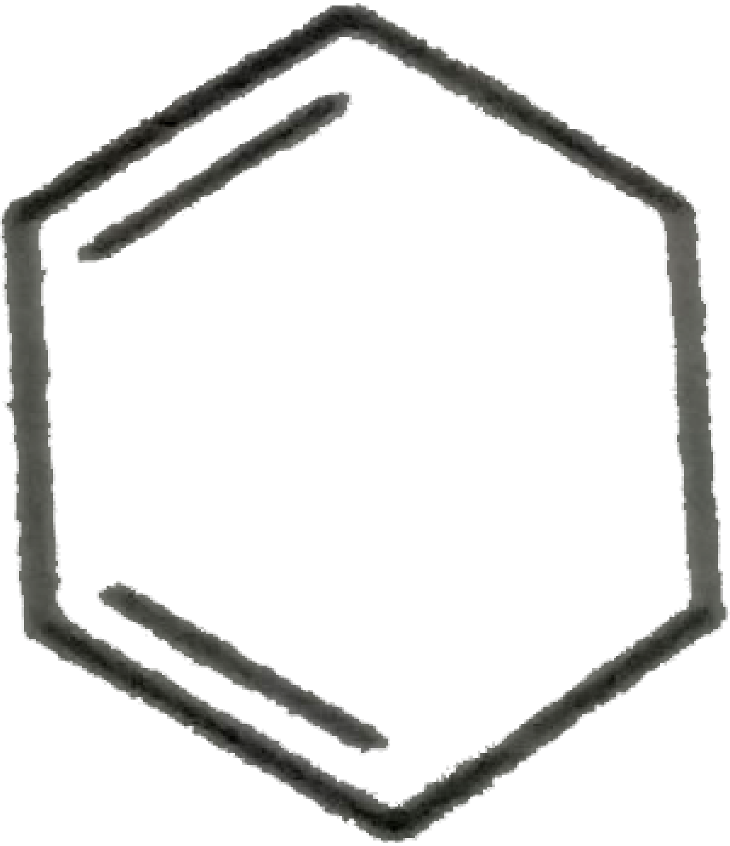
353.



Give the value of resonance energy for



using these data :

A. 1 kcal/mole

B. 2 kcal/mole

C. 3 kcal/mole

D. 4 kcal/mole

Answer: B

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354. Calculate $C - H$ bond energy from the following data :

$\Delta_f H \quad [C(g)] = 716.68 kJ/\text{mole}$

$\Delta_f H \quad [H(g)] = 217.97 kJ/\text{mole}$

$\Delta_f H \quad \left[CH_4(g)\right] = -74.81 kJ/\text{mole}$

A. 1663.37 kJ

B. 415.84 kJ

C. 179.17 kJ

D. 74.81 kJ

Answer: B

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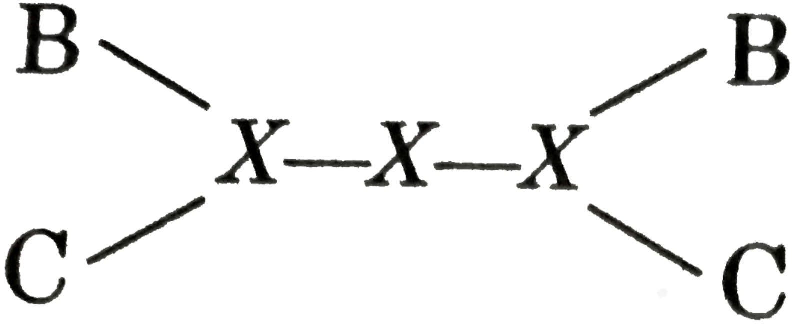
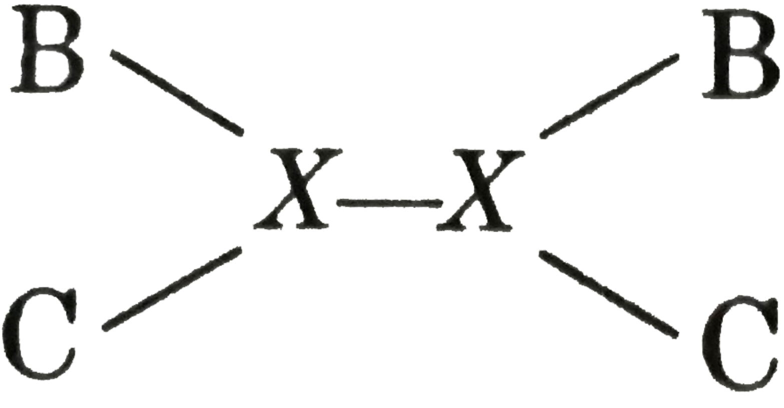
355. Calculate bond energy of X - X bond from the following data.



$\Delta H_f \text{of} X(g) = +300 kJ/\text{mole}$



A. 400 kJ

B. 200 kJ

C. 100 kJ

D. 150 kJ

Answer: A

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356. The combustion of 1.22 g benzoic acid (M=122) in a bomb calorimeter at 300 K caused a temperature rise of 3 K, While combustion of 0.88 g ethyl ethanote (M=88) caused a temperature rise of 2 K. Calculate the enthalapy change of combustion of $CH_3COOC_2H_5(l)$ at 300 K. Given : Internal energy change of combustion for benzoic acid =-300kJmol^{-1} at 300 K and R=8.3$JK^{-1}mol^{-1}$

A. $-2000kJ/mol$

B. $-2002.49kJ/mol$

C. $-2006.5kJ/mol$

D. $-3002.5kJ/mol$

Answer: B

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357. Which of the following substances will have positive value of $\Delta H_{\text{formation}}$?

A. $Br_2(l)$

B. $O_3(g)$

C. ZnO(s)

D. $H^+(aq)$

Answer: B

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358. It is observed that an combustion of 5.6 g of but-1ene(g) 70 kcal of heat is liberated in a closed rigid vessel at 300 K. What could be a possible value of $\left|\Delta H^{\circ}_{combustion}\right|$ of gaseous cyclone propane [Take : R=2 cal /K mole]?

A. 490 kcal

B. 491.5 kcal

C. 49 kcal

D. 500 kcal

Answer: C

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359. It is observed that on combustion of 4.2 g of gaseous propene in a closed rigid vessel 49 kcal of heat was liberated at 300 K. What could be a possible value of $\left|\Delta H^{\circ} \text{combustion}\right|$ of gaseous cyclone propane[Take : R=2 cal/K mole]?

A. 490 kcal

B. 491.5 kcal

C. 49 kcal

D. 500 kcal

Answer: D

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360. Standard enthalpy of formation of N_2O_5 is $-100 kcal/mol$ and standard entorpy of N_2, O_2 and N_2O_5 are 35, 40 and 115 kcal respectively, then $\Delta_r G^\circ$ of following reaction of 227° C will be :

$2N_2 + 5O_2 \rightarrow 2N_2O_5$

A. $-80 kcal$

B. $-180 kcal$

C. $-1800 kcal$

D. $+1800 kcal$

Answer: B

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361. The bond energy of C=O if $\Delta H_f^\circ\left(CO_2\right)$=390$kJ$, $\Delta H^\circ_{\text{sublimation}}$ (Graphite)=720 kJ, O=O bond energy = 490 kJ and renonce energy $\left(CO_2\right)$ =36 kJ :

A. 782 kJ

B. 1564 kJ

C. 500 kJ

D. 626 kJ

Answer: A

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362. What will be the maximum amount of heat realeased when 321 g of a mixuture of fe_2O_3 and Al is subjected to sparkling in absence of air?

$\Delta H_f\left(Fe_2O_3 = -199kJ/\text{mole}\right.$

$\Delta H_f\left(Al_2O_3 = -399kJ/\text{mole}\right.$

A. 200 kJ

B. 300 kJ

C. 400 kJ

D. 100 kJ

Answer: B

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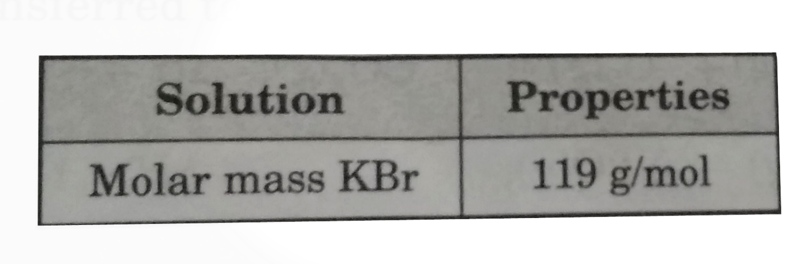
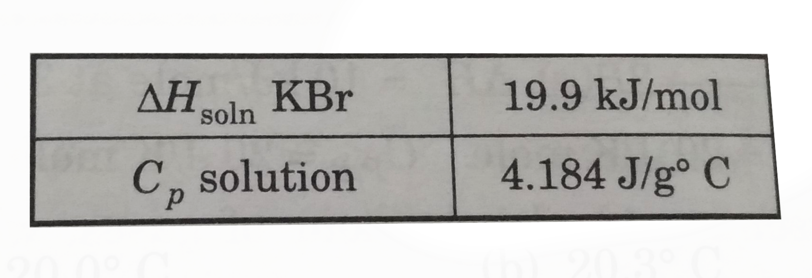
363. A 9.40 g sample of KBr is dissolved in 105 g of H_2O at 23.6° C in a coffee cup. Find the final temperature of this system. Assume that no heat is transferred to the cup or the surroundings.



Solution	Properties
Molar mass KBr	119 g/mol



ΔH_{soln} KBr	19.9 kJ/mol
C_p solution	4.184 J/g° C

A. 20.0 ° C

B. 20.3 ° C

C. 26.9 ° C

D. 27.2 ° C

Answer: B

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364. Which of the followig substances willl have non-zero standard enthalpy of formation ? $\Delta H_f^\circ \neq 0$

A. $H^+(aq)$

B. $C_{(gra\phi te)}$

C. $Rn_{(gas)}$

D. $Sn_{(grey)}$

Answer: D

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365. What will be the value of resonance energy of N_2O if :

$\Delta H_{BDE} N = N = 400 kJ/mol$

$\Delta H_f^\circ N_2O = 100 kJmol^{-1}$

$\Delta H_{BDE} N = N = 950 kJ/mol$

$\Delta H_{BDE} N = O = 600 kJmol^{-1}$

$\Delta H_{BDE} O = O = 500 kJ/mol$

A. $200kJ/mol$

B. $150kJ/mol$

C. $100kJ/mol$

D. $50kJ/mol$

Answer: C

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366. For the reaction, $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

Identify the statement which is not correct :

A. $S^{\circ}_{mN_2} + 3S^{\circ}_{mH_2} > 2S^{\circ}_{mNH_3}$

B. Heat absorbed at constant presssure and temperature will be more as compared to heat absorbed at constant volume .

C. $\Sigma\text{Bond energy}_{\text{rectant}} > \Sigma\text{bond energy}_{\text{product}}$

D. The value of ΔG° is expected to be negative at exteremely low temperatures.

Answer: D

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367. Identify the option which is correct :

A. $\Delta H_f^\circ HF_{\text{liquid}} < \Delta H_f^\circ HF(aq)$

B. $\left|\Delta H_f^\circ H_2O(g)\right| > \left|\Delta H_f^\circ H_2O(l)\right|$

C. $\Delta H_f^\circ HNO_3(l) > \Delta H_f^\circ HNO_3(aq)$

D. $\Delta H_f^\circ H^+(g) = 0$

Answer: C

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368. Calculate ΔH when 2 moles of solid benzoic acid undergo complete combustion at 300 K if

$$C_6H_5COOH(s) + \frac{15}{2}O_2(g) \rightarrow 7CO_2(g) + 3H_2O(l)$$

$\Delta U_{reaction} = -750 kJ/$mole

A. -751.247 kJ

B. -752.494 kJ

C. -1501.247 kJ

D. -1502.494 kJ

Answer: D

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369. Two solids A and B having molar masses 200 and 300 react to form another solid C as shown

$$2A(s) + 3B(s) \rightarrow C(s)$$

if $\Delta H^{\circ}_{\text{combustion}}$ of A, B and C are -200, -300 and -400 kJ respectively then maximum heat which can be released at constant pressure if total 2600 g of A and B is taken, is given by :

A. 200 kJ

B. 1800 kJ

C. 900 kJ

D. 450 kJ

Answer: B

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370. $A(g) \rightarrow 2B(g), \Delta H^{\circ} = 10kJ/$mole at 300 K,

$C_{P,A} = 20J/K$mole $C_{P,B} = 20J/K$mole

Asuming ideal behaviour of gases, which of the following statements is correct :

A. $\Delta H_{reaction} > 10$ kJ at 300 K if pressure is increased

B. $\Delta H_{reaction} < 10$ kJ at 300 K if pressure is increased

C. $\Delta H_{reaction} > 10$ kJ at 400 K if pressure is kept constant

D. $\Delta H_{reaction} > 10$ kJ at 200 K if pressure is decreased

Answer: C

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371. Calculate $\Delta H_{\text{combustion}^{\circ}}$ of C_{graphite} if ΔH_f° of ace tone $= -250kJ,$

$\Delta^{\circ}_{\text{combustion}}$of acetone $= -1760kJ,$

$\Delta H^{\circ}_{\text{combustion}}$ of $H_2(g) = -280kJ$

A. $-390kJ$

B. $-120kJ$

C. $-500kJ$

D. $-200kJ$

Answer: A

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372. The bond enthalpies of $C - C, C = C$ and $C = C$ bonds are 348, 610 and 835 kj/ mole respectively at 298 K and 1 bar . Calculate enthalpy of polymerisation per mole of butyne at 298 K and 1 bar :

A. $-123 kJ$

B. $-132 kJ$

C. $-139 kJ$

D. $-37 kJ$

Answer: A

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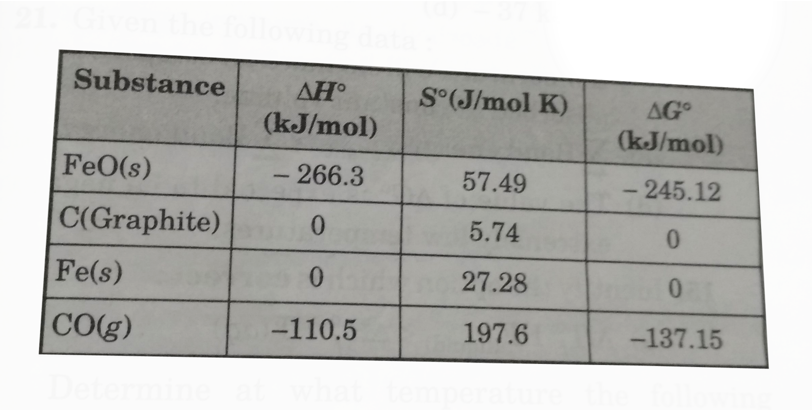
373. Given the following data :



Substance	ΔH° (kJ/mol)	S°(J/mol K)	ΔG° (kJ/mol)
FeO(s)	– 266.3	57.49	– 245.12
C(Graphite)	0	5.74	0
Fe(s)	0	27.28	0
CO(g)	–110.5	197.6	–137.15

Determine at what temperature the following reaction is spontanous?

$$FeO(s) + C_{\text{graphite}} \rightarrow Fe(s) + CO(g)$$

A. 298 K

B. 668 K

C. 964 K

D. ΔG° is $+ve$, hence the reaction will never be spontaneous

Answer: C

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374. If ΔH_f° for Ag^+ (infinately diluted), NO_3^- (infinity diluted), Cl^- (infinitely diluted) and AgCl(s) are 105.579, -207.36, -167.159 and -127.068 respectively. Calculate the enthalpy change for the reaction

$$AgNO_3(aq) + HCl(aq) \rightarrow AgCl(s) + HNO_3(aq)$$

A. 21.471 KJ/mol

B. 145.688 KJ/mol

C. 65.488 KJ/mol

D. none of these

Answer: C

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375. For the equations

$$C(\text{diamond}) + 2H_2(g) \rightarrow CH_4(g) \quad \Delta H_1,$$

$$C(g) + 4H(g) \rightarrow CH_4(g) \quad \Delta H_2$$

Predict whether

A. $C(g) + 4H(g) \rightarrow CH_4(g) \quad \Delta H_2,$

B. $\Delta H_1 > \Delta H_2$

C. $\Delta H_1 < \Delta H_2$

D. $\Delta H_1 = \Delta H_2 + \Delta_{vap}H(C) = \Delta_{diss}H\left(H_2\right)$

Answer: B

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376. IN Haber's process of manufacturing of ammonia :

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g), H^{\circ}_{25^{\circ}C} = -92.2kJ$

Molecule $N_2(g)$ $H_2(g)$ $NH_3(g)$

C_pJK^{-1} 29.1 28.8 35.1

If C_p is independent of temperature, then reaction at 100° C as compared to that of 25° C will be :

A. More endothermic

B. less endothermic

C. More exothermic

D. Less exothermic

Answer: C

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377. Which of the reaction defines molar ΔH_f° ?

A. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g), H^{\circ}_{25^{\circ}C} = -92.2kJ$

B. $\frac{1}{2}Br_2(g) = \frac{1}{2}H_2(g) \rightarrow HBr(g)$

C. $N_2(g) + 2H_2(g) + \frac{3}{2}O_2(g) \rightarrow NH_4NO_3(s)$

D. $I_2(s) = H_2(g) \rightarrow 2HI(g)$

Answer: C

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378. In the reaction,

$$CO_2(g) = H_2(g) \rightarrow CO(g) = H_2O(g), \quad \Delta H = 2.8kJ$$

ΔH represents :

A. Heat of reaction

B. Heat of combustion

C. Heat of formation

D. Heat of solution

Answer: A

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379. Given,

$$H_2(g) + Br_2(g) \rightarrow 2HBr(g), \Delta H_1^\circ$$

and standard enthalpy of condensation of bromine is ΔH_2°, standard enthalpy of formation of HBr at 25° C is :

A. $\frac{\Delta H_1^\circ}{2}$

B. $\frac{\Delta H_1^\circ}{2} + \Delta H_2^\circ$

C. $\frac{\Delta H_1^\circ}{2} - \Delta H_2^\circ$

D. $\frac{\left(\Delta H_1^\circ - \Delta H_2^\circ\right)}{2}$

Answer: D

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380. For the following reaction,

$C_{\text{diamond}} + O_2 \rightarrow CO_2(g), \Delta H = -94.3 \quad kcal$

$C_{\text{graphite}} + O_2 \rightarrow CO_2(g), \Delta H = -97.6 \quad kcal$

the heat require to change 1 g of

$C_{\text{diamond}} \rightarrow C_{\text{graphite}}$ is:

A. 1.59 kcal

B. 0.1375 kcal

C. 0.55 kcal

D. 0.275 kcal

Answer: D

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381. $C(s) + O_2(g) \rightarrow CO_2(g), \quad \Delta H = -94.3 kcal/mol$

$CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g), \quad \Delta H = -67.4 kcal/mol$

$O_2(g) \rightarrow 2O(g), \quad \Delta H = 117.4 kcal/mol$

$CO(g) \rightarrow C(g) + O(g), \quad \Delta H = 230.6 kcal/mol$

Calculate ΔH for $C(s) \rightarrow C(g)$ in $kcal/mol$

A. 171

B. 154

C. 117

D. 145

Answer: D

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382. The difference between ΔH and ΔE on a molar basis for the combustion of n-octane(l) at 25° C would be :

A. - $13.6kJ$

B. - $1.14kj$

C. - $11.15kJ$

D. $+11.15kJ$

Answer: C

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383. The standard heat of combustion of solid boron is equal to :

A. $\Delta H_f^\circ \left(B_2O_3\right)$

B. $\frac{1}{2}\Delta H_f^\circ \left(B_2O_3\right)$

C. $2\Delta H_f^\circ \left(B_2O_3\right)$

D. $\frac{1}{4}\Delta H_f^\circ \left(B_2O_3\right)$

Answer: B

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384. From the following data of ΔH, of the following reactions

$$C(s) + \frac{1}{2}O_2(g) \rightarrow CO(g) \quad \Delta H = -110kJ$$

$$C(s) + H_2O(g) \rightarrow CO(g) + H_2(g) \quad \Delta H = 132kJ$$

What is the mole composition of the mixture of steam and oxygen on passed over coke at 1273 K, to maintain constant temperature :

A. $0.5:1$

B. $0.6:1$

C. $0.8:1$

D. $1:1$

Answer: B

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385. 2 mole of zinc is dissolved in HCl at 25° C. The work done in open vessel is :

A. $-2.477kJ$

B. $-4.955kJ$

C. 0.0489 kJ

D. None of these

Answer: B

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386. If heat of dissociation of $CHCl_2COOK + H_2O$ is 0.7 kcal/mole then, ΔH for the reaction :

$CHCl_2COOH + KOH \rightarrow CHCl_2COOK + H_2O$

A. $-13kcal$

B. $+13kcal$

C. $-14.4kcal$

D. $-13.7kcal$

Answer: A

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387. A solution of $500mL$ of $2MKOH$ is added to $500mL$ of $2MHCl$ and the mixture is well shaken. The rise in temperature T_1 is noted. The experiment is then repeated using $250mL$ of each solution and rise in temperature T_2 is againg noted. Assume all heat is taken up by the solution :

A. $T_1 = T_2$

B. T_1 is 2 times as large as T_2

C. T_2 is twice of T_1

D. T_1 is 4 times as large as T_2

Answer: A

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388. One mole of anahydrous $MgCl_2$ dissolves in water and liberates 25 cal/mol. Heat of dissolution of $MgCl_2.H_2O$ is :

A. $+5 cal/mol$

B. $-5 cal/mol$

C. $55 cal/mol$

D. $-55 cal/mol$

Answer: A

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389. $C_2H_6(g) + 3.5O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g)$

$\Delta S_{\text{vap}}\left(H_2O, l\right) = x_1 \quad calK^{-1}$ (boiling point = T_1)

$\Delta H_f\left(H_2O, l\right) \quad = x_2$

$\Delta H_f\left(CO_2\right) \quad = x_3$

$\Delta H_f\left(C_2H_6\right) \quad = x_4$

Hence, ΔH for the reaction is :

A. $2x_3 + 3x_2 - x_4$

B. $2x_3 + 3x_2 - x_4 + 3x_1T_1$

C. $2x_3 + 3x_2 - x_4 - 3x_1T_1$

D. $x_1T_1 + x_2 + x_3 - x_4$

Answer: B

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390. Consider the ΔG_f° and ΔH_f° (kJ/mol) for the following oxides. Which can be most easily decomposedto form the metal and oxygen gas?

A. $ZnO \quad (\Delta G^{\circ} = -318.4, \quad \Delta H^{\circ} = -348.3)$

B. $Cu_2O \quad (\Delta G^{\circ} = -146.0, \quad \Delta H^{\circ} = -168.8)$

C. $HgO \quad (\Delta G^{\circ} = -58.5, \quad \Delta H^{\circ} = -90.8)$

D. $PbO \quad (\Delta G^{\circ} = -187.9, \quad \Delta H^{\circ} = -217.3)$

Answer: C

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391. If $\Delta G = -177 kcal$ for

$$(1) 2Fe(s) + \frac{3}{2}O_2 \rightarrow Fe_2O_3(s)$$

and $\Delta G = -19 kcal$ for

$$(2) 4FeO_3(s) + Fe(s) \rightarrow 3Fe_3O_4(s)$$

What is the Gibbs free energy of formation of Fe_3O_4?

A. $+229.6kcal/mol$

B. $-242.3kcal/mol$

C. $-727kcal/mol$

D. $-229.6kcal/mol$

Answer: B

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392. The bond dissociation energy of gaseous H_2, Cl_2 and HCl are 104,58,103 kcal mol^{-1} respectively. The enthalpy of formation for HCl gas will be :

A. $-44.0kcal$

B. $-22.0kcal$

C. 22.0 kcal

D. 44.0 kcal

Answer: B

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393. In this reaction

$CS_2(l) + 3O_2(g) \rightarrow CO_2(g) + 2SO_2(g)$

$\Delta H = - 265 kcal$

The enthalpies of formation of CO_2 and SO_4 are both negative are in the ratio $4:3$. The entalpy of formation of CS_2 is $+26$ kcal/mol. Calculate of enthalpy of formation of SO_2 :

A. $-90 kcal/mol$

B. $-52 kcal/mol$

C. $-78 kcal/mol$

D. $-71.7 kcal/mol$

Answer: D

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394. The average $O - H$ Bond energy in H_2O with the help of following data :

(P) $H_2O(l) \rightarrow H_2O(g), \quad \Delta H = +40.6 kJmol^{-1}$

(Q) $2H(g) \rightarrow H_2(g), \quad \Delta H = -435.0 kJmol^{-1}$

(R) $O_2(g) \rightarrow 2O(g), \quad \Delta H = +489.6 kJmol^{-1}$

(S) $2H_2(g) + O_2(g) \rightarrow 2H_2O(l), \quad \Delta H = -571.6 kJmol^{-1}$

A. $584.9 kJ\text{mole}^{-1}$

B. $279.8 kJ\text{mole}^{-1}$

C. $462.5 kJ\text{mole}^{-1}$

D. $925 kJ\text{mole}^{-1}$

Answer: C

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395. Heat of hydronization of ethene is x_1 and that of benzene is x_2. Hence, resonance energy is :

A. $x_1 - x_2$

B. $x_1 + x_2$

C. $3x_1 - x_2$

D. $x_1 - 3x_2$

Answer: C

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396. From the following data , the enthalpy change for the sublimation of of ice at 223 K will be [mean heat capacity of ice $= 2JK^{-1}g^{-1}$, mean heat capacity of $H_2O(l) = 4.2JK^{-1}g^{-1}$, mean heat capacity of $H_2O(v) = 1.85JK^{-1}g^{-1}$, entalpy of fusion of ice at $0^\circ C = 334Jg^{-1}$.enthalpy of evaporation of water at $100^\circ C = 2255Jg^{-1}$]

A. $3000 J g^{-1}$

B. $3109 J g^{-1}$

C. $3827 J g^{-1}$

D. $4000 J g^{-1}$

Answer: B

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397. If $S + O_2 \rightarrow SO_2, \Delta H = -298.2 \text{ kJ mole}^{-1}$

$SO_2 + \frac{1}{2}O_2 \rightarrow SO_3 \Delta H = -98.7 \text{ kJ mole}^{-1}$

$SO_3 + H_2O \rightarrow H_2SO_4, \Delta H = -130.2 \text{ kJ mole}^{-1}$

$H_2 + \frac{1}{2}O_2 \rightarrow H_2SO_4, \Delta H = -287.3 \text{ kJ mole}^{-1}$

the enthlapy of formation of H_2SO_4 at 298 K will be

A. $-814.4 kJ \text{ mole}^{-1}$

B. $+814.4 kJ \text{ mole}^{-1}$

C. $-650.3 kJ \text{ mole}^{-1}$

D. $-433.7kJ\ \text{mole}^{-1}$

Answer: A

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398. The standerd enthalpy of formation of FeO and Fe_2O_3 is -65 kcal mole^{-1} and $-197\ \text{kcal mole}^{-1}$ respectively . A mixture of two oxides containes FeO and Fe_2O_3 in the mole ratio $2:1$. If by oxidation, it is changed into a $1:2$ mole ratio mixture , How much of thermal energy will released per mole of the internal mixture ?

A. 13.4 kcal/mole

B. 14.6 kcal/mole

C. 15.7 kcal/mole

D. 16.8 kcal/ mole

Answer: A

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399. An athelete is given 100 g of glucose $\left(C_6H_{12}O_6\right)$ of energy equivalent to 1560 kJ. He utilizes $50\ \%$ of this gained energy in the event. In order to avoid storage of energy in body , the weight of water he would need to perspire is : (The enthalpy of evaporation of water is 44 kJ/ mole)

A. 319 g

B. 422 g

C. 293 g

D. 378 g

Answer: A

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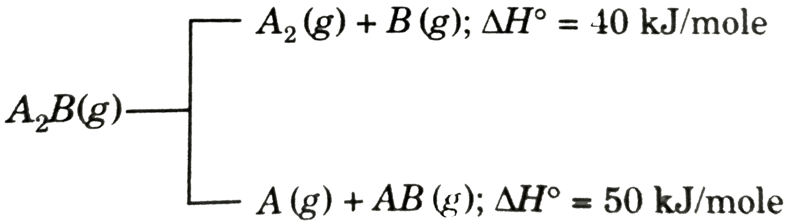
400. Substance $A_2B(g)$ can undergo decomposition to form of set of products :



$A_2B(g) \rightarrow A_2(g) + B(g)$; $\Delta H^\circ = 40$ kJ/mole

$A_2B(g) \rightarrow A(g) + AB(g)$; $\Delta H^\circ = 50$ kJ/mole

if the molar ratio of $A_2(g)$ to A(g) is $5:3$ in a set of product gases, then energy involved in the decomposition of 1 mole of A_2B is :

A. 43.75 kJ/mol

B. 18.73 kJ/mol

C. 46.25 kJ/mol

D. None of these

Answer: A

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401. The heat of formation of $C_2H_5OH(l)$ is -66 kcal/mole. The heat of combustion of $CH_3OCH_3(g)$ is -348 kcal/mole, ΔH_f for $H_2O(l)$ and $CO_2(g)$ are $-68kcal$/mole and $-94kcal$/mole respectively,. Then the ΔH for the isomerisation reaction,

$C_2H_5OH(l) \rightarrow CH_3OCH(g)$, and ΔE for the same are : (Take: $T_{\text{surr}} = 298K$)

A. $\Delta H = 18kcal/\text{mole}, \Delta E = 17.301kcal/\text{mole}$

B. $\Delta H = 22kcal/\text{mole}, \Delta E = 21.404kcal/\text{mole}$

C. $\Delta H = 26kcal/\text{mole}, \Delta E = 25.709kcal/\text{mole}$

D. $\Delta H = 30kcal/\text{mole}, \Delta E = 28.522kcal/\text{mole}$

Answer: B

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402. In the reaction $AB_2(l) + 3X_2(g) \Leftrightarrow AX_2(g) + 2BX_2(g)\Delta H =$ - 2700 kcal per mole. Of $AB_2(l)$. The entalpies of formation of $AX_2(g)$ and $BX_2(g)$ are in the ratio of $4:3$ and have opposite sign. The value of $\Delta H_f^\circ\left(AB_2(l)\right) = 30kcal/mol$. Then :

A. $\Delta H_f^\circ\left(AX_2\right) =$ - $96kcal/mol$

B. $\Delta H_f^\circ\left(BX_2\right) = +480kcal/mol$

C. $K_p = K_c$ and $\Delta H_f^\circ \left(AX_2\right) = +480 kcal/mol$

D. $K_p = K_c$ RT and $\Delta H_f^\circ \left(AX_2\right) + \Delta H_f^\circ \left(BX_2 = -240 kcal/mol\right.$

Answer: C

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403. AB,A_2 and B_2 are diatomic molecules. If the bond enthlpies of A_2, AB and B_2 are in the ratio $1:1:0.5$ and enthalopy of formation of AB from A_2 to B_2 is $-100 kJ/mol^{-1}$. What is the bound enthalpy of A_2?

A. 400 kJ/mol

B. 200kJ/mol

C. 100 kJ/mol

D. 300 kJ/mol

Answer: A

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404. When a certain amount of ethylene was combusted, 6226 kJ heat was evolved. If heat of combustion of ethylene is 1411 kJ, the volume of O_2 (at STP) that entered into the reaction is :

A. 296.5 litres

B. 300.3 litres

C. 6226×22.7 litres

D. 22.7 litres

Answer: B

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405. Given the following reaction :

$P: N_2(g) + 2O_2(g) \rightarrow 2NO_2(g), \Delta H_p = 16.18 kcal$

$Q: N_2(g) + 2O_2(g) \rightarrow N_2O_4(g), \Delta H_Q = 2.31 kcal$

Based on the above facts :

A. NO_2 is more stable than N_2O_4 at low temperature

B. N_2O_4 is more stable than than NO_2 at low temperature

C. both are equally stable at low temperature

D. none of these

Answer: B

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406. Enthalpy of polymerisation of ethylene, as represented by the reaction ,

$Q: N_2(g) + 2O_2(g) \rightarrow N_2O_4(g), \Delta H_Q = 2.31 kcal$ is -100 kJ per mole of ethylene. Given bond enthalpy of $C = C$ bond is 600 kJ mol^{-1}, enthalpy of $C - C$ bond (in kJ mol) will be :

A. 116.7

B. 350

C. 700

D. intermediate

Answer: B

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407. The heat of formation of HCl at 348 K from the following data will be :

$0.5H_2(g) + 0.5Cl_2(g) \rightarrow HCl \quad \Delta H^{\circ}_{298} = -22060$ cal. The mean heat capacities over this temperature range are,

$H_2(g), \quad C_p = 6.82 \text{ cal mol}^{-1}K^{-1}$

$Cl_2(g), \quad C_p = 7.71 \text{ cal mol}^{-1}K^{-1}$

$HCl(g), \quad C_p = 6.81 \text{ cal mol}^{-1}K^{-1}$

A. $-20095 cal$

B. -32758 cal

C. -37725 cal

D. -22083 cal

Answer: D

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408. The average $Xe - F$ bond energy is $34 Kcal / mol$, first $I.E.$ Of Xe is $279 Kcal / mol$, electron affinity of F is $85 Kcal / mol$. Then, the enthalpy change for the reaction

$XeF_4 \rightarrow Xe^+ + F^- + F_2 + F$ will be

A. 367 kcal / mole

B. 425 kcal / mole

C. 292 kcal / mole

D. 392 kcal / mole

Answer: C

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409. Reactions involving gold have been of particular intrests to alchemists. Consider the following reactions ,

$Au(OH)_3 + 4HCl \rightarrow HAuCl_4 + 3H_2O,$

$\Delta H = -28kcal$

$Au(OH)_3 + 4HBr \rightarrow HAuBr_4 + 3H_2O$

$\Delta H = -36.8kcal$

In an experiment there was an absorption of 0.44 kcal when one mole of $HAuBr_4$ was mixed with 4 moles of HCl. Then the fraction $HAuBr_4$ converted into $HAuCl_4$: (percentage conversion)

A. 5 %

B. 6 %

C. 7 %

D. 8 %

Answer: A

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410. Enthalpy of neutralization of $H_3PO_3$with $NaOH$ is - $106.68\text{kJ}/\text{mol}$. If enthalpy of neutralization of HCL with NaOH is -$55.84\text{kJ}/\text{mole}$, then calculate enthalpy of ionization of H_3PO_3 in to its ions in kJ.

A. 50.84 kJ/mol

B. 5 kJ/mol

C. 2.5 kJ/mol

D. None of these

Answer: B

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411. The enthalpy of neutralisation of a weak acid in 1 M solution with a strong base is -56.1 kJ mol^{-1}/ If the enthalpy of ionization of the acid is 1.5 kJ mol^{-1} and enthalpy of neutralization of the strong acid with a strong base is -57.3 kJ equiv^{-1}, what is the % ionization of the weak acid in molar solution (assume the acid to be monobasic)?

A. 10

B. 15

C. 20

D. 25

Answer: C

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412. Combustion of sucrose is used by aerobic organisms for providing energy for the life sustaining process. If all the capturing of energy from the reaction is done through electrical process (non P-V work), then calculate, maximum available energy which can be captured by combustion of 34.2 g of sucrose :

(Given : $\Delta H_{\text{combustion}}(\text{sucrose}) = -6000 kJmol^{-1}$

$\Delta S_{\text{combustion}} = 180j/K - mol$ and bodyntemperature is 300 K)

A. 600 kJ

B. 594.6 kJ

C. 5.4 kJ

D. 605.4 kJ

Answer: D

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413. The ΔH_f° for $CO_2(g)$, CO(g) and $H_2O(g)$ are -395.5, -110.5 and $-241.8 \text{ kJ}mol^{-1}$ respectively. The standard enthalpy change in (in kJ) for the reaction

$CO_2(g) + H_2(g) \rightarrow CO(g) + H_2O(g)$ is

A. 524.1

B. 41.2

C. -262.5

D. -41.2

Answer: B

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414. Diborane is a potential rocket fuel which undergoes combustion according to the reaction,

$B_2H_6(g) + 3O_2(g) \rightarrow B_2O_3(s) + 3H_2O(g)$

from the following data, the enthalpy change for the combustion of diborane will be :

$2B(s) + \frac{3}{2}O_2(g) \rightarrow B_2O_3(s), \quad \Delta H = -1273 \text{ kJ}$

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l), \quad \Delta H = -286 \text{ kJ}$

$H_2O(l) \rightarrow H_2O(g), \quad \Delta H = 44 \text{ kJ}$

$2B(s) + 3H_2(g) \rightarrow B_2H_6(g), \quad \Delta H = 46 \text{ kJ}$

A. $-2079 \text{ kJ mol}^{-1}$

B. $-1091 \text{ kJ mol}^{-1}$

C. $-2045 \text{ kJ mol}^{-1}$

D. -762 kJ mol^{-1}

Answer: C

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415. Which of the following equation gives the values of heat of formation $\left(\Delta H_f^{\circ}\right)$?

A. $C(\text{diamond}) + O_2(g) \rightarrow CO_2(g)$

B. $\frac{1}{2}H_2(g) + \frac{1}{2}F_2(g) \rightarrow HF(g)$

C. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

D. $H_2(g) + F_2(g) \rightarrow 2HF(g)$

Answer: B

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416. The enthalpies of combustion of carbon and carbon monoxide are -393.5 and -283 kJ mol^{-1} respectively. The enthaly of formation of carbon monoxide per mole is :

A. 110.5 kJ

B. 676.5 kJ

C. $-676.5kJ$

D. $-110.5kj$

Answer: B

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417. Calculate standard molar entropy $O_2(g)$ from the following thermodynamics data at 300 K :

$4Cr(s) + 3O_2(g) \rightarrow 2Cr_2O_3(s), \Delta G^\circ = -2093.4 \text{ kJ}/mol$

$\Delta H_f^\circ Cr_2O_3(s) = -1129.05 \text{ kJ/mole}$

$S_m^\circ Cr(s) = 24 \text{ J}/K \text{ mole}$

$S_m^\circ Cr_2O_3(s) = 81 \text{ J}/K \text{ mole}$

A. 0

B. 205 J/K mole

C. 100 J/K mole

D. 410 J/K mole

Answer: B

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418. The enthalpy changes for the following process are listed below :

$Cl_2(g) = 2Cl(g), \quad 242.3 \text{ kJ}mol^{-1}$

$I_2(g) = 2I(g), \quad 151.0 \text{ kJ}mol^{-1}$

$ICl(g) = 2I(g) + Cl(g), \quad 211.3 \text{ kJ}mol^{-1}$

$I_2(s) = I_2(g), \quad 62.76 \text{ kJ}mol^{-1}$

Given that standard states for iodine and chlorine are $I_2(s)$ and $Cl_2(g)$, the standerd enthalpy of formation for ICl(g) is :

A. $-16.8 \text{ kJ mol}^{-1}$

B. $+16.8 \text{ kJ mol}^{-1}$

C. $+244.8 \text{ kJ mol}^{-1}$

D. $-14.6 \text{ kJ mol}^{-1}$

Answer: B

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419. The standard enthalpy of formation $\left(\Delta_f H^\circ\right)$ at $298K$ for methane $\left(CH_{4(g)}\right)$ is $-74.8kJmol^{-1}$. The additional information required to determine the average energy for $C-H$ bond formation would be :

A. the dissociation energy of H_2 and enthelpy of sublimation of carbon.

B. latent heat of vaporisation of methane.

C. the first four ionization energies of carbon and electron gain enthlpy of hydrogen.

D. the dissociation energy of hydrogen molecule, H_2

Answer: A

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420. Standard entropy of X_2 , Y_2 and XY_3 are $60, 40$ and $50JK^{-1}mol^{-1}$, respectively. For the reaction, $\frac{1}{2}X_2 + \frac{3}{2}Y_2 \rightarrow XY_3, \Delta H = -30KJ$, to be at equilibrium, the temperature will be:

A. 500 K

B. 750 K

C. 1000 K

D. 1250 K

Answer: B

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421. On the basis of the following thermochemical data :

$$\left(\Delta_f G^\circ H^+_{(aq.)} = 0\right)$$

$$H_2O_{(l)} \rightarrow H^+_{(aq.)} + OH^-_{(aq.)}, \Delta H = 57.32 kJ$$

$$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)}, \Delta H = -286.20 kJ$$

The value of enthalpy of formation of OH^- ion at $25^\circ C$ is :

A. -228.88 kJ

B. 228.88 kJ

C. -343.52 kJ

D. -22.88 kJ

Answer: A

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422. In a fuel cell methanol is used as fuel and oxygen gas is used as an oxidizer. The reaction is :

$$CH_3OH_{(l)} + \frac{3}{2}O_{2(g)} \rightarrow CO_2((g)) + 2H_2O_{(l)}$$

At $298K$ standard Gibb's energies of formation for $CH_3OH(l), H_2O(l)$ and $CO_2(g)$ are -166.2, -237.2 and $-394.4 kJmol^{-1}$ respectively. If standard enthalpy of combustion of methanol is $-726 kJmol^{-1}$, efficiency of the fuel cell will be :

A. $87\ \%$

B. $90\ \%$

C. $97\ \%$

D. $80\ \%$

Answer: C

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423. Given the following equations and ΔH° values, determine the enthalpy of reaction at 298 K for the reaction :

$$C_2H_4(g) + 6F_2(g) \rightarrow 2HF_4(g) + 4HF(g)$$

$$H_2(g) + F_2(g) \rightarrow 2HF(g) + 2HF(g), \quad \Delta H_1^\circ = -537 \text{ kJ}$$

$C(s) + 2F_2(g) \rightarrow CF_4(g), \quad \Delta H_2^\circ = -680 \text{ kJ}$

$2C(s) + 2H_2(g) \rightarrow C_2H_4(g), \quad \Delta H_3^\circ = 52 \text{ kJ}$

A. -1165

B. -2382

C. $+1165$

D. $+2382$

Answer: B

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424. Consider the following reactions:

$C(s) + O_2(g) \rightarrow CO_2(g) + x \text{ kJ}$

$CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g) + y \text{ kJ}$

The heat formation of CO(g) is :

A. $-(x+y) \text{ kJ}/mol$

B. (x-y) kJ/mol

C. (y-x) kJ/ mol

D. None of these

Answer: C

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425. If $\Delta_f H^\circ\left(C_2H_4\right)$ and $\Delta_f H^\circ\left(C_2H_6\right)$ are x_1 and x_2 kcal mol^{-1}, then heat of hydrogenation of C_2H_4 is :

A. $x_1 + x_2$

B. $x_1 - x_2$

C. $x_2 - x_1$

D. $x_1 + 2x_2$

Answer: C

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426. Determine enthalpy of formation for $H_2O_2(l)$, using the listed enthalpies of reaction :

$N_2H_4(l) + 2H_2O_2(l) \rightarrow N_2(g) + 4H_2O(l),$

$\Delta_r H_1^{\circ} = -818 kJ/mol$

$N_2H_4(l) + O_2(g) \rightarrow N_2(g) + 2H_2O(l)$

$\Delta_r H_2^{\circ} = -622 kJ/mol$

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l) \quad \Delta_r H_3^{\circ} = -285 kJ/mol$

A. $-383 \text{ kJ}/mol$

B. $-187 \text{ kJ}/mol$

C. $-498 \text{ kJ}/mol$

D. None of these

Answer: B

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427. Heat of combustion of ethanol at constant pressure and at temperature TK is found to be $-qJ\ \mathrm{mol}^{-1}$. Hence, heat of combustion (in J mol^{-1}) of ethanol at the same temperature and at constant volume will be :

A. $RT - q$

B. $-(q + RT)$

C. $q - RT$

D. $q + RT$

Answer: A

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428. Stearic acid $\left[CH_3\left(CH_2\right)_{16}CO_2H\right]$ is a fatty acid the part of fat that stores most of the energy .1.0 g of Stearic acid was burnt in a bomb calorimeter . The bomb had capacity of 652 $J/{}^\circ C$. If the temperature of 500 g water rose from 25.0 to $39.3\ {}^\circ C$ how much heat is released when the stearic acid was burned?

$\left[\text{Given } C_p\left(H_2O\right) = 4.18J/g^\circ c\right]$

A. 39.21kj

B. 29.91Kj

C. 108Kj

D. 9.32Kj

Answer: a

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429. a Coffee cup calorimeter initially contains 125 g of water , at a temperature of 24.2°C ,8 of ammonium nitrate $\left(NH_4NO_3\right)$ also at $24.2^\circ C$is added to the Water and the final temperature is $18.2^\circ c$ What is the heat of solution of ammonium nitrate in KJ /mol? (The specific heat capacity of the solution is $4.2J/^\circ c$.)

A. 33.51kJ /mol

B. 39.5kJ/mol

C. 32.2kJ/mol

D. 37.3kJ/mol

Answer: a

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430. From the following data at$25^\circ C$

$Reaction$	$\Delta_r H^o kJ/mol$
$\frac{1}{2}H_2(g) + \frac{1}{2}O_2(g) \rightarrow OH(g)$	42
$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g)$	-242
$H_2(g) \rightarrow 2H(g)$	436
$O_2(g) \rightarrow 2O(g)$	495

Which of the following Statement (s) is /are Correct:

StatementA:$\Delta_r H^\circ$ for the reaction

$H_2O(g) \rightarrow 2H(g) + O(g)$is 925.5kJ/mol

Statement B:$\Delta_r H^\circ$ for the reaction

$H_2O(g) \rightarrow H(g) + O(g)$is 423.5kJ/mol

Statement C:Enthalpy of formation of H(g) is-218 kJ/mol

Statement D: Enthalpy of formation of OH(g) is 42 kJ/mol

A. Statement C

B. Statement A,B,D

C. Statement B,C

D. Statement A,B only

Answer: b

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431. Ethyl chloride $\left(C_2H_5Cl\right)$, is prepared by reaction of ethylene with hydrogen chloride:

$C_2H_4(g) + HCl(g) \rightarrow C_2H_5Cl(g)$

$\Delta H = -72.3kJ/mol$

What is the value of $\Delta E($ in $kJ)$, if $98g$ of ethylene and $109.5g$ of HCl are allowed to react at $300K$

A. -64.81

B. -190.71

C. -208.41

D. -224.38

Answer: c

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432. If the enthalpy of formation and enthalpy of solution of HCl (g) are-92.3kj /mol and -75.14kJ/mol respectively then find the enthalpy of Cl^{-}(aq):

A. $-17.16kJ/mol$

B. $-167.44kJ/mol$

C. 17.16kj/mol

D. none of these

Answer: b

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433. The enthalpy of neutraliztion of weak base A OH and a strong base BOH by HCl are -12250 cal/mol and -13000 cal/mol respectively . When one mole of HCl is added to a solution containting 1 mole of A OH and 1 mole of BOH , the enthalpy change was -12500 cal/mol . In what ratio is the acid distribution between A OH and BOH?

A. $2:1$

B. $2:3$

C. $1:2$

D. none of these

Answer: a

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434. Calculate $\Delta_r G^\circ$ for $\left(NH_4Cl, s\right)$ at 310K.

Given :$\Delta_r H^\circ \left(NH_4Cl, s\right)$ =-314 kj/mol,$\Delta_r C_p = 0$

$S^\circ_{N_2(g)} = 192 JK^{-1 mol^{-1}}, S^\circ_{H_2(g)} = 130.5 JK^{-1} mol^{-1},$

$S^\circ_{Cl_2(g)} = 233 JKmol^{-1}, S^\circ_{NH_4Cl(s)} = 99.5 JK^{-1} mol^{-1}$

All given data at 300K

A. $-198.56 kJ/mol$

B. $-426.7 KJ/mol$

C. $-202.3 KJ/mol$

D. none of these

Answer: a

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435. The molar heat capacities at constant pressure (assumed constant with respect to temperature) of A,B and C are in ratio 3:1.5:2.0. the enthyalpy change for the exothermic reaction $A + 2B \rightarrow 3c$ at 300k and 310 K is ΔH_{300} and ΔH_{310} respectively then:

A. $\Delta H_{300} > \Delta H_{310}$

B. $\Delta H_{300} < \Delta H_{310}$

C. $\Delta H_{300} = \Delta H_{310}$

D. $IfT_2 > T_1 then\Delta H_{310} > \Delta H_{300}$ and if $T_2 < T_1$ then$\Delta H_{300} < \Delta H_{300}$

Answer: c

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436. Determine ΔU° at 300K for the following reaction using the listed enthalpies of reaction :

$4CO(g) + 8H_2(g) \rightarrow 3CH_4(g) + CO_2(g) + 2H_2O(l)$

$C(\text{graphite}) + \frac{1}{2}O_2(g) \rightarrow CO(g), \Delta H_1^\circ = -110.5KJ$

$CO(g)\frac{1}{2}O_2(g) \rightarrow CO_2(g), \Delta H_2^\circ = -282.9KJ$

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l), \Delta H_3^\circ = -285.8KJ$

$C(\text{graphite}) + 2H_2(g) \rightarrow CH_4(g), \Delta H_4^\circ = -74.8KJ$

A. $-653.5KJ$

B. $-686.2KJ$

C. $-747.4KJ$

D. none of these

Answer: d

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437. When 1.0 g of oxalic acid $\left(H_2C_2O_4\right)$ is burnt in a bomb calorimeter whose capacity is 8.75 KJ/K, the enthalpy of combustion of oxalic acid at $27^\circ C$ is :

A. $-245.7KJ/mol$

B. $-244.452KJ/mol$

C. $-246.947 KJ/mol$

D. none of these

Answer: d

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438. The enthalpy of neutralization of a Weak monoprotic acid (HA) in 1 M solution with a strong base is -55.95 KJ/mol . If the unionized acid required 1.4 KJ/mol heat for it's comptate ionzatation and enthalpy of netralization of the strong monobasic acid with a strong monoacidic base is -57.3 KJ/mol . What is the % ionzation of the weak acid in molar solution ?

A. 1%

B. 3.57

C. 35.7%

D. 10%

Answer: b

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439. The enthalpy of combustion of propance $\left(C_3H_8\right)$ gas in temes of given of geven data is , Bond energy (kJ/mol)

$.^{\varepsilon}C-H+x_1.^{\varepsilon}O-O+x_2.^{\varepsilon}C-O+x_3.^{\varepsilon}O-H+x_4.^{\varepsilon}C-C+x_5$

[Resonance energy of CO_2 is -z KJ/mol and $\Delta H_{\text{vaporization}}\left[H_2O(l)\ \text{is y}\ KJ/mol\right]$

A. $8x_1+2x_5+5x_2-6x_3-8x_4-4y-3z$

B. $6x_1+x_5+5x_2-3x_3-4x_4-4y-3z$

C. $8x_1+2x_5+6x_2-8x_3-4x_4-y-z$

D. $8x_1+x_5+5x_2-6x_3-8x_4-4y-3z$

Answer: a

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440. Benzene burns according to the following equation:

$2C_6H_6(l) + 15O_2(g) \rightarrow 12CO_2(g) + 6H_2O(l)$

$\Delta H^\circ = -6542 KJ/mol$

what is the ΔE° for the combustion of 1.5 mol of benzene?

A. $-3271 KJ$

B. $-9813 KJ$

C. $-4906 KJ$

D. none of these

Answer: d

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441. ΔH_f° of water is $-285.5 KJmol^{-1}$. If enthalpy of neutraliztion of monoacidic strong base is $-57.3 KJmol^{-1}$ then ΔH_f° of OH^- ion will be :

A. $-285.5 KJmol^{-1}$

B. $285.5KJmol^{-1}$

C. $114.5KJmol^{-1}$

D. $-114.5KJmol^{-1}$

Answer: a

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442. For the following reaction,

$C(\text{diamond}) + O_2 \rightarrow CO_2(g) \qquad \Delta H = -97.6kcal$

$C(\text{graphite}) + O_2 \rightarrow CO_2(g) \qquad \Delta H = -94.3kcal$

The heat change for the conversion of 1 g of C (diamond) to C(graphite) is:

A. 1.59kcal

B. 0.1375 kcal

C. 0.55kcal

D. 0.275kcal

Answer: d

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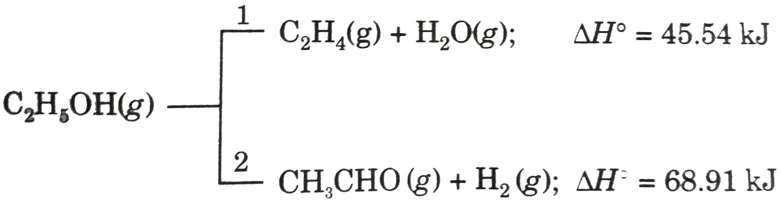
443. Ethanol can undergo decompostion to form two sets of products. If the molar ratio of $C_4H_4 \text{to} CH_3CHO$ is 8:1 in a set of product gases, then the energy involved in the decomposition of 1 mole of ethanol is:



A. 65.98KJ

B. 48.137 KJ

C. 48.46 KJ

D. 57.22 KJ

Answer: b

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444. (p) Cis-2- butene $\rightarrow$ trans -2-butene,ΔH_1

(Q)Cis-2-butene $\rightarrow$ 1-buture, ΔH_2

(R) Trans -2-buture is more stable than cis-2-buture

(S) Enthalpy of combustion of 1-buture,

$\Delta H = -649.8 kcal/mol$

(T)$9\Delta H_1 + 5\Delta H_2 = 0$

(U) Enthalpy of combustion of trans -2- buture,

$\Delta H = -647.0 kcal/mol$

The value of ΔH_1 and ΔH_2 in kcal/mole are:

A. $-1.0, 1.8$

B. $1.8, -1.0$

C. $-5, 9$

D. $-2, 3.6$

Answer: a

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445. Calculate the amount of heat released at constant pressure when 10 moles of carbon react with 6 moles of O_2 leaving none of the reactants.

$\Delta H_{\text{combustion}} C_{(\text{graphite})} = -390 KJ/\text{mole},$

$\Delta H_{\text{combustion}} CO(g) = -250 KJ/\text{mole}$

A. 1900KJ

B. 750KJ

C. 3900KJ

D. 2450KJ

Answer: a

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446. The reaction $CH_4(g) + Cl_2(g) \rightarrow CH_3Cl(g) + HCl(g) has \Delta H = -25 kcal$

$Bond$	Bond Energy ,kcal
ε_{C-Cl}	84
ε_{H-Cl}	103
ε_{C-H}	x
ε_{Cl-Cl}	y

x:y=9.5

From the given data , what is the bond energy of $Cl - Cl$ bond?

A. 70kcal

B. 80kcal

C. 67.85 kcal

D. 57.85 kcal

Answer: d

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447. Calculate the ethanly change for the given reaction from data provided (KJ/mole)

$HA(g)$	$+$	$B(g)$	$\rightarrow$	$AHB(s)$
(weak acid)		(Weak base)		(Salt)

$\Delta H_{\text{neutralization}}$ $\{HA(aq)[\text{at infinte dilution }]/B(aq)$

$[\text{at infinite dilution }] = -40kJ/\text{mole}$

$\Delta H_{\text{solution}}$ $[HA(aq)] = -10kJ/\text{mole}\{\text{at infinite dilution }\}$

$\Delta H_{\text{soltuion}}[B(g) = -5KJ/\text{mole}\{\text{at infinite dilution}\}$

$\Delta H_{\text{solution}}$ $[HAB(s)] = +8KJ/\text{mole}$

$\{\text{at infinite dilution}\}$

A. -36

B. -63

C. -45

D. -37

Answer: b

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448. Lattice energy of Na_2CO_3 is -205 KJ/mole and hydrogen energy of $Na^+ ion$ and CO_3^{2-} ion are -80 KJ/mole and -40KJ/mole respectively . What can be predicted abount solubility of Na_2CO_3 in water from the above data ?

A. The solubility of Na_2CO_3 will increase with increase in temperature.

B. The solubility ofNa_2CO_3 will decrease with increase in temperature.

C. The solubility of NA_2CO_3 will remain constant.

D. The solubility of Na_3CO_3 will first decrease and then increase.

Answer: a

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449. If x_1 , x_2 and x_3 are enthalpies of $H-H$, $O=O$ and $O-H$ bonds respective, and x_4 is the enthaply of vaporisation of water, estimate the standard enthalpy opf combustion of hydrogen.

A. $x_1 + \frac{x_2}{2} - 2x_3 + x_4$

B. $x_1 + \frac{x_2}{2} - 2x_3 - x_4$

C. $x_1 + \frac{x_2}{2} - x_3 + x_4$

D. $2x_3 - x_1 - \frac{x_2}{2} - x_4$

Answer: b

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450. $NH_3(g) + 3Cl_2 \rightarrow NCl_3(g) + 3HCl(g), \Delta H_1$

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g), \Delta H_2$

$H_2(g) + Cl_2(g) \rightarrow 2HCl(g), \Delta H_3$

The heat of formation of NCl_3(g) in the terms of

$\Delta H_1, \Delta H_2, \Delta H_3$ is :

A. $\Delta H_f = -\Delta H_1 + \frac{\Delta H_2}{2} - \frac{3}{2}\Delta H_3$

B. $\Delta H_f = \Delta H_1 + \frac{\Delta H_2}{2} - \frac{3}{2}\Delta H_3$

C. $\Delta H_f = \Delta H_1 - \frac{\Delta H_2}{2} - \frac{3}{2}\Delta H_3$

D. none of these

Answer: b

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451. For the combustion of 1 mole of liquid benzene at $27^\circ C$ the heat of reaction at constant pressure is given by:

$$C_6H_6(l) + \frac{15}{2}O_2(g) \rightarrow 6CO_2(g) + 3H_2O(l),$$

$\Delta H = -78kcal$

What would the be heat of reaction at constant volume?

A. $-78.0kcal$

B. $-78.9kcal$

C. $-77.1kcal$

D. $816.1Kcal$

Answer: c

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452. Consider the equation:

$4PH_3(g) + 80_2(g) \rightarrow P_4O_{10}(s) + 6H_2O(g),$

$\Delta H^\circ = -4500KJ$

Calculate $\Delta H_f^\circ\ of P_4O_{10}(s)$in KJmol^{-1}.

Substance	$\Delta H_f^\circ . KJmol^{-1}$
$PH_3(g)$	$+9.2$
$H_2O(g)$	-241.8

A. $-5914KJ$

B. $-4751KJ$

C. $-4249KJ$

D. $-3012KJ$

Answer: d

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453. Molar enthalpy of combustion of $C_2H_2(g), C_{\text{graphite}}$ and $H_2(g)$ are -1300,-394, and -286 KJ/mole respectively , then , Calculate Bond enthalpy of $C \equiv C$ bond inKJ /mole:

$$\text{Given}: \Delta H_{\text{sub}}\left(C_{\text{graphite}}\right) = 715KJ/\text{mole}$$

$$\Delta H_{BE}(H - H) = 436KJ/\text{mole}$$

$$\Delta H_{BE}(C - H) = 413KJ/\text{mole}$$

A. 415

B. 610

C. 1215

D. 814

Answer: d

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454. If $CH_3COOH + OH^- \rightarrow CH_3COO^- + H_2O + q_1$ and $H^+ + OH^- \rightarrow H_2O + q_2$, then the enthalpy change for the reaction $CH_3COOH \rightarrow CH_3COO^- + H^+$ is "equal to :

A. $q_1 + q_2$

B. $q_1 - q_2$

C. $q_2 - q_1$

D. $-q_1 - q_2$

Answer: c

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455. The enthalpy of solution , sodium and sodium oxide in large volume of water , are -18KJ/mole and -238KJ/mol, respectively . If the enthalpy of formation of water is -286 KJ/mol, then what is the enthalpy of formation of sodium oxide ? All the enthalpies are at 298K and 1 bar pressure.

[Given : reaction involved are

$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$

$Na_2O(s) + H_2O(l) \rightarrow 2NaOH(aq)$

A. $+54KJ/mol$

B. $-130KJ/mol$

C. $-416KJ/mol$

D. $+156KJ/Mol$

Answer: c

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456. Which of the following Statement are Correct ?

(1) $\Delta H = \Delta U + \Delta n_g RT$ for chemical and phase change

(2) $\Delta H = \Delta U$for the reation

(3) $C(s) + O_2(g) \rightarrow CO_2(g)$

(4) Heat of formation for C_6H_6can be calculated by bond enthalpies only

A. 2,3

B. 1,4

C. 1,2,3

D. 1,3

Answer: c

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457. Enthalpy of atomiation of $C_2H_6(g)$ and $C_3h_8(g)$ are 620 and $880KJmol^{-1}$ respectivelty. The C-C and C-H bond energies are respectively:

A. $80 \text{ and } 60KJMol^{-1}$

B. $80 \text{ and } 90KJmol^{-1}$

C. 70and 90KJ mol^{-1}

D. $100 \text{ and } 80Kjmol^{-1}$

Answer: b

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458. A 500 gm sample of water is reacted with an equimoplar amount of CaO (both at an initial temperature of $25^\circ C$) . What I sthe final emperature of the product ? [Assume that the poduct absorbs all of the heat released in the reaction heat product per mol of $Ca(OH)_2$ is 65.2 KJ and specific heat $Ca(OH)_2$is $1.2 J/g^\circ C$

A. $\approx 735^\circ C$

B. $\approx 760^\circ C$

C. $\approx 746^\circ C$

D. $\approx 789^\circ C$

Answer: b

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459. Use the bond energies in the table to estimate $\Delta H$for this reaction .

$H_2C = CH_2 + Cl_2 \rightarrow ClH_2C - CH_2Cl$

Bond energies	
$C - C$	$347 KJmol^{-1}$
$C = C$	$612 KJmol^{-1}$
$c - Cl$	$331 KJmol^{-1}$
$C - H$	$414 KJmol^{-1}$
$Cl - Cl$	$243 KJmol^{-1}$

A. $\Delta H = - 684 KJ$

B. $\Delta H = - 154 KJ$

C. $\Delta H = + 89 KJ$

D. $\Delta H = + 177 KJ$

Answer: b

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460. 0.2 M, 100ml NaOH is mixed wih 0.4 M, 100mL HCl solution .

Determine energy released during the reaction :

Given $H^+(aq)_O H^-(aq) \rightarrow H_2o(l)$,

$\Delta H = -57.5 KJmol^{-1}$

A. 1150J

B. 1150KJ

C. 2300J

D. 2300KJ

Answer: a

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461. The ΔH° for the mutarotation of glucose in aqueous solution ,

α-D- glucose (aq) $\rightarrow$ β-D-glucose (aq)

has been measured in a microcalorimeter and found to be -1.16 kj $.mol^{-1}$.

The enthalpies of solution of the two forms of glucose have been determined to be

α-D- glucose (aq) $\rightarrow$ α-D-glucose (aq)

$\Delta H^{\circ} = 10.72 KJmol^{-1}$

β-D- glucose (aq) $\rightarrow$ β - D-glucose (aq)

$\Delta H^\circ = 4.68 KJmol^{-1}$

Calculate ΔH° (in KJ/mol) for the mutarotation of soild α-D-glucose $\rightarrow$ $soild$ beta - D - $glucose$:

A. $+4.88 KJ/mol$

B. $-4.88 KJ/mol$

C. $-2.44 KJ/mol$

D. $+2.44 KJ/mol$

Answer: a

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462. In a constant pressure calorimeter, 224 mL of 0.1 M KOH (aq) solution is reacted with 50ml of 0.1 M $H_2SO_4(aq)$ solution then increase in temperature of solution will be 9assume heat capacity of calorimeter is negligible):

Given : Specific heat of solution =1cal/g-K Density of solution =1g/mL

A. $0.5K$

B. $1K$

C. $2K$

D. $4K$

Answer: a

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463. $2NO_2(g) \rightarrow N_2O_4(g)$

$\Delta U_f^\circ \left[N_2O_4(g)\right] = 2kcal/\text{moleand } \Delta U_{reaction}^\circ = -16kcal/mol,$ then calculate $\Delta H_{\text{formation}}^\circ = -16kcal/mol,$ then calculate $\Delta H_{\text{formation}}^\circ ofNO_2at727^\circ C:$

A. 9kcal/mol

B. 4.5kcal/mol

C. 8kcal/mol

D. 10kcal/mol

Answer: c

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464. The heat or rectin does not depend upon :

A. Number of steps in which the reaction is carried out

B. Temperature at which the reaction is carrired out

C. physical state of reactant and products

D. Whether the reaction the reaction is carried out at constant pressure or at constant volume

Answer: a

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465. Which of the following enthalpy may be positive or negative?

A. Enthalpy of atomisation

B. Enthalpy of combustion

C. Enthalpy of solution

D. Enthalpy of hydration

Answer: c

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466. Heat of reaction of

$C(\text{diamond}) + 2S(s) \rightarrow CS_2(l)$ is known as :

A. Heat of formation of $CS_2(l)$

B. Heat of transition of C(diamond)

C. Sum of Heat of formation of $CS_2(l)$ and heat of transition of C(diamond) to c(graphite)

D. Bond energy of (C=S)bond

Answer: c

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467. What is heat of submisation of $P_4O_6(s)$?

Given heat of sublimation of P_4o_6 is x KJ/mol and P - O bond energy is y KJ/mol.

A. x+6y

B. x+y

C. x+8y

D. x+12y

Answer: d

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468. If the enthalpy of combustion of benzene (l), carbon (s) and hydrogen (g)are $Q_1 Q_2$ and Q_3 respectively, what will be enthalpy of formation of Benzene?

A. $Q_1 + 6Q_2 + Q_3$

B. $6Q_2 + Q_1 + 3Q_3$

C. $6Q_2 + 3Q_3 + Q_1$

D. $6Q_2 + 3Q_3 - Q_1$

Answer: d

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469. The enthalpy of dissolution of $BaCl_2(s)$ and $BaCl_2.2H_2O$ are -20.6 and 8.8 KJ mol^{-1} respectively . Calculate enthalpy of hydration forgiven reaction:

$BaCl_2(s) + 2H_2O \rightarrow BaCl_2.2H_2O(s)$

A. $-29.4KJ$

B. $-35.4KJ$

C. $-24.4KJ$

D. $-15.2KJ$

Answer: a

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470. the heat of atomization of methane and ethane are 360 KJ/mol and 620 KJ/mol , respectively . The longest Wavelength of light capable of breaking . The c-c bond is :

(Avogadro number $= 6.02 \times 10^{23}, h = 6.62 \times 10^{-34} Js\big)$

A. $1.49 \times 10^{3} cm$

B. $2.48 \times 10^{4} nm$

C. $2.48 \times 10^{3} nm$

D. $1.49 \times 10^{4} nm$

Answer: a

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471. Calculate the standard enthalpy of formation of acetylena from the following data:

$C(s) + O_2(g) \rightarrow CO_2(g), \Delta H^\circ = -393.5KJmol^{-1}$

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l), \Delta H^\circ = -285.8KJmol^{-1}$

$2C_2H_2(g) + 50_2(g) \rightarrow 4Co_2(g) + 2H_2O(l0,$

$\Delta H^\circ = -2598.8KJmol^{-1}$

A. $226.6KJmol^{-1}$

B. $230.5KJmol^{-1}$

C. $233.8KJmol^{-1}$

D. none of these

Answer: a

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472. The enthalpy of neutralisation of HCl and NaOH is $-57 KJmol^{-1}$ .The heat evolved at constant pressure (in KJ when 0.5 mole of H_2SO_4 reacts with 0.75 mole of NaOH is equal to :

A. $57 \times \frac{3}{4}$

B. 57×0.5

C. 57

D. 57×0.25

Answer: a

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473. Calculate standard entropy change in the reaction

$Fe_2O_3 + 3O_a(g) \rightarrow 2Cr_2O_3(s)$

$\Delta G^\circ = -2093.4 KJmol,$

$\Delta H_f^\circ Cr_2O_3(s) = -1129.05 KJ/\text{mole},$

$S_m^\circ Cr(s) = 24J/Kmol,$

$S_m^\circ Cr_2O_3(s) = 81j/Kmol$

A. 0

B. 205J/Kmole

C. 100j/Kmole

D. 410J/Kmole

Answer: b

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474. Calculate standard entropy change in the reaction

$Fe_2O_3(s) + 3H_2(g) \rightarrow 2Fe(s) + 3H_2O(l)$

Given : $S_{m_0}\left(Fe_2O_3. S\right) = 87.4, S_m^\circ(Fe, S) = 27.3$

$S_m^\circ\left(H_2, g\right) = 130.7, S_m^\circ\left(H_2O, l\right) = 69.9JK^{-1}mol^{-1}$

A. $-212.5JK^{-1}mol^{-1}$

B. $-215.2JK^{-1}mol^{-1}$

C. $-120.9JK^{-1}mol^{-1}$

D. none of these

Answer: b

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475. Heat produced by burning 1 mol carbon with O_2 to CO_2 is 80 KJ and by maximum amount of heat produced on burning 30 g carbon with 48G O_2:

A. 40KJ

B. 65KJ

C. 160KJ

D. 140KJ

Answer: d

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476. 4g NH_4NO_3 were dissolved in 100 g water in bomb calorimeter with heat capacity of calorimether system 150JK^{-1}. the temperature dropped by 1.5 K Enthalpy of solution of $NH_4NO_3$is :

A. $450KJmol^{-1}$

B. $-450KJmol^{-1}$

C. $4.5KJmol^{-1}$

D. $-4.5KJmol^{-1}$

Answer: c

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477. Which of the following enthalpy is always positive ?

A. Enthalpy of solution

B. Enthalpy of formation

C. Enthalpy of phase trasition

D. none of these

Answer: d

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478. The following sequence of reaction occurs in commercial producatio of aqueous nitric acid.

$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(l),$

$\Delta H = -904Kj...(i)$

$2NO(g) + O_2(g) \rightarrow 2NO_2(g), \Delta H = -112KJ...(ii)$

$2NO_2(g) + 2H_2O(l) \rightarrow 2HNO_3(aq) + H_2(g),$

$\Delta H = -140KJ...(iii)$

Determine the total heat liberated (in KJ/mol) at mole of aqueous nitric acid from NH_3 by this process:

A. -352

B. -405

C. 246.5

D. none of these

Answer: a

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479. If bond enthalpies Of $N \equiv N, H - H$ and $N - H$ bonds are x_1, x_2 and x_3 respectively ,ΔH_f° for NH_3 will be :

A. $x_1 + 3x_2 - 6x_3$

B. $\frac{1}{2}x_1 + \frac{3}{2}x_2 - 3x_3$

C. $3x_3 - \frac{1}{2}x_1 + \frac{3}{2}x_2$

D. $6x_3 - x_1 - 3x_2$

Answer: b

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480. The C-Cl bond energy can be calculated from:

A. $\Delta_f^{\circ}\left(CCl_4, l\right) only$

B. $\Delta_f^{\circ}\left(CCl_4, l\right)$ and $BE\left(Cl_2\right)$

C. $\Delta_f^{\circ}\left(CCl_4, l\right) BE\left(Cl_2\right)$

D. $\Delta_f^{\circ}\left(CCl_4, l\right) BE\left(Cl_2\right), \Delta H_f^{\circ}(C, g)$ and $\Delta H_{vap}^{\circ}\left(CCl_4\right)$

Answer: d

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481. When 100mL 0.2 MKOH is mixed with 100mL0.2 M HCl in a rigid adiaabatic container ,temperature of solution increase by $t_1^{\circ} C$ while when 300mL 0.1 M Koh is mixed with 3000mL 0.1 M HCl then increase in temperature is t_2° C then which one is correct? (Assume density as well as specfic heat capacity o final solution are same.)

A. $t_1 = t_2$

B. $t_1 > t_2$

C. $t_1 < t_2$

D. none of these

Answer: b

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482. oxidising power of chlorine in aqueous solution can be determined by the parameters indicated below: Calculate the energy involved in the conversion of

$\frac{1}{2}Cl_2(g)\text{to}Cl^-(aq)$

Using the data ,

$\Delta H^\circ_{\text{disso}}(Cl_2) = 240KJmol^{-1}$,

$\Delta H^\circ_{\text{eg}}(Cl_2) = -349KJmol^{-1}$,

$\Delta H^\circ_{\text{hydroation}}(Cl_2) = -381KJmol^{-1}$,

A. $+120KJmol^{-1}$

B. $+152KJmol^{-1}$

C. $-610Kjmol^{-1}$

D. $-850KJmol^{-1}$

Answer: c

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483. Which Statement is correct at$25^{\circ}C$and 1 atm pressure?

A. ΔG_f° for$H_2O(l) = 0Kj/mol^{-1}$

B. ΔG_f° for$I_2(l) = 0Kj/mol^{-1}$

C. ΔG_f° for $H_2O(l) = 0Kj/mol^{-1}$

D. S° for$O_2(g) - 0J.mol^{-1}$

Answer: a

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484. Calculate the enthalpy change for the isomerization reaction as given:

$CH_2 = CH - CH_2 - CH = CH - CH = CH_2$

(A) $\xrightarrow[\Delta]{NaNH_4} CH_2 = CH - CH = CH - CH = CH - CH_3$

$(B)\text{Use the following data:}$

$\Delta H_f^\circ\left(C_2H_4\right) = -2275.5KJ/mol$

$\Delta H_f^\circ\left(C_2H_6\right) = -2839.2KJ/mol$

Resonance energy of A=50Kj/mol

`Resonance energy of B=70KJ/mol

A. $-1692.6KJ/mol$

B. $-1642.6KJ/mol$

C. $-1622.6K\frac{J}{m}ol$

D. $-20,000J/mol$

Answer: d

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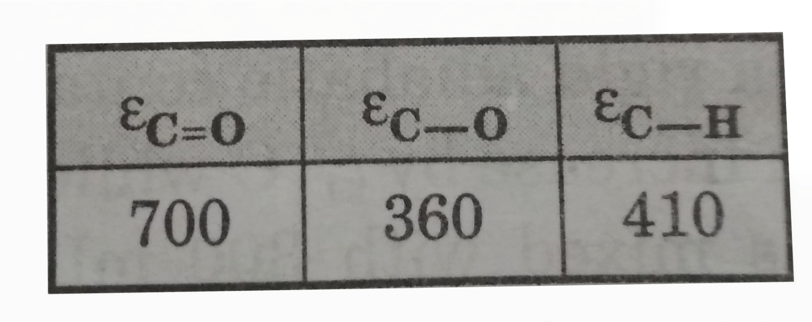
485. The enthalpy of gas phase trimerzation of one mole of gaseous formaldehyde in (KJ/mole)



$\varepsilon_{C=O}$	ε_{C-O}	ε_{C-H}
700	360	410

Bond energies (kj/mole)

Given:

$\varepsilon_{c=o}$	ε_{c-o}	ε_{c-H}
700	360	410

A. -20

B. -60

C. -10

D. -50

Answer: a

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486. During complete combustion of one mole of butane ,2658Kj of heat is released. The thermochemical reaction for above change is

A. $2C_4H_{10}(g) + 130_2(g) \rightarrow 8CO_2(g) + 10H_2O(l)$

$\Delta_cH = -2658.0KJmol^{-1}$

B. $C_4H_{10}(g) + \frac{13}{2}O_2(g) \rightarrow 4CO_2(g) + 5H_2O(g)$

$\Delta_cH = -1329.0KJmol^{-1}$

C. $C_4H_{10}(g) + \frac{13}{2}O_2(g) \rightarrow 4CO_2(g) + 5H_2O(l)$

$\Delta_cH = -2658.0KJmol^{-1}$

D. $C_4H_{10}(g) + \frac{13}{2}O_2(g) \rightarrow 4CO_2(g) + 5H_2O(l)$

$\Delta_cH = -2658.0KJmol^{-1}$

Answer: c

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487. The Standard heat of formation of carbon atom gaseous state in KJ/mol is:

ΔH° (atomisation of CO gas) $= 1072 KJ/mol$

ΔH° (formation of 'O' gas) $= 247 KJ/mol$

ΔH° (formation of CO gas) $= -114 KJ/mol$

A. 400

B. 311

C. 600

D. 711

Answer: d

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488. On the basic of thermochemical equations (I),(II)and (III), Find out which of the algebraic relationships given in options (a)to (d) is correct ?

(I)$C(\text{graphite}) + O_2(g) \rightarrow CO_2(g),$

$\Delta_r H = XKJmol^{-1}$

$(\text{II}) C(\text{graphite}) + \frac{1}{2}O_2(g) \rightarrow CO(g),$

$\Delta_r H = yKJmol^{-1}$

$(III) CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g), \Delta_r H = zKJmol^{-1}$

A. z=x+y

B. x=y-z

C. x=y+z

D. y=2z-x

Answer: c

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489. Consider the reactions given below .On the basis of these reactions ,Find out which of the algebraic relations given in options (a) to(d) is correct?

$(p) C(g) + 4H(g) \rightarrow CH_4(g), \Delta_r H = xKJmol^{-1}$

$(Q) C(\text{graphite}) + 2H_2(g) \rightarrow CH_4(g)$,

$\Delta_r H = yKJmol^{-1}$

A. x=y

B. x=2y

C. xgty

D. xlty

Answer: d

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490. The enthalpy of elements in their standard atates are taken as zero .The enthalpy of formation of a compound:

A. Is always negative

B. is always positive

C. may be positive or negative

D. is never negative

Answer: c

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491. Enthalpy of sublimation of a substance is equal to :

A. Enthalpy of fusion + enthalpy of vaporisation

B. enthalpy of fusion

C. enthalpy of vaporisation

D. twice the enthalpy of vaporisation

Answer: a

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492. For the given reaction:

$H_2(g) + Cl_2(g) \rightarrow 2H^+(aq) + 2Cl^-(aq)$

$\Delta G° = -262.4kJ$

The value of Gibbs free energy of formation $\left(\Delta G_r^\circ\right)$ for the ion $Cl^-(aq)$ is:

A. $-131.2KJmol^{-1}$

B. $+131.2KJmol^{-1}$

C. $-262.4KJmol^{-1}$

D. $+262.4KJmol^{-1}$

Answer: a

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493. Using the data provided, calculate the multiple bond energy $\left(kJmol^{-1}\right)$ of a $C \equiv C$ bond in C_2H_2. That energy is (take the bond energy of a $C-H$ bond as $350kJmol^{-1}\big)$.

$2C_{(s)} + H_{2(g)} \rightarrow C_2H_{2(g)}, \Delta = 225kJmol^{-1}$

$$2C_{(s)} \rightarrow 2C_{g}\Big), \Delta H = 1410kJmol^{-1}$$

$$H_{2(g)} \rightarrow 2H_{(g)}, \Delta H = 330kJmol^{-1}$$

A. 1165

B. 837

C. 865

D. 815

Answer: d

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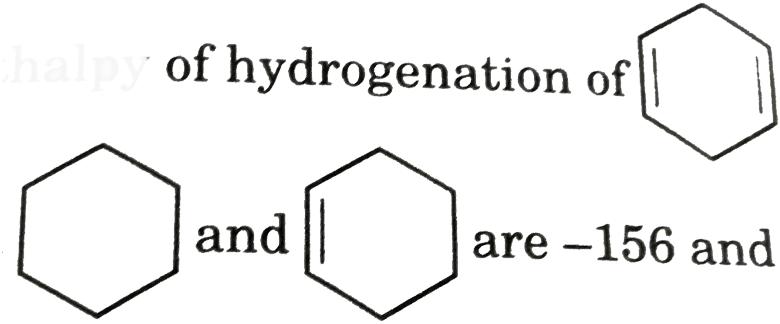
494. Calculate the Enthalpy of hydrogenation of If the $\Delta_f H$ of and



are -156 and

-37 Kj /mol respectively.

A. $-199KJ/mol$

B. $-238KJ/mol$

C. $-59.5KJ/mol$

D. $-476KJ/mol$

Answer: b

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495. The enthalpies of vombustion of formaldehyde and paraformaldehyde (a ploymer of formaldehyde) arae -134 and -732 kcal/mol respectively .The enthalpy of polymerisation per mole of paraformaldehtde is -72 kcal the molecular formula of paraformaldehyde is:

A. CH_2O

B. $C_6H_{12}O_6$

C. $c_{12}H_{22}O_{11}$

D. $C_3H_6O_3$

Answer: b

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496. The Standard enthalpy of formation of gaseous H_2O at 298K is $-242mol^{-1}$. Calculate ΔH° at$373K$ given the following values of the molar feat capacities at constant pressure .

Molar heat capcity of $H_2O(g) = 33.5JK^{-1}mol^{-1}$

molar heat capacity of $H_2(g) = 28.8JK^{-1}mol^{-1}$

Molar heat capacity of $O_2(g) = 29.4JK^{-1}mol^{-1}$

{Assume that the heat capacities are independent of temperature.}

A. $508KJmol^{-1}$

B. $-242KJmol^{-1}$

C. $-242.75KJmol^{-1}$

D. none of these

Answer: c

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497. Glucose when dissolved in water leads to cooling of the solution . Suppose you take 250 mL Water at room temperature in an open container (such as a bowl) made of thermally insulated material and dissolve a sponnful of glucose in it .If you are able to accurately measure the heat absorbed by this (assuming negligible changes in the composition and the amount of solution during this process), you will be measuring :

A. the enthalpy of dissolution of the glucose in water

B. the Gibbs free energy of dissolution of the glucose in water

C. the work done by the atmosphere on the system during the dissolution proces

D. the heat capacity of the solution

Answer: a

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498. Consider this equation and the associated value for ΔH°.

$2H_2(g) + 2Cl_2(g) \rightarrow 4HCl(g), \Delta H = \text{ - } 92.3Kj$

which statement abount this information is incorrect?

A. If the equation is reversed ,the ΔH° value equals +92.3KJ.

B. The four HCl bonds are stronger then the four bonds in H_2 and Cl_2.

C. The ΔH° value will be -92.3 KJ if the HCl is produced as a liquid.

D. 23.1 KJ of heat will be enolved when 1 mol of HCl(g)Is produced.

Answer: c

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499. A bomb calorimeter has a heat capacity of $783J \times {}^{\circ}c^{-1}$ and contains 254 g of water which has a specific heat of $4.184J \times g^{-1} \times {}^{\circ}C_{-1}$ .How much heat is enolved or absorbed by a reaction when the temperature goes from $23.73\,^{\circ}\text{to}26.01\,^{\circ}$ C ?

A. 1.78 KJ absorbed

B. 2.42KJ absorbed

C. 1.78 KJ evolved

D. 4.21KJ evolved

Answer: d

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500. Determine the heat of reaction for this process

$Fe(s) + O_2(g) \rightarrow 2FeO(s)\Delta H^{\circ} = -544.0KJ$

$4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)\Delta H = -1648.4Kj$

$Fe_3O_4(s) \rightarrow 3Fe(s) + 2O_2(g)\Delta H^{\circ} = - + 1118.4Kj$

A. $-1074.1KJ$

B. $-22.2KJ$

C. $+249.8KJ$

D. $+2214.6KJ$

Answer: b

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501. Use bond energy to estimate ΔH for this rection:

$$H_2(g) + O_2(g) \rightarrow H_2O_2(g)$$

$Bond$	BondEnergy
$H - H$	$436KJmol^{-1}$
$O - O$	$142KJmol^{-1}$
$O = O$	$499KJmol^{-1}$
$H - O$	$460Kj.mol^{-1}$

A. $-127KJ$

B. $-209KJ$

C. $-484KJ$

D. $-841 Kj$

Answer: a

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502. For which of these is ΔH_f° not equal to zone?

A. $Br_2(l)$

B. $Fe(S)$

C. $I_2(s)$

D. $O_3(g)$

Answer: d

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503. The enthalpy change change for which reaction represents the standard enthalpy of formation for hydrogen cyanide, HCN?

A. $H(g) + C_{\text{graphite}} + N(g) \rightarrow HCN(g)$

B. $\frac{1}{2}H_2(g) + C_{\text{graphite}}\frac{1}{2}N_2(g) \rightarrow HCN(g)$

C. $HCN(g) \rightarrow \frac{1}{2}H_2(g) + C_{\text{graphite}} + \frac{1}{2}N_2(g)$

D. $H_2(g) + 2C_{\text{graphite}} + N_2(g) \rightarrow 2HCn(g)$

Answer: b

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504. What is the standed enthalpy of formation of MgO(s) is 300.9 Kj is evoled when 20.15 g of MgO(s) is formaed by the combustion when magnesium under standerd conditions?

A. $-597.3KJmol^{-1}$

B. $-300.9KJmol^{-1}$

C. $+300.9KJmol^{-1}$

D. $+597.3KJmol^{-1}$

Answer: a

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505. For the formation of one mole of each of these gases from their elements , which reaction is most endothermic?

A. $CO\left(\Delta H_f^{\circ} = -110.5KJmol^{-1}\right)$

B. $NO\left(\Delta H_f^{\circ} = +33.9KJmol^{-1}\right)$

C. $O_3\left(\Delta H_f^{\circ} = +142.2KJmol^{-1}\right)$

D. $SO_2\left(\Delta H_f^{\circ} = -300.4KJmol^{-1}\right)$

Answer: c

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506. $4Li(s) + O_2(g) \rightarrow 2Li_2O(s)$

At $25^\circ C$, ΔH for this reaction is -598.8 kilo joules per mole of Li should be reacted with excess $O_2(g)$ in order to relaase 150 Kj?

A. 0.874g

B. 1..74g

C. 3.15g

D. 7.01g

Answer: c

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507. The heat of formation of NO from its elements is +90KJmol^{-1} What is the appoximate bond dissociation energy of the bond in NO?

$Bond$	Bond Energy
$N \equiv N$	$941 KJmol^{-1}$
$O = O$	$499 KJmol^{-1}$

A. $630 KJmol^{-1}$

B. $720 KJmol^{-1}$

C. $765 KJmol^{-1}$

D. $810 KJmol^{-1}$

Answer: a

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508. $Fe_2O_2(s) + \frac{3}{2}C(s) \rightarrow \frac{3}{2}CO_2(g) + 2Fe(s)$

$\Delta H^\circ = +234.12KJ$

$C(s) + O_2(g) \rightarrow CO_2(g) \Delta H^\circ = -393.5KJ$

Use these equations and ΔH° value to calculate ΔH° for this reaction :

$4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$

A. $-1228.7Kj$

B. $-1255.3KJ$

C. $-1021.2KJ$

D. $-129.4KJ$

Answer: a

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509. Which combination of solution of Hcl and NAOH would produce the largest ΔT?

A. 50mL of M HCl with 50mL of 1 M NaOH

B. 50mL of 2M HCl with 50mL of 2 MNaOH

C. 100mLof 1M HCl with 50mL of 2M NAOH

D. 100mL o f1 M HCl with 100mL of 1 M NaOH

Answer: b

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510. Consider this reaction .

$2N_2H_4(l) \rightarrow 3N_2(g) + 4H_2O(g)$

$\Delta H = -1078 Kj$

how much energy is released by this reaction during the formation of 140 g of $N_2(g)$?

A. 1078KJ

B. 1797KJ

C. 3234KJ

D. 5390KJ

Answer: b

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511. Use the information in the table to calculate the enthalpy of this reaction .

$$C_2H_6(g) + \frac{7}{2}O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$$

Reaction	$\Delta H_f^\circ KJ.mol^{-1}$
$2C(s) + 3H_2(g) \rightarrow C_2H_6(g)$	-84.7
$2C(s) + O_2(g) \rightarrow CO_2(g)$	-393.5
$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$	-285.8

A. $-764KJ$

B. $-1560KJ$

C. $-1664KJ$

D. $-3120KJ$

Answer: b

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512. 50.0mL of 0.10 M HCl is mixed with 50.0mL of 0.10 M NaOH .The solution temperature rises by $3.0\,^\circ C$Calculate the enthalpy of neutralization per mole of HCl.

solution	Values
C_p	$4.18J.\, g^{-1} {}^{\circ}C^{-1}$
Density	$1.0.\, mL^{-1}$

A. $-2.5 \times 10^2 KJ$

B. $-1.3 \times 10^2 KJ$

C. $-8.4 \times 10^1 KJ$

D. $-6.3 \times 10^1 KJ$

Answer: a

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513. The boiling point of chorofrom ,$CHCl_3$, $is 61.7\,^{\circ}$C and its enthalpy of vaporization is $31.4KJ - mol^{-1}$ Calculate the molar entropy of vaporization for chlorofrom :

A. $10.7J \times mol^{-1}.\, K^{-1}$

B. $93.8J \times mol^{-1}.\, K^{-1}$

C. $301 J \times mol^{-1}. K^{-1}$

D. $509 J \times mol^{-1}. K^{-1}$

Answer: b

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514. Calcualte the amount of energy released when 0.100 mol of diborane ,B_2H_6 , reacts with oxygen to produce soild $B_2O_3$and steam:

	$\Delta_f H\left(kJ.mol^{-1}\right)$
$B_2H_6(g)$	35
$B_2O_3(g)$	-1272
$BH_2O(l)$	-285
$H_2O(g)$	-241

A. 203KJ

B. 216KJ

C. 330KJ

D. 343KJ

Answer: a

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515. Given the thermochemical equations:

$Br_2(l) + Fe(g) \rightarrow 2BrF(g)\Delta H^\circ = -188KJ$

$Br_2(l) + 3F_2(g) \rightarrow 2BrF_3(g)\Delta H^\circ = -768KJ$

detemine ΔH° for the reaction

$BrF(g) + F_2(g) \rightarrow BrF_3(g)$

A. $-956KJ$

B. $-478KJ$

C. $-5820KJ$

D. $-290KJ$

Answer: d

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516. A liquid has a vapour pressure of 40mm Hg at $19.0^\circ C$ and a normal boiling point of $78.3^\circ C$ What is its enthalpy of vaporization in KJ $.mol^{-1}$?

A. 42.4

B. 18.4

C. 5.10

D. 1.45

Answer: a

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517. The combustion of 0.200 mol of liquid carbon disulphide, CS_2 to give $CO_2(g)$ and $SO_2(g)$ releases 215 KJ of heat . What is ΔH_F° for $CS_2(l)$ in $Kj \times mol^{-1}$? ,

ΔH_f°	$kj. mol^{-1}$
$CO_2(g)$	-393.5
$SO_2(g)$	-296.8

A. 385

B. 87.5

C. -385

D. -475

Answer: b

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518. how should a student prepare 100mL of a 1.0 M H_2SO_4 solution from a 10M H_2SO_4 solution?

A. Add 90 mL of H_2O to10mL of 10 M H_2SO_4.

B. Add 90 mL of 10M $H_2O_4 to 90 mL H_2O$.

C. Add 10ML of 10 M $H_2SO_4 to 80 mL of$ H_2O, Stir and dilute to 100 ML after allowing to cool .

D. Add 80ml o f$H_2O$to 10mL of 10M H_2SO_4, stir and dilute to 100 mLafter allowing to cool.

Answer: c

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519. The enthalpy change of which reaction corresponds to ΔH_f° for$Na_2CO_3(s)298K$?

A. $2Na(s) + C(s) + \frac{3}{2}O_2(g) \rightarrow Na_2CO_3(s)$

B. $2Na_2O(s) + CO_2(g) \rightarrow Na_2CO_3(s)$

C. $2Na^+(aq) + CO_3^{2-}(aq) \rightarrow Na_2CO_3(s)$

D. $2Na^+(aq) + 2OH^-(aq) + CO_2(aq) \rightarrow Na_2CO_3(s) + H_2O$

Answer: a

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520. For the reaction shown , which which is closest to the value o fΔH?

ΔH_f°	$(KJ.\,mol^{-1})$
$Cr^{3+}(aq)$	-143
$Ni^{2+}(aq)$	-54

$2Cr^{3+}(aq) + 3Ni(s) \rightarrow 2Cr(s) + 3Ni^{2+}(aq)$

A. 124KJ

B. 89KJ

C. $-89Kj$

D. $-124KJ$

Answer: a

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521. When a bomb calorimeter is used to determine the heat of recation is most likely of the system under investigation is most likely to remain constant ?

A. number of molecules

B. pressure

C. temperature

D. volume

Answer: d

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522. For the reaction ,$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$ which expression given ΔH?

Bond dissociation	$Kj.\, mol^{-1}$
$C-H$	413
$C-Cl$	328
$Cl-Cl$	242
$H-Cl$	431

A. $\Delta H = (413 + 328) - (242 + 431)$

B. $\Delta H = (413 - 328) - (242 - 431)$

C. $\Delta H = (413 - 242) - (328 - 431)$

D. $\Delta H = (413 + 242) - (328 + 431)$

Answer: d

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523. Which equation represents the reaction for the stanard enthalpy of formation ,ΔH_f° , for$B_5H_9(g)$ at 298 K and 1atm?

A. $5B(S) + 9H(g) \rightarrow B_5H_9(g)$

B. $2B(S) + 3BH_3(g) \rightarrow B_5H_9(g)$

C. $\frac{5}{2}B_2(g) + \frac{9}{2}H_2(g) \rightarrow B_5H_9(g)$

D. $5B(s) + \frac{9}{2}H_2(g) \rightarrow B_5H_9(g)$

Answer: d

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524. $C_2H_6(g)+\frac{7}{2}O_2(g)\rightarrow 2CO_2(g)+3H_2O(g)$

$\Delta H^\circ = -1427.7KJ$

If the enthalpy of vaporization for $H_2O(l)$is 44.0 KJ.mol, what is ΔH° for this reaction if $H_2O(l)$ is formed insteat of $H_2O(g)$?

A. $-1295.7KJ$

B. $-1383.7KJ$

C. $-1471.7KJ$

D. $-1559.7KJ$

Answer: d

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525. Calculate the change in enthalpy ,ΔH, for the combustion of 11.2 L of hydrogen gas , measured at $0^\circ C$ and 1 atm pressure , to orm $H_\circ O(g)$:

$\Delta H_f^\circ \quad \left(KJ.\,mol^{-1}\right)$

$H_2O(g) \quad -241.8$

A. $-60.5KJ$

B. $-121KJ$

C. $-484KJ$

D. $-271.8KJ$

Answer: b

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526. Calculate ΔH° for the reaction :

$$TiCl_4(g) + 2H_2O(l) \rightarrow TiO_2(s) + 4Hcl(g)$$

ΔH_f°	$\left(KJ.\,mol,^{-1}\right)$
$TiCl_4(g)$	-763
$H_2O(l)$	-286
$TiO_2(s)$	-945
$HCl(g)$	-92

A. $-264KJ$

B. $12KJ$

C. $22KJ$

D. $298KJ$

Answer: c

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527. Use bond energies to estimate the value of ΔH° for the reaction :

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

$Bond$	EnergiesKJ/mol
$H - H$	436
$H - N$	386
$N - N$	193
$N = N$	418
$N \equiv N$	941

A. $-995KJ$

B. $-590KJ$

C. $-67Kj$

D. $815KJ$

Answer: c

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528. Use the thermochemical data given to calculate Δh_f° for $N_2O_5(g)$ in KJ/mol^{-1}

$N_2(g) + O_2(g) \rightarrow 2NO(g)\Delta H^\circ = +180.5KJ$

$2NO(g) + O_2(g) \rightarrow 2NO_2(g)\Delta H^\circ = -114.1Kj$

$4NO_2(g) + O_2(g) \rightarrow 2N_2O_5\Delta H^\circ = -110.2Kj$

A. -332.8

B. -43.8

C. 11.3

D. 22.6

Answer: c

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529. Which process requires the greatest amount of energy for 1 mole of H_2O?

A. Breaking the o-H bonds

B. Melting

C. Evaporating

D. Subliming

Answer: a

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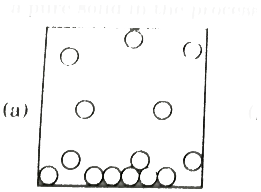
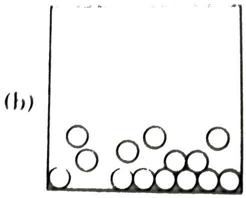
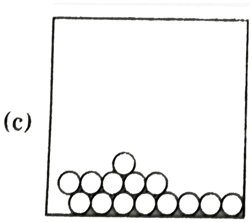
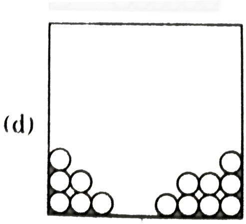
530. If the circles represent molecules , which diagram provides the best molecular level representation of a pure solid in the process of melting?

A. 

B. 

C. 

D. 

Answer: b

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531. Which of these coversios has a poitive ΔS° ?

(p)combustion of charcoal

(Q) condensation of $Br_2(g)$

(R) precipitation ofAgCl(s)

A. P only

B. Qonly

C. R only

D. Qand R only

Answer: a

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532. Given these reactions :

$A \rightarrow 2B\Delta H = 40KJ$

$B \rightarrow C\Delta H = -50KJ$

$2C \rightarrow D\Delta H = -20KJ$

Calculate ΔH for the reaction : $D + A \rightarrow 4C$

A. $-100KJ$

B. $-60KJ$

C. $-40KJ$

D. $100Kj$

Answer: c

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533. Hydrazine , N_2H_4, contains aN-N single bond and 4N -H bonds . Use bond energies to calculate ΔHin KJ for the reaction :

$$N_2 + 2H_2 \rightarrow N_2H_4$$

$Bond$	Energies$\left(KJ.\,mol^{-1}\right)$
$H-H$	436
$H-N$	386
$N-N$	193
$N=N$	418
$N \equiv N$	941

A. $-425KJ$

B. $-76KJ$

C. $76KJ$

D. $245KJ$

Answer: c

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534. Rank the enthalpy of fusion , sublimation and vaporization for water :

A. sublimation =vaporization =fusion

B. vaporization> sublimation> fusion

C. fusion> sublimation > vaporization

D. fusion > vaporization >sublimation

Answer: d

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535. The stande enthalpy of formation for $NH_3(g)$is $-46.1KJ \times mol^{-1}$ .Calculate ΔH° for the reaction :

$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

A. $-92.2KJ$

B. $-46.1KJ$

C. $46.1Kj$

D. $92.2KJ$

Answer: d

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536. Which are exothrmic processes?

(p) Combustion of ethane

(Q)Dehyration of barium choride dihdrate

A. Ponly

B. Qonly

C. Both p and Q

D. Neither P nor Q

Answer: a

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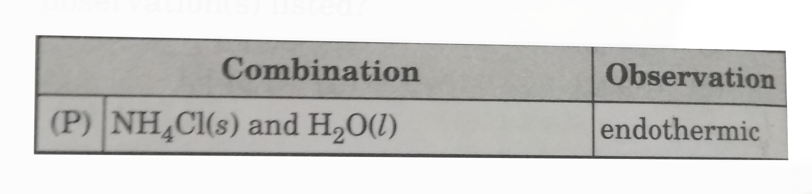
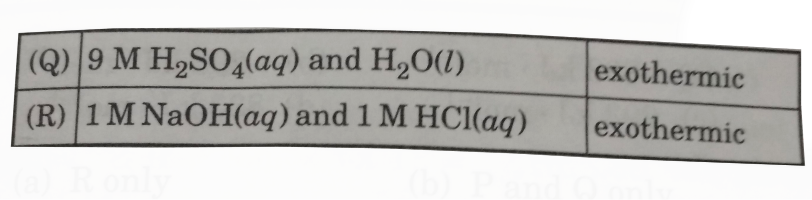
537. Which sets of chemicals , when mixed , produce the observation (s) listed ?



Combination		Observation
(P)	$NH_4Cl(s)$ and $H_2O(l)$	endothermic



(Q)	9 M $H_2SO_4(aq)$ and $H_2O(l)$	exothermic
(R)	1 M $NaOH(aq)$ and 1 M $HCl(aq)$	exothermic

A. R only

B. Pand Qonly

C. Qand Ronly

D. p,Qand R

Answer: d

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538. The vapour pressure of phoshorus trichoride is100 mm Hg at 21.0° and its normal boiling point is 74.2° C What is the enthalpy of vaporization in KJ . mol^{-1}

A. 0.493

B. 3.93

C. 23.0

D. 32.4

Answer: d

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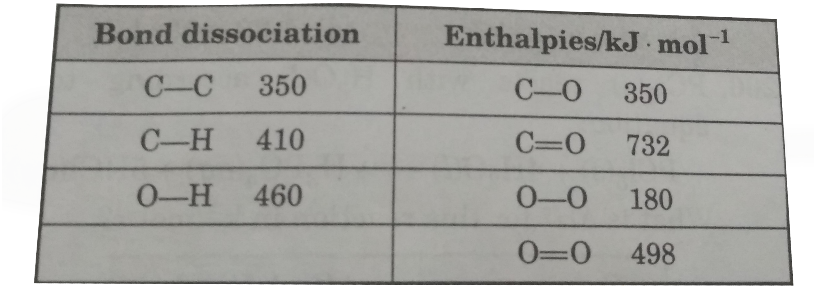
539. Estimate the enthalpy of combustion of methane in KJ . mol^{-1}

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$



Bond dissociation	Enthalpies/kJ · mol^{-1}
C—C 350	C—O 350
C—H 410	C=O 732
O—H 460	O—O 180
	O=O 498

A. 668

B. 540

C. -540

D. -668

Answer: d

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540. Which Statement is always true for an exothermic reaction ?

A. The enthalpy change is negative .

B. The entropy change is negative .

C. The reaction absorbs heat from the surroundings.

D. The reaction is spontaneous.

Answer: a

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541. For which reaction is ΔH°_{rxn} equal to ΔH°_{f} for $CUSO_4(s)$?

A. $Cu^{2+}(aq) + SO_4^{2-}(aq) \rightarrow CuSO_4(s)$

B. $CuO(s) + SO_3(g) \rightarrow CuSO_4(s)$

C. $CuS(s) + SO_2(g) \rightarrow CuSO_4(s)$

D. $Cu(s) + S(s) + 2O_2(g) \rightarrow CuSO_4(s)$

Answer: d

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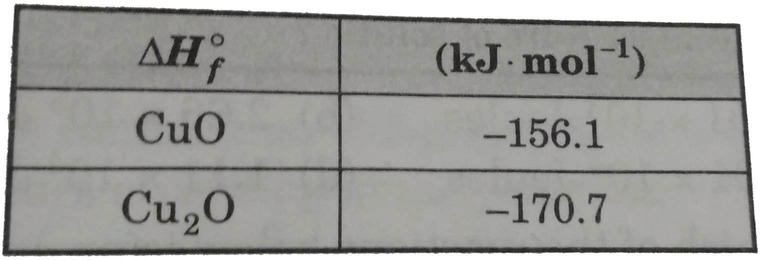
542. What is the value of ΔH° (inKJ) for this reaction ?ltbr gt



ΔH_f°	$(kJ \cdot mol^{-1})$
CuO	-156.1
Cu_2O	-170.7

$$2CuO(s) \rightarrow CuO(s) + \frac{1}{2}O_2(g)$$

A. 141.5

B. 14.6

C. - 14.6

D. - 141.5

Answer: a

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543. The heat of a reaction is measured in a bomb calorimeter . This heat is equal to which thermodynamic quantity?

A. ΔE

B. ΔG

C. ΔH

D. ΔS

Answer: a

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544. $NO(g) \rightarrow \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g), \Delta H_1^\circ$

$2NO(g) \rightarrow N_2O(g) + \frac{1}{2}O_2(g), \Delta H_2^\circ$

Which relationship is correct ?

A. $\Delta H_1^\circ = \Delta H_2^\circ$

B. $\Delta H_f^\circ f$ or $NO(g) = \Delta H_1^\circ$

C. $\Delta H_f^\circ f$ or $N_2O(g) = \Delta H_2^\circ$

D. $\Delta H_f^\circ f$ or $N_2O(g) = \Delta H_2^\circ - 2\Delta H_1^\circ$

Answer: d

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545. When 2.74 g of Ba(s) reacts with $O_2(g)$ at 298K and 1 atm to from Ba(s),11,100J of heat is released . What is ΔH_f° for BaO(s)in $Kj \times mol^{-1}$?

A. 556

B. 221

C. -221

D. -556

Answer: d

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546. What is the relationship among the magnitudes of the enthalpies of combustion $\left(\Delta H_{comb}\right)$, fusion $\left(\Delta H_{fus}\right)$ and vaporization $\left(\Delta H_{vap}\right)$ for a hydrocarbon such as hexane,C_6H_{14}?

A. $\Delta H_{fus} < \Delta H_{fus} < \Delta H_{vap}$

B. $\Delta H_{vap} < \Delta H_{fus} < \Delta H_{comb}$

C. $\Delta H_{comb} < \Delta H_{vap} < \Delta H_{fus}$

D. $\Delta H_{fus} < \Delta H_{vap} < \Delta H_{comb}$

Answer: d

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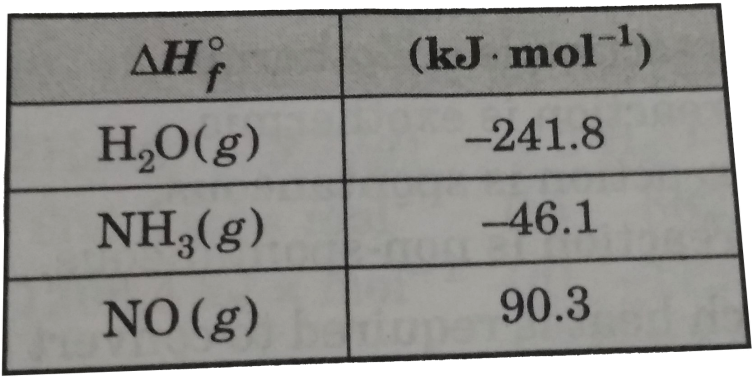
547. Determine ΔH_{rxn} for the reaction in KJ $.mol^{-1}$

$$2NH_3(g) + \frac{5}{2}O_2(g) \rightarrow 2NO(g) + 3H_2O(g).$$



ΔH_f°	$(kJ \cdot mol^{-1})$
$H_2O(g)$	–241.8
$NH_3(g)$	–46.1
$NO(g)$	90.3

A. -105.4

B. -226.3

C. -452.6

D. -6377.0

Answer: c

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548. Calculate Δ E when one mole of liuid is vaporized at its boiling point $(80\,^\circ C)$ and 1atm pressure .

$\left[\Delta H_{vap} = 30.7KJ/mol\right]$

A. 33.6KJ

B. 31.4Kj

C. 30.0KJ

D. 27.8KJ

Answer: d

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549. Use the following data to calculate the molar enthalpy of combustion of ethane ,C_2H_6:

$2C_2H_2(g) + 5O_2(g) \rightarrow 4CO_2(g) + 2H_2O(l),$

$\Delta H = -2511 KJ/mol$

$C_2H_2(g) + 2H_2(G) \rightarrow C_2H^6(g), \Delta H = -311 KJ/mol$

$2H_2(g) + O_2(g) \rightarrow 2H_2O(l), \Delta H = -484 KJ/mol$

A. $-1428 KJ/mol$

B. $-2684 KJ/mol$

C. $-2856 KJ/mol$

D. $-3306 KJ/mol$

Answer: a

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550. Which process is exothermic ?

A. condensation

B. fusion

C. sublimation

D. vaporization

Answer: a

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551. use the thermodymanmic information :

$\frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)\Delta H^\circ = 90.4Kj/mol$

$\frac{1}{2}N_2(g) + O_2(g)\Delta H^\circ = 33.8KJ/mol$

$2NO_2(g) \rightarrow N_2O_4(g)\Delta H^\circ = -58.0KJ/mol$

to Calcualate ΔH° Kj /mol for the reaction :

$2NO_2(g) + O_2(g) \rightarrow N_2O_4$

A. -171.2

B. -114.6

C. 114.6

D. 171.2

Answer: a

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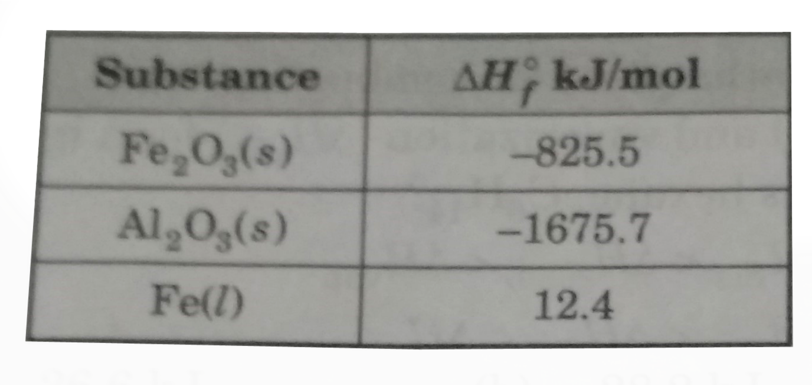
552. Determine the enthalpy change for the reaction of 5.00 g $Fe_2O_3$with aluminium metal according to the equation :

$Fe_2O_3(s) + 2Al(s) \rightarrow Al_2O_3(s)Fe(l)$



Substance	ΔH_f° kJ/mol
$Fe_2O_3(s)$	–825.5
$Al_2O_3(s)$	–1675.7
$Fe(l)$	12.4

A. - $26.6KJ$

B. - $28.2Kj$

C. - $52.4KJ$

D. - $77.9KJ$

Answer: a

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553. The energies of the bonds broken in a certain eaction arae greater than the energies of the bonds formed. Which one of the following statements about this reaction must be true?

A. The reaction is endothermic.

B. The reaction is exothermic.

C. The reaction is spontaneous.

D. The reaction is non- spontaneous.

Answer: a

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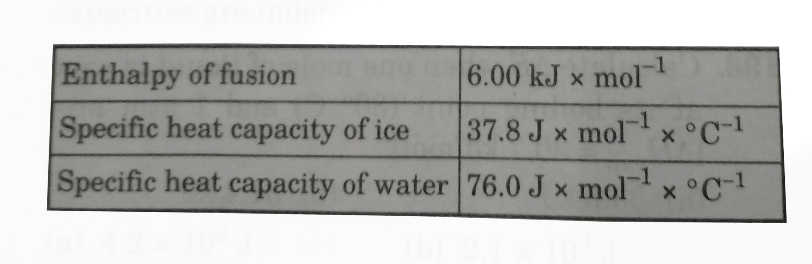
554. How much heat is reuired to convert 5.0 g of ice at - 10.0° C to liquid water at 15.0° C ? (Assume heart capacities are indendent o ftemperature.)



Enthalpy of fusion	$6.00 \text{ kJ} \times \text{mol}^{-1}$
Specific heat capacity of ice	$37.8 \text{ J} \times \text{mol}^{-1} \times {}^\circ\text{C}^{-1}$
Specific heat capacity of water	$76.0 \text{ J} \times \text{mol}^{-1} \times {}^\circ\text{C}^{-1}$

A. $4.2 \times 10^2 j$

B. $2.1 \times 10^3 J$

C. $9.3 \times 10^3 J$

D. $3.8 \times 10^4 J$

Answer: b

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555. The standed enthalpies of combustion of formaldehyde , $H_2C = O(g)$, and formic acid HCOOH(l), are -563 and -270 Kj.mol^{-1} respectively . What Is ΔH° for the following reaction ?

$$H_2C = O(g) + \frac{1}{2}O_2(g) \rightarrow HCOOH(l)$$

A. $-833KJ.\,mol^{-1}$

B. $-293KJ.\,mol^{-1}$

C. $293KJ.\,mol^{-1}$

D. $833KJ.\,mol^{-1}$

Answer: b

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556. for $Br_2(g), \Delta H^{\circ}_{vap} = 31Kj \times mol^{-1}$. If S° values for $Br_2(g)$ and $Br_2(l) are 245 J.mol^{-1}.K^{-1}$ and $153 Jmol^{-1}.K^{-1}$ respectively , what is the normal boiling point for $Br_2(l)$?

A. 340K

B. 200K

C. 130K

D. 70K

Answer: a

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557. The combustion of 1.00 mole of mehtane , CH_4,produces carbon dioxide and water releases $802Kj \times mol^{-1}$ .when 3.00 mol oxygen reacts with a stoichiometric quantity o fmethane , what is ΔH for the reaction ?

A. $-1.20 \times 10^3 Kj$

B. $-8.02 \times 10^2 KJ$

C. $8.02 \times 10^2 Kj$

D. $1.20 \times 10^3 Kj$

Answer: a

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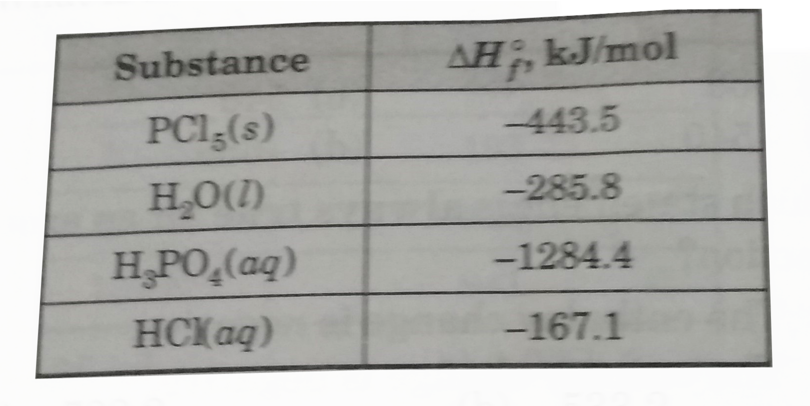
558. $PCl_5(s)$ reacts with $H_2O(l)$ accoding to the equation :

$PCl_5(s) + 4H_2O(l) \rightarrow H_3PO_4(aq) +_5HCl(aq)$

What is ΔH° for this rection in Kj/mol^{-1}



Substance	ΔH_f°, kJ/mol
$PCl_5(s)$	–443.5
$H_2O(l)$	–285.8
$H_3PO_4(aq)$	–1284.4
$HCl(aq)$	–167.1

A. -722.2

B. -533.2

C. 533.2

D. 722.2

Answer: b

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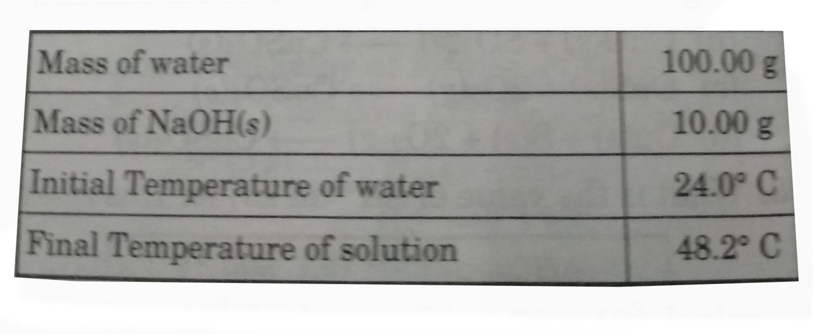
559. A sample of NaOH (s) was added to water in a calorimeter. The temperature was monitoredas the NaOH dissolved to give the data below . Determinethe heat released during the solution process.(Assume the solution specific heat is $4.18 J.\,g^{-1}.K^{-1}$)



Mass of water	100.00 g
Mass of NaOH(s)	10.00 g
Initial Temperature of water	24.0° C
Final Temperature of solution	48.2° C

A. 1.01×10^3 joules

B. 2.66×10^3Joules

C. 1.01×10^4Joules

D. 1.11×10^4Joules

Answer: d

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560. For Which of the reaction below is (are) the heat of reaction euqal to the heat of formation ?

$$(p)\frac{1}{2}N_2(g) + O_2(g) \rightarrow NO_2(g)\Delta H > 0$$

$$(Q)SO_2(g) + \frac{1}{2}O_2(g) \rightarrow SO_3(g)\Delta H < 0$$

A. P only

B. Q only

C. Both p and Q

D. Neither P nor Q

Answer: a

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561. $C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g)$ During an experiment 10.00 g of ethanol is complately burned in air to release $CO_2(g)$ and $H_2O(g)$ as shown in the equation above .During the combustion ,296.6 Kj of heat energy is released. What Is the molar enthalpy ofcombution ,ΔH°_{comb}?

A. $-2966KJ \times mol^{-1}$

B. $-1364KJ \times mol^{-1}$

C. $-64.36Kj \times mol^{-1}$

D. $-29.66KJmol^{-1}$

Answer: b

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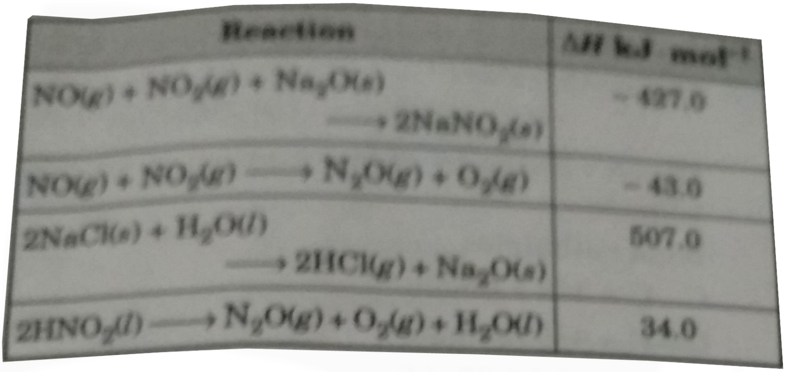
562. $HNO_2(l) + NaCl(s) \rightarrow HCl(g) + NaNO_2(s)$

Calculate the ΔH° value for the reaction above from the information below:



Reaction	ΔH kJ mol^{-1}
$NO(g) + NO_2(g) + Na_2O(s) \longrightarrow 2NaNO_2(s)$	-427.0
$NO(g) + NO_2(g) \longrightarrow N_2O(g) + O_2(g)$	-43.0
$2NaCl(s) + H_2O(l) \longrightarrow 2HCl(g) + Na_2O(s)$	507.0
$2HNO_2(l) \longrightarrow N_2O(g) + O_2(g) + H_2O(l)$	34.0

A. 157KJ

B. 78.5KJ

C. -78.5Kj

D. -157KJ

Answer: b

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563. For which reacrion (s) is the ΔH value close to the ΔE value ?

$(p)CH_4(g) + 2O(g) \rightarrow CO(g) + 2H_2O(l)$

$(Q)C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(g)$

A. P only

B. Q only

C. Both p and Q

D. Neither P nor Q

Answer: b

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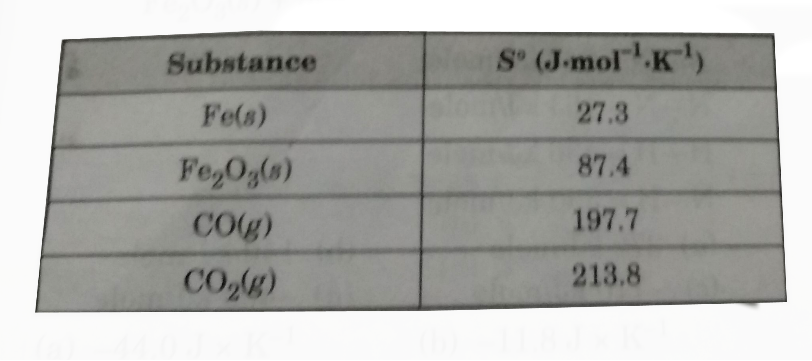
564. What is the value of Δs° for the reaction below?

$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3CO_2(g)$



Substance	S° ($J \cdot mol^{-1} \cdot K^{-1}$)
$Fe(s)$	27.3
$Fe_2O_3(s)$	87.4
$CO(g)$	197.7
$CO_2(g)$	213.8

A. $-44.0J \times K^{-1}$

B. $-11.8J \times K^{-1}$

C. $15.5J \times K^{-1}$

D. $42.8J \times K^{-1}$

Answer: c

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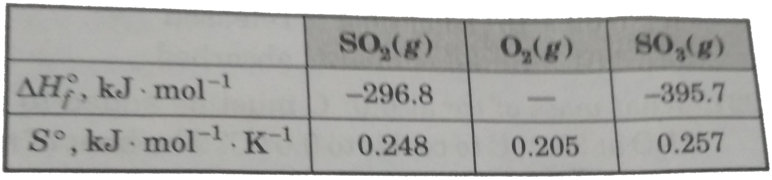
565. the combustion of 2- propanol $\left(M = 60.0g \times mol^{-1}\right)$ occurs according to the equation ,

$2CH_3CHOHCH_3(l) + 90_2(g) \rightarrow 6CO_2(g) + 8H_2O(l)$

What is q for the combustion of 15.0 g of 2- propanol?



	$SO_2(g)$	$O_2(g)$	$SO_3(g)$
ΔH_f°, $kJ \cdot mol^{-1}$	–296.8	—	–395.7
S°, $kJ \cdot mol^{-1} \cdot K^{-1}$	0.248	0.205	0.257

A. $-5.01 \times 10^2 KJ$

B. $-1.00 \times 10^3 KJ$

C. $-2.01 \times 10^3 KJ$

D. $-4.01 \times 10^3 Kj$

Answer: a

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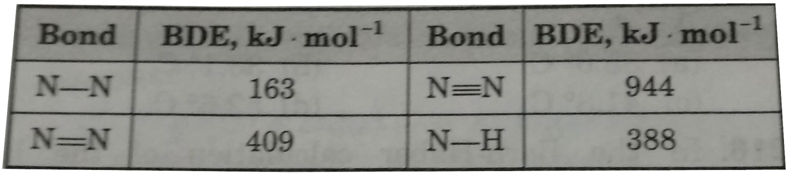
566. At what temperature does the reaction below change from favoring products to favoring



Bond	BDE, $kJ \cdot mol^{-1}$	Bond	BDE, $kJ \cdot mol^{-1}$
N—N	163	N≡N	944
N=N	409	N—H	388

A. 162K

B. 509K

C. 1060K

D. 1540K

Answer: c

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567. A 10.0 g piece of gallium (m=69.7) at 25.0° c is placed in 10.0 g of $H_2Oat55.0^\circ c$ what is the final temperature when this system comes to equilbium ? (Assume the specific heat capacity of liquid Ga is the same as that of solid $Ga = 0.37jg^{(-1)} {}^\circ C^{-1}\big)$.

A. $35.0^\circ C$

B. $38.1\,^{\circ}C$

C. $41.8\,^{\circ}C$

D. $52.6\,^{\circ}$C

Answer: d

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568. In the Born- Haber calculation of the lattice enthalpy of LiF from its elements , which process is exothermic?

A. Dissociation energy of $F_2(g)$

B. electron gain enthalpy of F(g)

C. ionization ebergy of Li(g)

D. sublimation erergy of Li(s)

Answer: b

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569. Given chemical equations for these reactions

$S(s) + O_2(g) \rightarrow SO_2(g) \Delta H = -29608 KJ \times mol^{-1}$

$H_2(g) + \frac{1}{2} O_2(g) \rightarrow H_2O(l) \Delta = -285.8 KJ \times mol^{-1}$

$H_2(g) + S(s) \rightarrow H_2S(g) \Delta H = -20.6 Kj \times mol^{-1}$

What is the value of ΔH for the reaction below?

$2H_2s(g) + 3O_2(g) \rightarrow 2H_2O(l) + 2SO_2(g)$

A. $-603.2 KJ \times mol^{-1}$

B. $-562.0 KJ \times , mol^{-1}$

C. $-1206.4 KJ \times mol^{-1}$

D. $-1124.0 Kj \times mol^{-1}$

Answer: d

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570. Calculate the energy released by the reaction 4 $Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$ when a 55.8 g sample of iron reacts ccompletely with 1.00 mole of oxygen . The enthalpy of iron reacts complately with 1.00 mole of Oxygen. The enthalpy of formation $\left(\Delta H_f^\circ\right)\mathrm{Of}Fe_2O_3(s)$, is - $826KJ \times mol^{-1}$:

A. 206KJ

B. 413KJ

C. 826KJ

D. 1650KJ

Answer: b

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571. The enthalpy of formation , ΔH_f° equals zero at $25\,^\circ$C for which of the following in their standard states?

A. elements

B. compounds

C. gases

D. solids

Answer: a

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572. The ΔH_f° of MgO is $-602KJ \times mol^{-1}$ .when 20.15g MgO is decomposed at constant pressure according to the equation below , how much heat will be transferred?

$2MgO(s) \rightarrow 2MG(s) + O_2(g)$

A. $1.20 \times 10^3 KJ$of heat is released

B. $6.02 \times 10^2 KJ$of heat is absorbed

C. $6.02 \times 10^2 KJ$of heat is released

D. $3.01 \times 10^2 KJ$of heat is absorbed

Answer: d

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573. What mass of ice at 0.0° C must be added to 100g H_2O at $25.0^{\circ}C$ to cool It to 0.0°C? The heat of fusion of ice is $334Jg^{-1}$

A. $1.25g$

B. $7.49g$

C. $31.3g$

D. 100g

Answer: c

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574. Using the bond dissciation enthalpies (BDEO in the table , estimate ΔH° for the disproportionation of hydrazine described in the equation below:

$$3N_2H_4(g) \rightarrow 4NH_3(g) + N_2(g)$$

A. $+283KJ \times mol^{-1}$

B. $-283KJ \times mol^{-1}$

C. $-393KJ \times mol^{-1}$

D. $-455KJ \times mol^{-1}$

Answer: d

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575. How is the enthalpy of vaporization of a substance relateed to its enthalpy of fusion?

A. The enthalpy of vaprization is greater than the enthalpy of fusion.

B. The enthalpy of vaporization is greater than the enthalpy of fusion.

C. The enthalpy of vaporization is less than the enthalpy of fusion.

D. There is no general relationship between a substance's enthalpy of vaporization and enthalpy of fusion

Answer: a

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576. The enthalpy change under standard condition for which of the reactions below would be equal to the ΔH_f° of NaOH(s)?

A. $Na(s) + H_2O(l) \rightarrow NaOH(s) + \frac{1}{2}H_2(g)$

B. $Na(s) + \frac{1}{2}O_2(g) + \frac{1}{2}H_2(g) \rightarrow NaOH(s)$

C. $Na(s) + \frac{1}{2}H_2O_2(l) \rightarrow NaOH(s)$

D. $Na^+(aq) + OH^-(aq) \rightarrow NaOH(s)$

Answer: b

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577. Given the enthalpy changes:

$A + B \rightarrow C\Delta H = -35KJ \times mol^{-1}$

$A + D \rightarrow E + F\Delta H = +20KJ \times mol^{-1}$

$F \rightarrow C + E\Delta H = +15KJ \times mol^{-1}$

What is $\Delta H$for the reaction $2A + B + D \rightarrow 2F$?

A. $0KJ. mol^{-1}$

B. $-30KJ. mol^{-1}$

C. $-40KJ. mol^{-1}$

D. $-70KJ \times mol^{-1}$

Answer: b

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578. Enthalpy of neutralization of NaOH with H_2SO_4 is $-57.3KJeq^{-1}$ and with ethanoic acid is $-55.2KJ. eq^{-1}$ Which of thefollowing is the best explanation of this difference?

A. Ethanioc acid is a weak acid and thus requires less NaOH for neutralization .

B. Ethanoic acid is only partly ionised , neutralization is therefore incomplete.

C. Ethanoic acid is monobasic while H_2SO_4 Is dibasic.

D. Some heat is used to ionize ethanioc acid completely.

Answer: d

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579. Calculate the enthalpy of isomerization of ethanol to dimethy ether:

$C_2H_5OH(l) \rightarrow CH_3OCH_3(g)$

Given : Enthalpy of vaporisation of equal =41 KJ/mole

bond enthalpies

C-C=348KJ/mole

C-H=415KJ/mole

C-o=352KJ/mole

O-h=463KJ/mole

A. 65KJ/mole

B. 25KJ/mole

C. 125KJ/mole

D. 85KJ/mole

Answer: d

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580. Determine enthalpy change for the following polymerizartion reaction per mole of $N_2(g)$ consumed

$nN_2(g) + nH_2(g) \rightarrow (NH - NH)_n(g)$

Given :

bond enthalpy :

n-=N=942KJ/mole,

N-N=163Kj/mole

H-H=436KJ/mole

N-H=390Kj/mole

A. 272Kj/mole

B. 140KJ/mole

C. $-110KJ/\text{mole}$

D. $-400KJ/\text{mole}$

Answer: a

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581. Standar enthalpy of formation of three combustible isomers compound A,B,C are -20Kcal/mol ,30kcal /mol and 40kcal /mol respectively then what will be order of their enthalpy of combustion ?

A. $\Delta H_c^\circ[A] < \Delta H_c^\circ[B] < \Delta H_c^\circ[C]$

B. $\Delta H_c^\circ[B] > \Delta H_c^\circ[A] > \Delta H_c^\circ[C]$

C. $\Delta H_c^\circ[A] > \Delta H_c^\circ[B] > \Delta H_c^\circ[C]$

D. $\Delta H_c^\circ [C] > \Delta H_c^\circ [A] > \Delta H_c^\circ [B]$

Answer: c

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582. How much heat energy must be supplied to change36 g of ice at $0\,^\circ C$ to Water at room temperature $25\,^\circ C$?

Data for Water

$\Delta H^\circ_{\text{fusion}} = 9Kj/mol, c_{p(\text{liquid})} = 4JK^{-1}g^{-1}$

A. 18KJ

B. 3.6Kj

C. 22KJ

D. 21.6Kj

Answer: d

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583. $H^+ + OH^- \rightarrow H_2O, \Delta H^\circ = -57Kj/mol$

$\Delta H^\circ_{\text{ionistion}}[HCN] = 45KJ/mol$

If 200mL of $\frac{1}{10}MBa(OH)_2$solution is mixed in 500mL Of $\frac{1}{10}MHCN$ solution ,then ,heat evolved will be :

A. 600 Joule

B. 240 Joule

C. 12 Joule

D. 480 Joule

Answer: d

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584. Calculate resonance enthalpy of $CO_2(g)$ from following data:

$\Delta H^\circ_{\text{combustion}}\left[C_{\text{graphite}}\right] = -390Kj/mol$

$\Delta H^\circ_{\text{Sublimation}}\left[C_{\text{graphite}}\right] = -715Kj/mol$

$\Delta H_{B.E.}[O = O] = 500KJ/mol$

$\Delta H_{B.E.}[C = O] = 875KJ/mol$

A. $-40KJ/mol$

B. $-145KJ/mol$

C. $-72.5KJ/mol$

D. $-290K\frac{J}{m}ol$

Answer: b

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585. The enthalpy change at 298 K for decompostion is Given in following steps:

$Step - 1H_2O(g) \rightarrow H(g) + OH(g)\Delta H = 498Kj/mol^{-1}$

$Steps - 2Oh(g) \rightarrow H(g) + O(g)\Delta H = 428KJ/mol^{-1}$

then value of mean bond enthalpy of O-H bond will be :

A. 498KJ/mol

B. 463KJ/mol

C. 428KJ/mol

D. 70KJ/mol

Answer: b

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586. $H^{+}_{aq} + OH^{-}_{aq} \rightarrow H_2O, \Delta H = -105Kj/mol$

$2HA(aq) \rightarrow BaA_{2(aq)+2H_2O}$,

$\Delta H = -105KJ/mol$

Iopnistion enthalpy of weak acid Ha (aq)will be :

A. 9KJ/mol

B. 48KJ/mol

C. 4.5KJ/mol

D. 24Kj/mol

Answer: c

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587. Enthalpy change when a solution is diluted from 4 M to 2 M is -1.6 KJ/mol . Enthalpy change when 5 litre of such a solution is diluted, is:

A. $-1.6KJ$

B. $-3.2KJ$

C. $-32Kj$

D. $-16KJ$

Answer: c

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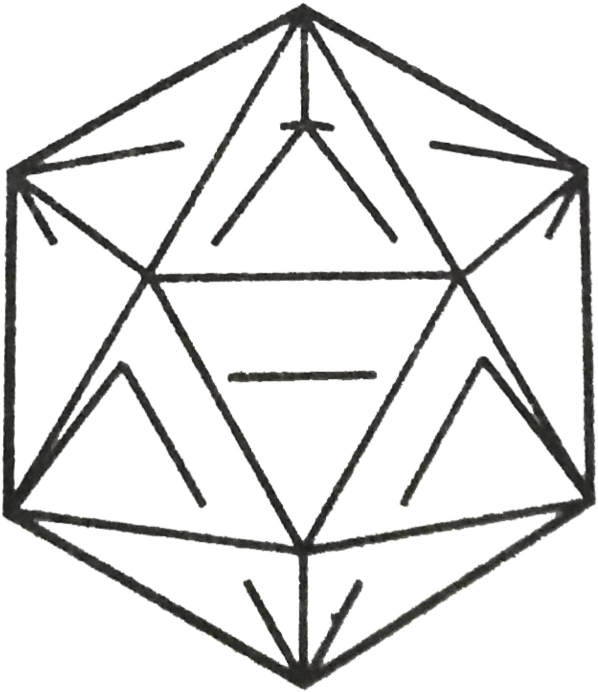
588. Boron exist in different allotropic forms .All allotropic fropm contains icosahedral units (icosahedral is a regular shape with 12 corners and 20 faces) with boron atoms at all 12 corners and all bonds are equivalent .



Icosahedron

Calculate ΔH (n KJ) per mole of boron atoms formating gaseous icosahedron if $\Delta H_{BE}(B - B) = 200KJ/mol$:

A. 1000

B. 600

C. 500

D. 250

Answer: c

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589. When 0.684 g of sucrose (Molar mass =342) is burnt in a constant pressure calorimeter, the temperature rises by 5.6 K./ If enthalpy of combustion of sucrose is -5600 Kj/mole then heat capacity of the calorimeter system is :

A. 200J/K

B. 2J/K

C. 2Kj/K

D. 4KJ/K

Answer: c

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590. The enthalpy change for the reaction of 50mL of acetyene with 150mL of H_2 to from ethane at 5 bar pressure is -1.2KJ/molethen heat capacity of the calorimeter system is:

A. $-1.25KJ$

B. $-1.3KJ$

C. $-1.4KJ$

D. $-1.15KJ$

Answer: d

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591. Enthalpy of hydrogenation of one mole benzene to cyclohexane is :

[Given : Resonance energy of benzene=-70KJ/mol, Enthalpy of hydrogenation of cyclohexene =-100KJ/mol]

A. $-170KJ$

B. $-30KJ$

C. $-370KJ$

D. $230KJ$

Answer: d

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592. magnitude of enthalpy of neutralization is minimum for:

A. $HCN + KOH$

B. $HCl + KOH$

C. $HCl + NH_4OH$

D. $HCN + NH_4OH$

Answer: d

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593. For the reaction

$N_2H_4(g) \rightarrow N_2H_2(g) + H_2(g),$

$\Delta H^{\circ}_{\text{reaction}} = 109KJ/mol$

$\in_{N-N} = 163KJ/mol$

$\in N - H = 391KJ/mol$

$\in_{H-H} = KJ/mol$

then ,then bond dissocition energy of N=N is:

A. 500KJ/mol

B. 436KJ/mol

C. 600KJ/mol

D. 400Kj/mol

Answer: d

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594. If for a chemical reaction ΔC_p I stemperature of reactants of this reaction bya certain amount $=q_1$ and heat required to increase temperature of products of the same reaction by same amount $=q_2$, then:

A. $q_1 > q_2$

B. $q_1 < q_2$

C. $q_1 = q_2$

D. q_1 may or may not be equal to q_2 will depend on nature of reactants and products .

Answer: a

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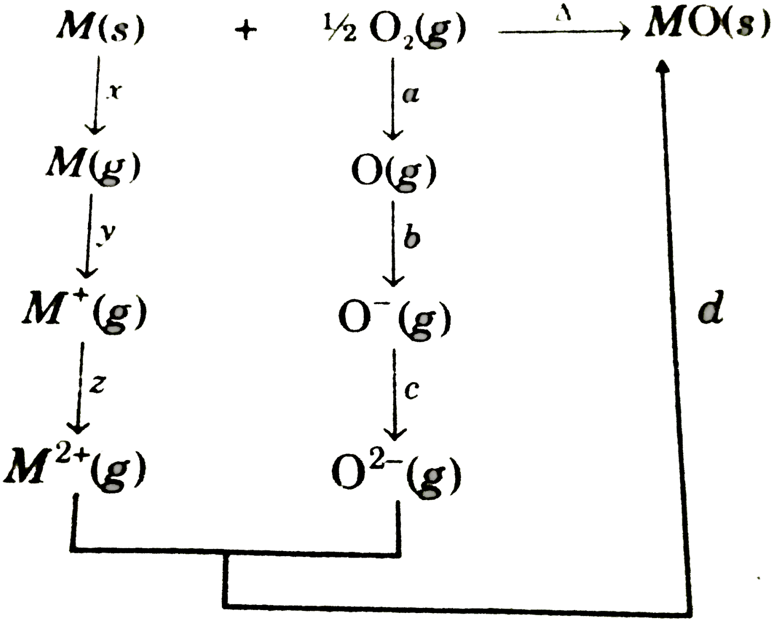
595. Born- Hyber cycle below respesents the energy changes occurring as 298 K, jwhen MO(s) is formed from its elements, wherx x, y,z, a, b,c and d are enthalpy change elements, for corresponding pro0cesses respectively



$\Delta H_{\text{sub}}\text{of}M = 180kJ/mol$

$I.E_1(M) = 218kJ/mol$

$I.E_2(M) = 384kJ/mol$

$\Delta H_{\text{atomisation}}\text{of}O_2 = 640kJ/mol$

$\Delta H\left(O \rightarrow O^{-}\right) = -142kJ/mol$

$\Delta H\left(O \rightarrow O^{-2}\right) = -844kJ/mol$

If $\Delta H_f\text{of MO(s) is } -196kJ/mol$ then lattice energy of MO (s) will be :

A. $-2000KJ/mol$

B. $-1000KJ/mol$

C. $-1500 KJ/mol$

D. $-600 KJ/mol$

Answer: a

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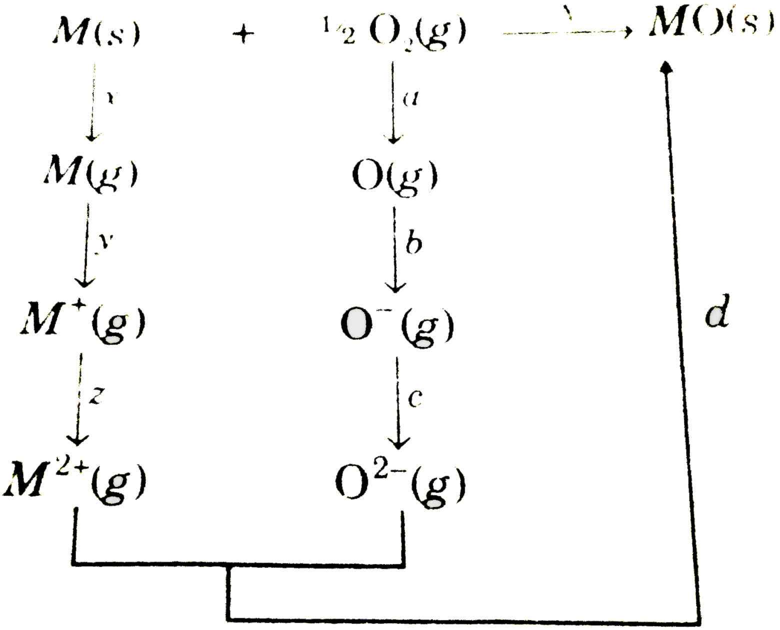
596. Born- Hyber cycle below respesents the energy changes occurring as 298 K, jwhen MO(s) is formed from its elements, wherx x, y,z, a, b,c and d are enthalpy change elements, for corresponding pro0cesses respectively



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$\Delta H_{\text{atomisation}}\text{of}O_2 = 640kJ/mol$

$\Delta H\left(O \rightarrow O^-\right) = -142kJ/mol$

$\Delta H\left(O \rightarrow O^{-2}\right) = -844kJ/mol$

"Enthaply change of reaction"

$2M^{2+}(g) + 20^{2-}(g) \rightarrow 2MO(s)$, is:

A. $-2000kJ/mol$

B. $-6000kJ/mol$

C. $-4000kJ/mol$

D. $-1000kJ/mol$

Answer: c

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597. With the help of fthermondynamic equation of state

$$\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$$

Answer the following questions for a van der Waals' gas

$$P = \frac{nRT}{V - nb} - \frac{an^2}{V^2}$$

$\left(\frac{\partial U}{\partial V}\right)$ For the van der Waals' is :

A. zero

B. $\frac{-an^2}{V^2}$

C. $\frac{-an^2}{V^2}$

D. none of these

Answer: c

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598. With the help of fthermondynamic equation of state

$$\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$$

Answer the following questions for a van der Waals' gas

$$P = \frac{nRT}{V - nb} - \frac{an^2}{V^2}$$

Work done for the isothermal process from $\left(P_1V_1T\right)$ to $\left(P_2V_2T\right)$ is :

A. zero

B. $an^2\left(\frac{1}{V_2} - \frac{1}{V_1}\right)$

C. $-an^2\left(\frac{1}{V_2} - \frac{1}{V_1}\right)$

D. none of these

Answer: c

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$$\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$$

Answer the following questions for a van der Waals' gas

$$P = \frac{nRT}{V - nb} - \frac{an^2}{V^2}$$

Work done for the isothermal process from $\left(P_1V_1T_1\right.$ to $\left(P_2V_2T\right)$ is :

A. $-nRT\frac{V_2 - nb}{V_1 - nb}$

B. $-nRt\ln'\frac{V_2 - nb}{V_1 - nb} - an^2\left(\frac{1}{V_2} - \frac{1}{V_1}\right)$

C. $an^2\left(\frac{1}{V_2} - \frac{1}{V_1}\right)$

D. none of the above

Answer: b

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600. With the help of fthermondynamic equation of state

$$\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$$

Answer the following questions for a van der Waals' gas

$$P = \frac{nRT}{V - nb} - \frac{an^2}{V^2}$$

Heat transfer for the isonthermal process from $\left(P_1 V_1 T\right)$ to $\left(P_2 V_2 T\right)$ is :

A. $nRT\ln'\frac{V_2 - nb}{V_1 - nb}$

B. $nRT\ln'\frac{V_2 - nb}{V_1 - nb} + an^2\left(\frac{1}{V_2} - \frac{1}{V_1}\right)$

C. $an^2\left(\frac{1}{V_2} - \frac{1}{V_1}\right)$

D. none of the above

Answer: a

601. With the help of fthermondynamic equation of state

$$\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$$

Answer the following questions for a van der Waals' gas

$$P = \frac{nRT}{V - nb} - \frac{an^2}{V^2}$$

ΔH for the insothermal process from $\left(P_1V_1T\right)$to $\left(P_2V_2T\right)$ to is :

A. $\Delta H = \left(P_2V_2 - P_1V_1\right)$

B. $\Delta H = -an^2\left(\frac{1}{V_2} - \frac{1}{V_1}\right) + \left(P_2V_2 - P_1V_1\right.$

C. $\Delta H = -an^2\left(\frac{1}{V_2} - \frac{1}{V_1}\right) + nRT\left[\frac{V_2}{V_2 - nb} - \frac{V_1}{V_1 - nb}\right]$

D. $\Delta H = nRT\left[\frac{V_2}{V_2 - nb} - \frac{V_1}{V_1 - nb}\right]$

Answer: b,c

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602. With the help of fthermondynamic equation of state

$$\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$$

Answer the following questions for a van der Waals' gas

$$P = \frac{nRT}{V - nb} - \frac{an^2}{V^2}$$

Work done during the process if n moles of van der Waals' gas is subjrcted to reversible adiabatic expansion from $\left(P_1V_1T_1\right)$ to $\left(P_2V_2T_2\right)$ is :

A. $nC_V\left(T_2 - T_1\right) - an^2\left(\frac{1}{V_2} - \frac{1}{V_1}\right)$

B. $nC_V\left(T_2 - T_1\right)$

C. $an^2\left(\frac{1}{V_2} - \frac{1}{V_1}\right)$

D. none of the above

Answer: a

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603. With the help of fthermondynamic equation of state

$$\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$$

Answer the following questions for a van der Waals' gas

$$P = \frac{nRT}{V - nb} - \frac{an^2}{V^2}$$

Which of the following is true for van der Walls' gas involved in reversible adiabatic process ?

A. $T^{CV/R}(V - nb) = const.$

B. $T^{R/CV}(V - nb) = const.$

C. $(T.a)^{CV/R}(V - nb) = const.$

D. $\left(\frac{T}{a}\right) = const.$

Answer: a

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604. With the help of fthermondynamic equation of state

$$\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$$

Answer the following questions for a van der Waals' gas

$$P = \frac{nRT}{V - nb} - \frac{an^2}{V^2}$$

Entropy change for van der Waals' gas going from $\left(P_1, V(1), T_1\right)$ to $\left(P_2, V_2, T_2\right)$ will be :

A. $nC_V \ln' \frac{T_2}{T_1} - nR \ln' \frac{V_2 - nb}{V_1 - nb}$

B. $nC_V \ln' \frac{T_2}{T_1} + nR \ln' \frac{V_2 - nb}{V_1 - nb}$

C. $nC_V \ln' \frac{T_2}{T_1} + nR \ln' \frac{V_2 - nb}{V_1 nb} + an^2\left(\frac{1}{V_2} - \frac{1}{V_1}\right)$

D. $nC_V \ln' \frac{T_2}{T_1} + nR \ln' \frac{V_2 + nb}{V_1 nb} - an^2\left(\frac{1}{V_2} - \frac{1}{V_1}\right)$

Answer: b

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605. With the help of fthermondynamic equation of state

$$\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$$

Answer the following questions for a van der Waals' gas

$$P = \frac{nRT}{V - nb} - \frac{an^2}{V^2}$$

Selectg the correct statements :

A. Heat absorbed in isothermal reversible expansion for real gas is more than ideal gas for same volume change.

B. Heat liberated in isothermal reversible isothermal reversible expansion.

C. Internal energy of ral gas increases during isothermal reversible expansion.

D. Internal energy of real gas increases during isothermal reversible compresssion.

Answer: a,b,c

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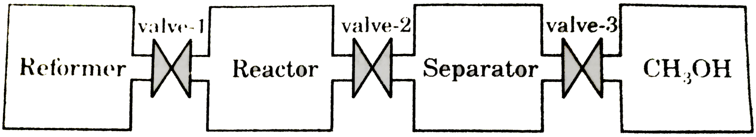
606. A factory, producing methanol, is based on the reaction :

$CO + 2H_2 \rightarrow CH_3OH$ ltBRgt Hydrogen and carbon monoxide are obtained by the reaction

$CH_4 + H_2O \rightarrow CO + 3H_2$

Three units of factory namely, the "reformer" for the H_2 and CO production, the "methanol reactor" for production of methonol adn a "separator" to separate CH_3OH form CO and H_2 are schematically shown in figure.



The flow of methonal from valve-3 is $10^3 mol/\sec$. The factory is so designed that $\frac{2}{3}$ of the CO is converted to CH_3OH. Assume that the feromer reaction goes to completion.

$CO + 2H_2 \rightarrow CH_3OH \Delta_r H = -100R$

What is the flow of CO and H_2 at valve-2 ?

A. $CO : 500 mol/\sec, \ H_2 : 1000 mol/\sec$

B. $CO: 1500 mol/\sec, \ H_2: 2500 mol/\sec$

C. $CO: 500 mol/\sec, \ H_2: 2000 mol/\sec$

D. $CO: 500 mol/\sec, \ H_2: 1500 mol/\sec$

Answer: b

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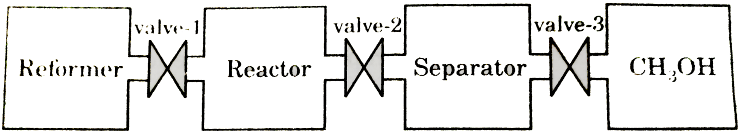
Three units of factory namely, the "reformer" for the H_2 and CO production, the "methanol reactor" for production of methonol adn a "separator" to separate CH_3OH form CO and H_2 are schematically shown in figure.



The flow of methonal from valve-3 is $10^3 mol/\sec$. The factory is so designed that $\frac{2}{3}$ of the CO is converted to CH_3OH. Assume that the feromer reaction goes to completion.

$CO + 2H_2 \rightarrow CH_3OH\Delta_rH = -100R$

Amount of energy released in methanol reactor in1 minute :

A. 1200 kcal

B. 12000 kcal

C. 6000 kcal

D. none of these

Answer: b

View Text Solution

608. One mole of a monoatomic ideal gas was isobarically heated from 300 K to 600 K at constant pressure of one atm. Subsequently, it is subjected to reversible adiabatic expansion till the volume becomes $4\sqrt{2}$ of origingl (starting) value. After that it is subjected to isobaric cooling to original volume.

what is the chanege in enthalpy in adiabatic process ?

A. $-750R$

B. $+500R$

C. $+750R$

D. $-500R$

Answer: a

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609. Bond dissociation enthaply of the first H-S bond in hydrogen sulphide is $376\text{Kj}/\text{mole}$. The enthalpies of formatin of $H_2S(g)$ and $S(g)are - 20.0$ and $277.0\text{kj}/\text{mole}$ respectively. The enthalpy of formation of gaseous hydrogen atomis $218\text{Kj}/\text{mole}$. Using above information, answer following questions :

The bond disscociation enthalpy of the free radical HS is :

A. $138kJ/\text{mole}$

B. $276kJ/\text{mole}$

C. $357kJ/\text{mole}$

D. $376kJ/\text{mole}$

Answer: c

View Text Solution

610. One mole of idea monoatomic gas at 300 K undergoes an adiabatic irrersible process due to which its interhnal energy decreases by 150 calories.

If the process is carried out isobarically to obtain same work then the enthalpy change of the isobaric process is :

A. 300 cal

B. -550 cal

C. 400 cal

D. 375 cal

Answer: d

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611. Adenosine triphosphate (ATP) is the energy. Currency for celuclar processes. ATP provides the energy for both energy consuming endergonic reaction and energy releasing exerogonic reactions, which require a small input of activation energy. When the chemical bonds within ATP are broken, energy is relased and can be harnessed for celluar work. The more bonds in a molecule, the more potential energy it containsl. Because the bond in ATP is si easily broken and reformed, ATP is like a rechargeable battery that power callular processes ranging rfeom DNA replicatin to protein synthesis.

Adenosine triphosphate (ATP) is comprising of the molecule adenosinek, bound to three phosphate groups. together, these chemical groups constitute energy powerhouse.

Together the two bonds between the phosphates are equal high-energy bonds (phosphonhydride bonds) that, when broken release sufficient energy to power a variet of cellular reaction and processes. the bond between the beta and gamma phosphate is considered "hi-energy" because wnen the bond breaks, the products [adenosine diphosphate (ADP) and one inorgnic phosphate group $\left(P_1\right)$is called hydrolysis because it concumes a water molecule (hydro, meaning "water" ,and lysis, meaning separation). ATP is hydrolyzed into ADP in the followinf reaction :

$$ATP(aq) + H_2O(l) \rightarrow ADP(aq) + P_i(aq) + H_3O^+(aq)\Delta_r = -30kJ/mol$$

Like most chemical reactions, the hydrolysis of ATP to ADP is reversible. The reverse reaction combines $ADP + P_1$ to regenerate ATP (adenosine diphosphate). Since ATP hydrolysis releases energy, ATP syntesis must require an input of free energy. The syntheses of ATP molecule involves oxidation of glucose by NDA^+ (Nicotinamide dinucleotide) to pyruvate ions $\left(CH_3COCOO^-\right)$ by reaction.

$$C_6H_{12}O_6(aq) + 2NAD^+(aq) \rightarrow 2CH_3COCO_2^-(aq) + 2NDHA(aq) + 4H_3O^+(aq),$$

Overall reaction :

$$C_6H_{12}O_6(aq) + 2NDA^+(aq) + 2ADP(aq) + 2P_i(aq) + 2H_3O^+(aq) \rightarrow 2CH_3COC$$

How many moles of ATP can by synthesised along with generation of maximum muscular and nervous work of 174 kJ by oxidation of glucose ?

A. 2 moles

B. 4 moles

C. 6 moles

D. 8 moles

Answer: b

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612. Adenosine triphosphate (ATP) is the energy. Currency for celuclar processes. ATP provides the energy for both energy consuming endergonic reaction and energy releasing exerogonic reactions, which require a small input of activation energy. When the chemical bonds within ATP are broken, energy is relased and can be harnessed for celluar work. The more bonds in a molecule, the more potential energy it containsl. Because the bond in ATP is si easily broken and reformed, ATP is like a rechargeable battery that power callular processes ranging rfeom DNA replicatin to protein synthesis.

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Overall reaction :

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Hydrolysis of adenosine triphosphate (ATP) is used to drive biological reaction. Which of following processes can be driven by hydrolysis of one mole of ATP molecules ?

A. Biosynthesis of tripeptide (3-peptide links) with each link involving $\Delta_r G^\circ = 17kJ/mol$

B. Biosynthesis of protein with 150peptide links with each link formation involving $\Delta_r G^\circ = 17kJ/mol$

C. Biosynthesis of 1 mole sucrose from glucose and fructoes with $\Delta_r G^\circ = 23kJ/mol$

D. All of the above

Answer: c

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613. Photosyntesis is a bio process by which planets make energy rich molecules from low energy molecules with the help of energy. From sunlight. The photosynthesis of glucose can be represented as :

$6CO_2(g) + 6H_2O(g) + hv \rightarrow C_6H_{12}O(s) + 60_2(g)$

Electrochemical oxidation of glucoses to CO_2 and $H_2O.$ which is the reverse of photosyhnthesis, is an impottaint reaction and it can be used in the construction of a fuel cell. In a fule cell, a working substance celled fule is electrochemiclly oxidised by O_2

$C_6H_{12}O_6 + 6HO \rightarrow 24_e^- + 24H^+ + 6CO_2$

Calculate the approximate standard emf of this fuel cell at $27\,^\circ C$ if ΔH° and ΔS° of above photosynthesis reaction are $-3 \times 10^6 Jmol^{-1}$ and $200JK^{-1}mol^{-1}$respectively :

A. 1.5 volt

B. 1 volt

C. 4.5 volt

D. 3 volt

Answer: a

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614. $N_2(g) + 20_2(g) \rightarrow 2NO_2(g)\Delta H_{\text{rxn}} > 0$

Under what temperature conditions is this reaction spontaneous at standard preassure?

A. At low temperatures only

B. At high temperatures only

C. At all temperatures

D. At no temperature

Answer: d

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615. Rubber bands comprise of loosely packed chains of atoms.When stretched, the chain of atoms get neatly lined up in rows and hens the entrops of system decreases whereas when contacted the chains get tangled up in a mess increasing entropy of system. Also on strectching rubber band, it is observed that any substance brought in its contact gets heated up. Based on this information, answer the following questions.

What should happen when a rubber band is heated ?

A. It should expand and get strectched.

B. It should contract.

C. Bonds/Attractions between the molecules of rubber band will keep on weakening.

D. The chains of molecules will get more tangled.

Answer: b,c,d

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616. Rubber bands comprise of loosely packed chains of atoms.When stretched, the chain of atoms get neatly lined up in rows and hens the entrops of system decreases whereas when contacted the chains get tangled up in a mess increasing entropy of system. Also on strectching rubber band, it is observed that any substance brought in its contact gets heated up. Based on this information, answer the following questions.

Which of the following statement(s) is/are correct?

A. A van dar wallls' get at is critical condition subjected to adiabatic free expansion experiences cooling effect.

B. If for a reaction $\Delta H^{\circ}_{400}K = \Delta H^{\circ}_{200}Kthen\Delta S^{\circ}_{300}K$ should be equal to $\Delta S^{\circ}_{500}K.$

C. The value of compressibility factor of a real gas is 1 at Boyle's temperature for all range of pressures.

D. Ametal peroxide has 68% by mass metal, hence equivalent mass of its chloride will be 69.5 gms.

Answer: a,b,d

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617.

	Column-I		Column-II
(a)	Reversible isothermal expansion of an ideal gas	(p)	$w = 2.330\text{nRTlog}($
(b)	Reversible adiabatic compression of an ideal gas	(q)	PV' cosntant
(c)	Irrevesible adiabatic expansion of anideal gas	(r)	$w = \frac{nR}{(\gamma - 1)}(T_2 - T_1$
(d)	Irrevesiable isothermal compression of an ideal gas	(s)	$\Delta H = 0$

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618.

	Column-I		Column-II
(a)	A process carried out infinitesimally	(p)	Adiabatic
(b)	A process inwhich no heat enters or leaves the system	(q)	$\Delta G = 0$
(c)	A process carried out at constant temperature	(r)	Sublimation
(d)	A process in equilibrium	(s)	$\Delta E = 0 \Delta H = 0$
(e)	$A(s) \rightarrow A(g)$	(t)	Reversible
(f)	Cyclic process	(u)	Isotermal

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619.

	Column-I		Column-II
(a)	$\left(\Delta G_{system}\right)_{T\,.\,P}{}^{=0}$	(p)	Process in equilibrium
(b)	$\Delta S_{system} + \Delta S_{\text{sorrounding}} > 0$	(q)	Process is non-spontaneous
(c)	$\Delta S_{system} + \Delta S_{\text{Surrounding}} < 0$	(r)	Process is spontaneous
(d)	$\left(\Delta G_{system}\right) +_{T\,,\,P} > 0$	(s)	System is unable to do useful work

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620.

	Column-I		Column-II
(a)	Reversible adiabatic compression	(p)	Process in equilibrium
(b)	Reversible vaporisation of liquid	(q)	$\Delta S_{system} < 0$
(c)	$2N(g) \rightarrow N_2(g)$	(r)	$\Delta S_{\text{surrounding}} < 0$
(d)	$MgCO_3(s) \overset{\Delta}{\rightarrow} Mg(s) + CO_2(g)$	(s)	$\Delta S_{\text{sublimation}} = 0$

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621.

	Column-I		Column-II
(a)	C(s,graphite) + $0_2(g) \rightarrow CO_2(g)$	(p)	ΔH° _ (Combustion)
(b)	C(s,graphite) $\rightarrow C(g)$	(q)	ΔH° _ (combustion)
(c)	$CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$	(r)	ΔH° _ (atomization)
(d)	$CH_4(g) \rightarrow C(g) + 4H(g)$	(s)	ΔH° (sublimation)

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622.

	Column-I		Column-II
(a)	Heating of an ideal gas at constant pressure	(p)	$\Delta H = nC_{p.m}$
(b)	Compression of liquid at constant temperature	(q)	$\Delta U = 0$
(c)	Reversible process for anideal gas at constant temperature	(r)	$\Delta G = V.\Delta P$
(d)	Adiabatic free expansion of an ideal gas	(s)	$\Delta G = nRT\ln$

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623. Match the column : (Given process does not include chemical reactionn and phase change)

	Column-I		Column-II
(a)	$\Delta H = \Delta U + \Delta(PV)$	(P)	Any matter undergong any process
(b)	$\Delta H = n.\, C_P \Delta T$	(q)	Isochoric process involving any substance
(c)	$q = \Delta U$	(r)	Ideal gas,under any process
(d)	$\Delta H = \Delta U + nR\Delta T$	(s)	Ideal gas under isothermal process
		(t)	Anysubstance undergoing isobaric process

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624. For process

$$H_2o(l)\left(100\,^\circ C, 1atm\right) \Leftrightarrow H_2O(g)\left(100\,^\circ C, 1atm\right)$$

	Column-I		Column-II
(a)	ΔU	(p)	0
(b)	ΔS(system+surrounding)	(q)	ΔH
(c)	work	(r)	positive
(d)	Heat involved	(s)	Negative

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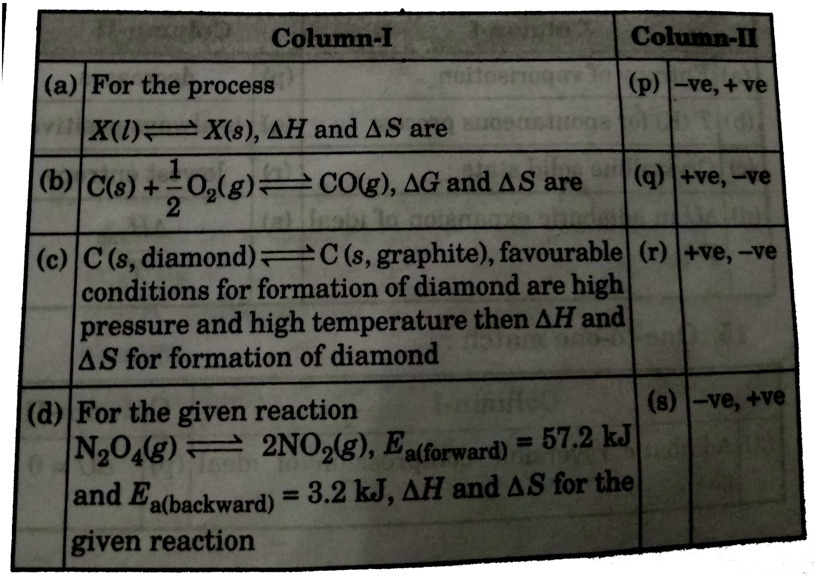
625.



Column-I		Column-II	
(a)	For the process $X(l) \rightleftharpoons X(s)$, ΔH and ΔS are	(p)	–ve, + ve
(b)	$C(s) + \frac{1}{2}O_2(g) \rightleftharpoons CO(g)$, ΔG and ΔS are	(q)	+ve, –ve
(c)	C (s, diamond) $\rightleftharpoons$ C (s, graphite), favourable conditions for formation of diamond are high pressure and high temperature then ΔH and ΔS for formation of diamond	(r)	+ve, –ve
(d)	For the given reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$, $E_{a(forward)} = 57.2$ kJ and $E_{a(backward)} = 3.2$ kJ, ΔH and ΔS for the given reaction	(s)	–ve, +ve

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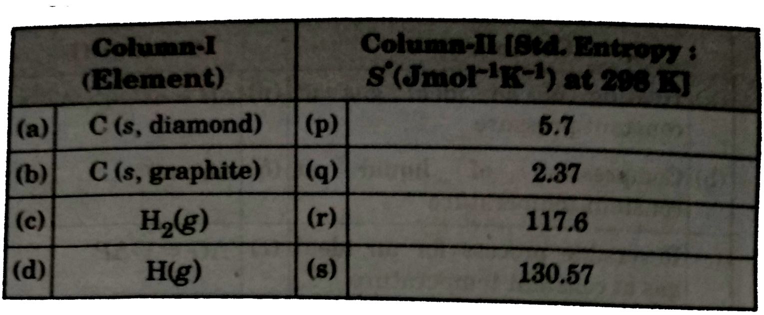
626.



Column-I (Element)		Column-II [Std. Entropy : S° ($Jmol^{-1}K^{-1}$) at 298 K]	
(a)	C (s, diamond)	(p)	5.7
(b)	C (s, graphite)	(q)	2.37
(c)	$H_2(g)$	(r)	117.6
(d)	$H(g)$	(s)	130.57

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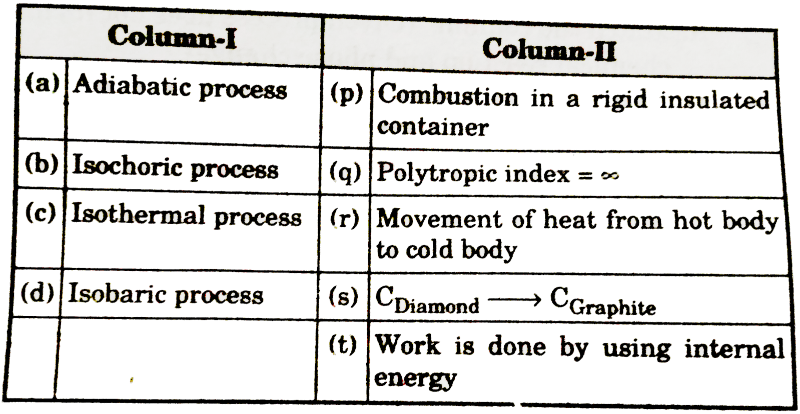
627.



Column-I		Column-II	
(a)	Adiabatic process	(p)	Combustion in a rigid insulated container
(b)	Isochoric process	(q)	Polytropic index = ∞
(c)	Isothermal process	(r)	Movement of heat from hot body to cold body
(d)	Isobaric process	(s)	$C_{\text{Diamond}} \longrightarrow C_{\text{Graphite}}$
		(t)	Work is done by using internal energy

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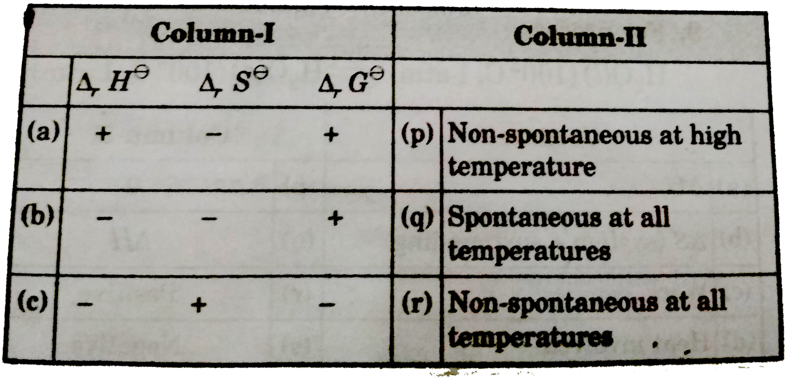
628. Match the following Columns



Column-I				Column-II	
	$\Delta_r H^\ominus$	$\Delta_r S^\ominus$	$\Delta_r G^\ominus$		
(a)	+	−	+	(p)	Non-spontaneous at high temperature
(b)	−	−	+	(q)	Spontaneous at all temperatures
(c)	−	+	−	(r)	Non-spontaneous at all temperatures

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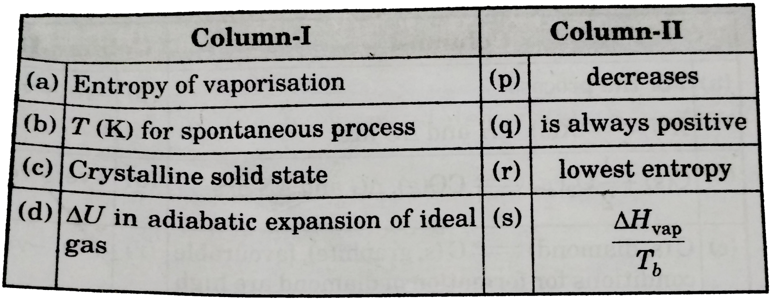
629.



Column-I		Column-II	
(a)	Entropy of vaporisation	(p)	decreases
(b)	T (K) for spontaneous process	(q)	is always positive
(c)	Crystalline solid state	(r)	lowest entropy
(d)	ΔU in adiabatic expansion of ideal gas	(s)	$\frac{\Delta H_{vap}}{T_b}$

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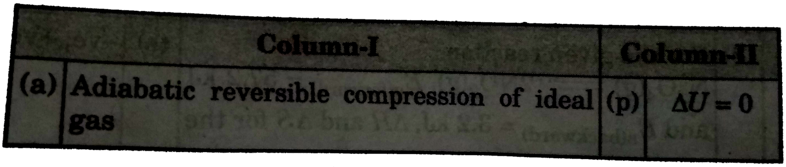
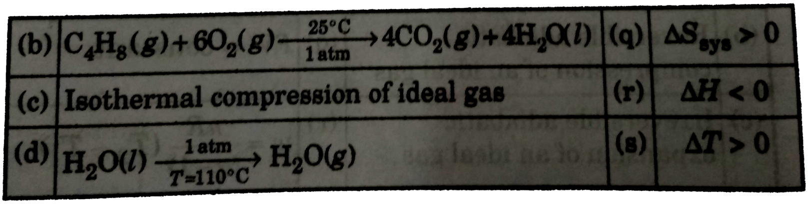
630.





Column-I		Column-II	
(a)	Adiabatic reversible compression of ideal gas	(p)	$\Delta U = 0$
(b)	$C_4H_8(g) + 6O_2(g) \xrightarrow[1\,atm]{25^\circ C} 4CO_2(g) + 4H_2O(l)$	(q)	$\Delta S_{sys} > 0$
(c)	Isothermal compression of ideal gas	(r)	$\Delta H < 0$
(d)	$H_2O(l) \xrightarrow[T=110^\circ C]{1\,atm} H_2O(g)$	(s)	$\Delta T > 0$

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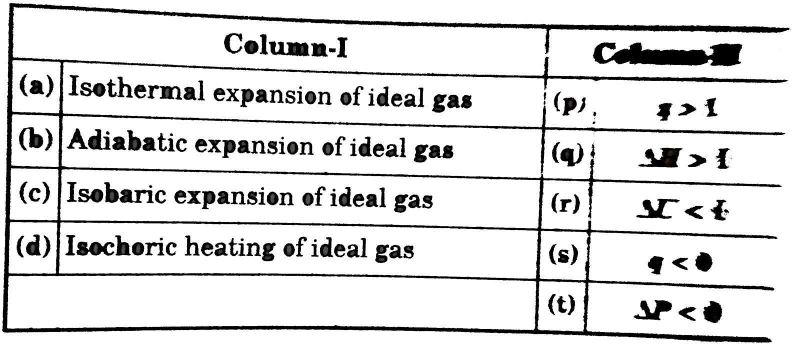

Column-I		Column-II	
(a)	Isothermal expansion of ideal gas	(p)	$q > 0$
(b)	Adiabatic expansion of ideal gas	(q)	$\Delta H > 0$
(c)	Isobaric expansion of ideal gas	(r)	$\Delta U < 0$
(d)	Isochoric heating of ideal gas	(s)	$q < 0$
		(t)	$\Delta P < 0$

631.

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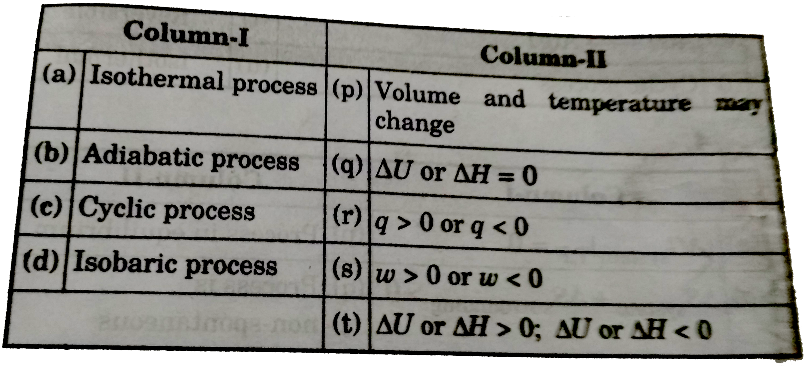

Column-I		Column-II	
(a)	Isothermal process	(p)	Volume and temperature may change
(b)	Adiabatic process	(q)	ΔU or $\Delta H = 0$
(c)	Cyclic process	(r)	$q > 0$ or $q < 0$
(d)	Isobaric process	(s)	$w > 0$ or $w < 0$
		(t)	ΔU or $\Delta H > 0$; ΔU or $\Delta H < 0$

632.

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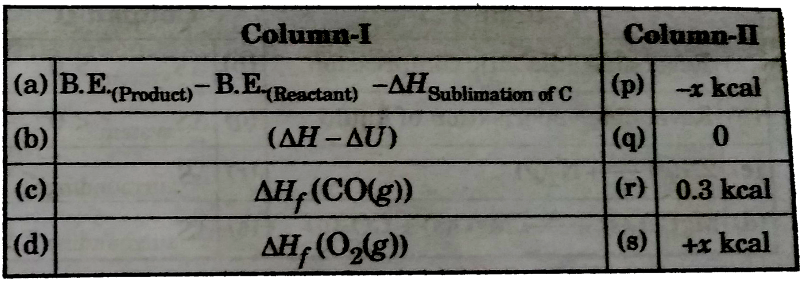

Column-I		Column-II	
(a)	B.E.$_{(Product)}$ − B.E.$_{(Reactant)}$ $-\Delta H_{\text{Sublimation of C}}$	(p)	$-x$ kcal
(b)	$(\Delta H - \Delta U)$	(q)	0
(c)	$\Delta H_f(CO(g))$	(r)	0.3 kcal
(d)	$\Delta H_f(O_2(g))$	(s)	$+x$ kcal

633.

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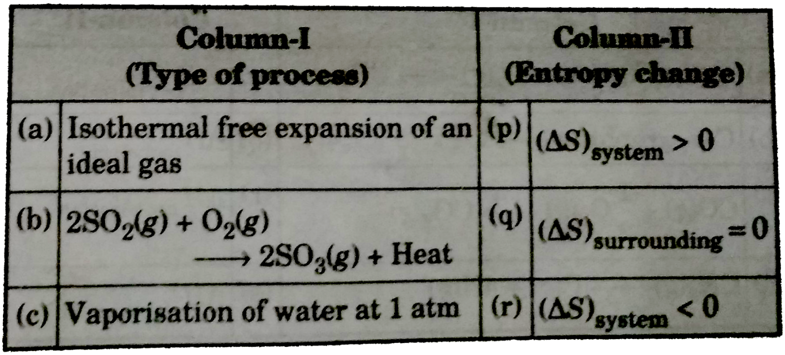

Column-I (Type of process)		Column-II (Entropy change)	
(a)	Isothermal free expansion of an ideal gas	(p)	$(\Delta S)_{system} > 0$
(b)	$2SO_2(g) + O_2(g) \longrightarrow 2SO_3(g) + \text{Heat}$	(q)	$(\Delta S)_{surrounding} = 0$
(c)	Vaporisation of water at 1 atm	(r)	$(\Delta S)_{system} < 0$

634.

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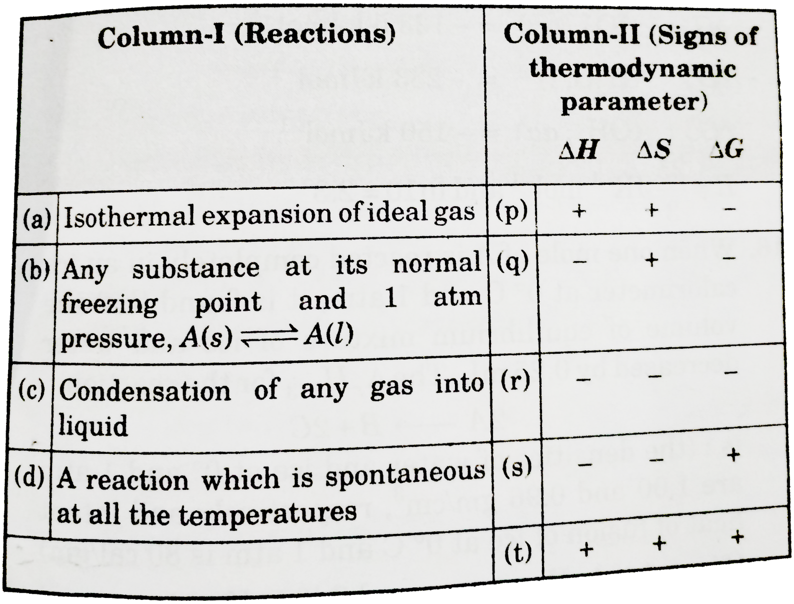
635.



	Column-I (Reactions)		Column-II (Signs of thermodynamic parameter)		
			ΔH	ΔS	ΔG
(a)	Isothermal expansion of ideal gas	(p)	+	+	−
(b)	Any substance at its normal freezing point and 1 atm pressure, $A(s) \rightleftharpoons A(l)$	(q)	−	+	−
(c)	Condensation of any gas into liquid	(r)	−	−	−
(d)	A reaction which is spontaneous at all the temperatures	(s)	−	−	+
		(t)	+	+	+

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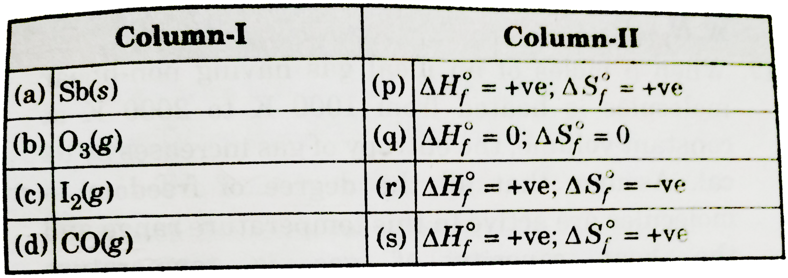
636.



	Column-I		Column-II
(a)	$Sb(s)$	(p)	$\Delta H_f^\circ = +ve; \Delta S_f^\circ = +ve$
(b)	$O_3(g)$	(q)	$\Delta H_f^\circ = 0; \Delta S_f^\circ = 0$
(c)	$I_2(g)$	(r)	$\Delta H_f^\circ = +ve; \Delta S_f^\circ = -ve$
(d)	$CO(g)$	(s)	$\Delta H_f^\circ = +ve; \Delta S_f^\circ = +ve$

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637. Calculated the final temprature (in Kelvin of a sample of argon of mass 12.0 g that is expanjded reversibly and adiabatically from 1.0 L at at 273 K to 3.0 L. (Take :$3\sqrt{9} = 2.08$)

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638. In how many of the folowinf reaction $\left|H^\circ\right| > \left|\Delta E^\circ\right|$, assuming reacftion to be occurring at a constant temperature and pressure.

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O(l)$

Combustion of $C_2H_8(g)$ at 400 K

Dimerisation of $NO_2(g)$

Fusion of water at 0° C

Vaporisation of any liquid at its boiling poing

Dossociation of $CaCO_3(s)$

Combustion of C_2H_4 at 300m K

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639. Calculate the final pressure of a sample of carbon dioxide that expands reversibly and adiabatically from $57.4kPa$ and 1.0 to a final volume of $2.0L$. Take $\gamma = 1.4$

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640. A sample of carbon dioxide of mass 2.45 g at $27.0\,^{\circ}$C is allowed to expand reversibly and adiabatically from 500 mL to 3.00 L What is the work done by the gass ?

Take: $(6)^{0.4} = 2, R = \frac{25}{3} J/mol/K\Big]$

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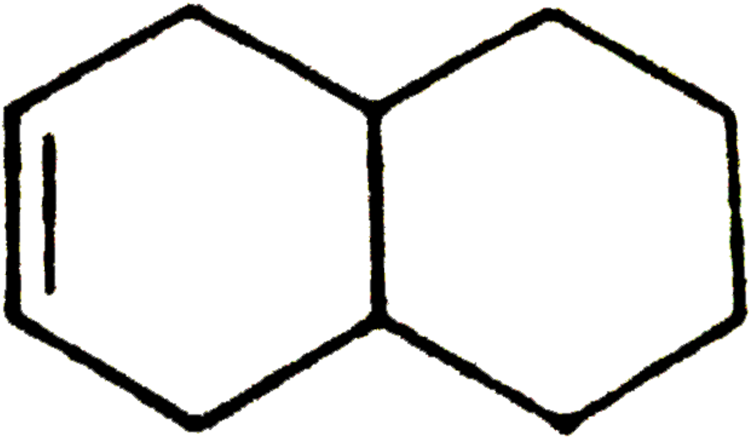
641. Calculate resonance energy for $\frac{1}{6}$ mole of naphtalene if its heat of hydrogenation is 91 kcal and heat of hydrogenation of



id 29 kcal.

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642. Once mole of gas is subjected to a process causing a change in astate from(1.25 atm, 300 K) to a final state of (1 atm, 600 K). Calculate the enthalpy change from the following information [in atm-litre]

Information 1: The process involvea 100 atm-litre of heat given to system of 20 atm-liter of work is done by the system.

Information :2 Molar mass of the gas is 49.26.

Information 3 : Density of gas as 1.25 atm and 300 K is 2 gm/liter.

Information 4: Density of gas at 1 atm and 600 K is l gm/litre.

[Given : R =0.0821 atm-litre/mol $K = \frac{18.47}{225}$ atm-litre/mole K] (Round off your answer to nearest integer).

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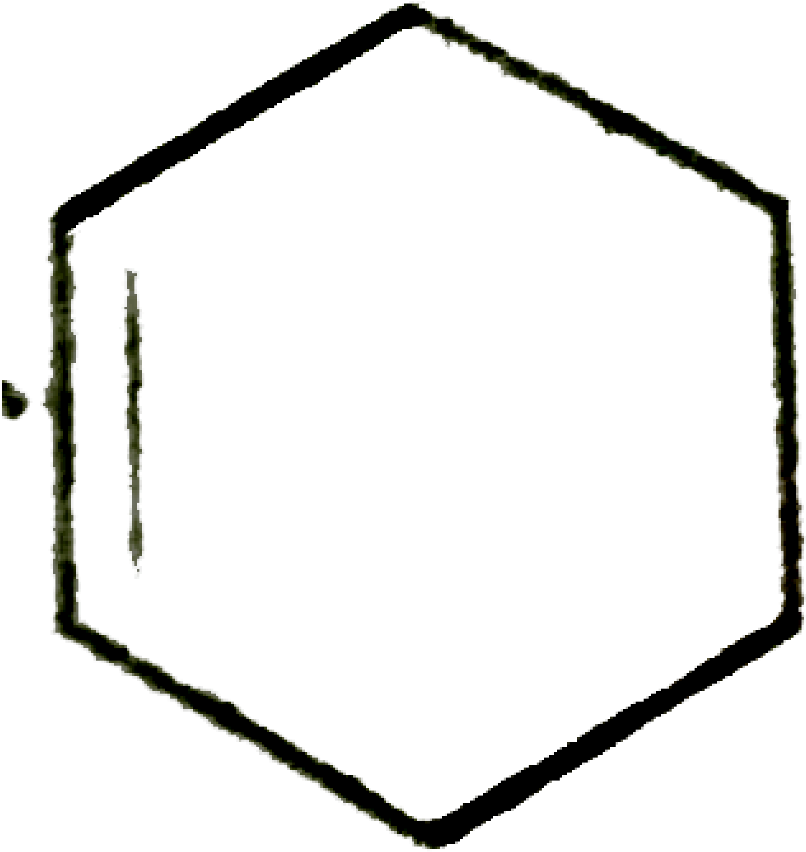
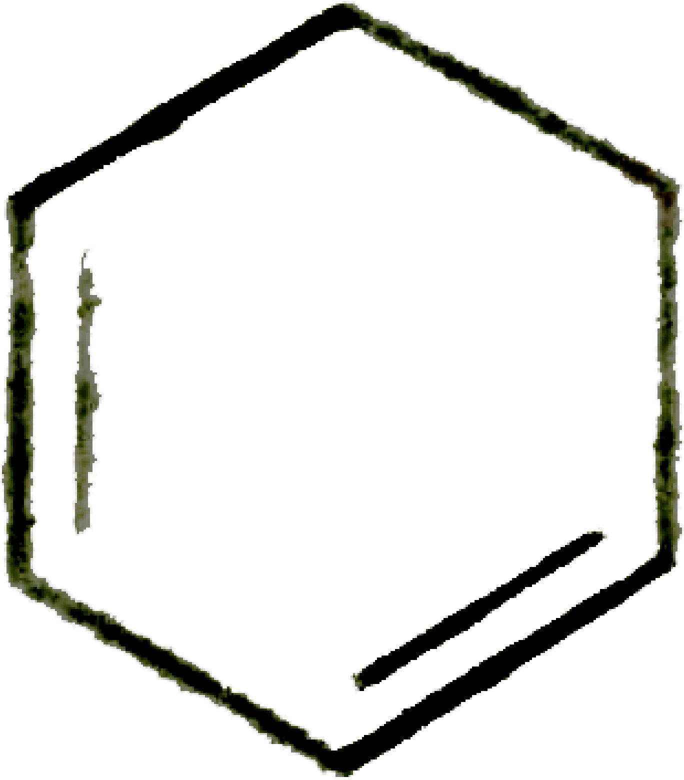
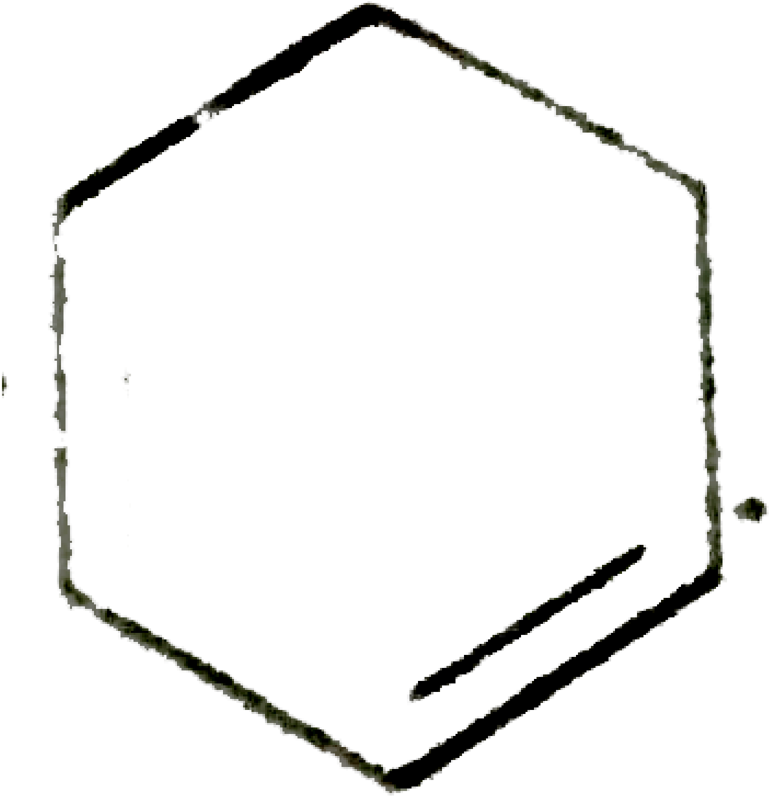
643. Heat of hydrogention of



is 29 kcal mol^{-1} and that of



is $56 \text{kcal} mol^{-1}$. Calculate the resonance energy of



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644. 4 moles of a van dr Walls'gas is subjected to 3 Kj of hrat in a closed rigid vessel of volume 20.2 L causing an increase in temperature from 300 K to 400 K. Calculate the value of ΔH (inJ) for the above change

[Given data : $R = 0.08L$ bar $\text{mole}^{-}K^{-1}, a = 2L^{2}$ bar $mol^{-2}, b = 0.05L\text{mole}^{-1}$]

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645. Three gases A, B and C were taken at partial pressures of 1 bar each along with excess of liquide D so thet following equation was established.

$A(g) + B(g) \Leftrightarrow C(g) + D(g)$

Calculate partial pressure of C (in pascal) when equalibrium gets established in the container at 300 k.

Given: $\Delta G^{\circ} f$ A (g) =- 200 kcal/mole

$\Delta G^{\circ} f$ D(l)=-49.58 kcal/mole

$\Delta G^{\circ} f$ B (g0 =-100 Kcal/mole

$\Delta G^{\circ} f$ D (g)=-49.58 kcal/mole

$\Delta G^{\circ} f$ C (g) =- 250 kcal/mole

R=2 cal/mol K, In 2=0.7 $\sqrt{5} = 2.24$ all data are given at 300 K.

Divede your answer by 10 and fill the OMR.

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646. A sustance undergoes a change represented as show A (l) [1bar,300K] $\rightarrow A$ (s) [1bar, 300 K].from the given information, calculate magnitude of change in internal energy (in Joules) when 1 mole of A (l) solidifies

Standard melting point of A (s) is 300 K.

Latent heat of fusion of A id 0.01 kJ/gm.

Specific volume of A (s) is 100 ml/gm.

Moar mass of A is 50 gm /mole

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647. A substance has normal boiling point pf 400 K. if ΔS_{vap} at 1 atm and $400K$ is $100J/k\text{mole},$ then calculte $|\Delta S|_{\text{surrounding}}$ at 1 atm and 200 K for the vaporization process.

Cp of substance in liquide phase =50 J/mol K

Cp of substance in vapour phase = 40 J/mol K

[Express answer in J/k mole]

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648. A gaseous reaction $A(g) \Leftrightarrow B(g)$ is at equilibrium under standard condition and 200 K. Calculate the equilibrium constant of the reaction at 400 K if $\Delta S^{\circ}_{\text{reaction}} = 6 \times 10^{-5} T^2 cal/K$, where T is temperature in kelvin. [Given : R = $2cal/molK$ and $\text{In } 2 = 0.7$]

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649. A difinite amount of an ideal gas cfhange its state from state-1 to state-2 isothermally at 300K. If the process is carried out reversibly then work done = -1750 KJ and if the process is carried out irreversibly then work doneis equal to -1000kJ. Calculate $\Delta S_{\rightarrow tal} = \left(\Delta S_{\text{system}} + \Delta S_{\text{surrounding}}\right)$ in joule per kelvin for the irreversible isothermal process.

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650. Calculate the pH which the following conversion will be at equilibrium in basic medium.

$I_2(s) \Leftrightarrow I^-(aq) + IO_3^-(aq)$

When the equilibrium concentrations at 300 K are $\left[I^-\right] = 0.1M$ and $\left[IO_3^-\right] = 0.1M$

Given that :

$\Delta G^\circ f\left(I^-, aq\right) = -50kJmol^{-1}$

$\Delta G^\circ f\left(IO_3, aq\right) = -123.\,kJmol^{-1}$

$\Delta G^\circ f\left(H_2O, l\right) = -233kJmol^{-1}$

$\Delta G^\circ f\left(HO^-, aq\right) = -150kJmol^{-1}$

$R = \frac{25}{3}JK^{-1}mol^{-1}$ and ln 10 = 2.3

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651. When one mole of A is reacted completely in an ice calorimeter at 0° C and at 1 atm, it is found that the volume of equlibrium mixture of ice and water decreased by $0.25Ml.$ The Δ_rH_{273} "for the reaction"

$2A \rightarrow B + 2C$

is : (the densities of water and icfe at 0° and 1 atm are 1.00 and 0.96 gm/cm^3, respectively and latent hete of fusion of ice at 0° C and 1 atm is

80cal//gm) [Use:1 if $\Delta_r H_{273}$ is+ ve and 2 if $\Delta_r H_{273}$ is -ve and answer as a abc or 2abc, where abc is magnitude of $\Delta_r H_{273}$]

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652. When 5 moles of an ideal gas having non- linear molecules is heated from 1000 K to 2000 K at cal. Assume that all the degree of freedom in molecules are active in this temperature range and the heat capacity of gas is temperature independent. The atomicity of gas is :[in2=0.7]

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653. It is obseved that functioning of neuronal circuits in our brain is driven by the energy available from combustion of glucose. Calculate the amount of glucose (in gm) which should be burnt per hour to produce sufficient energy for brain which operated $at\frac{128}{9}$ watts.

$\left|\Delta H^\circ\right|$ 400 K combustion of glucose = 3000 kJ/mole

[Geven : $\left|\Delta S^\circ\right|$ 400 K combustion of glucose = 180 J/mol K]

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654. Calculate heat relesed (in Kj) when 2 moles of gaseous methane undergoes combustion in a rigid vessel of volume 50 liters causing a change in pressure from 10 bar to 2 bar at 300K.

[Useful data : $\Delta H_f H_2O$ =-280kJ/mole,

$\Delta H_f CO_2$=-390kJ/mole,

$\Delta H_f CH_4$=-390kJ/mole,=-70kJ/mole],

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655. Calculate magnitude of change in Gibbs free energy (inkJ) of a reaction occurruong at 500 K:

$2O_3(g) \Leftrightarrow 3O_2$

When a sample of ozonide oxygen (having average molecular mass of the mixture $=\frac{128}{3}$ is taken at a pressure of 3 bar. Round off your answer to next highest integer.

[Given ΔG_f° of $O_3(g) = 145k\frac{J}{\text{mole}}$ and $500R\ln 2 = 2880.8J/mol.$]

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656. Consider a reaction :

$A(g) + B(g) \Leftrightarrow C(g) + D(g)$

A(g), B(g) and C(g) are taken in a container at 1 bar partial pressure each and adequate amount of liquid D is added. From the data give below calculate four digit number abcd.

Givin : $\Delta G_f^\circ A(g) = 30kJ/\text{mole}$,

$\Delta G_f^\circ B(g) = 20kJ/\text{mole}$,

$\Delta G_f^\circ C(g) = 50kJ/\text{mole}$,

$\Delta G_f^\circ D(g) = 100kJ/\text{mole}$,

Vapour pressure of G (l) at $300K = \frac{1}{6}\text{bar}$

(All data at 300K) where

Equilibrium constant of reaction (i)

Twice the partial pressure of B at equilibrium

Twice the partial pressure of B at equilibrium

Twice the partial pressure of C at equilibrium

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657. Calculate enthalpy change (in Kj) when 2 mole of liquid acetic acid undergoes dissociation into $CH_4(g)$ and $CO_2(g)$ from the following date :

$\Delta H_{vap}\left[CH_3COOH\right](l) = 50kJ/\text{mole}$

Resonance energy of $\Delta H_{vap}\left[CH_3COOH\right](g) = -50kJ/\text{mole}$

Resonance energy (kJ/mole): $C-H = 400, C-O = 350, o = o = 500$

$C-C = 350, O-H = 450, C = O = 800, H-H = 400$

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658. A substance can exists in two gaseous allotropic forms A and B. If the equibrium mixture at $2500K$ consists of 80 mole percent A then calculate $\left|\Delta G^{\circ}_{\text{reaction}}\right|$ at $2500K$ for $B(g) \rightarrow A(g)$.

Express answer in $kcal$. Round off your anwer to next higher interger.

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659. 10 moles of a van der Waals' gas are subjected to a process from $2L, 300K$ to $2L, 350K$.

Given: $\begin{array}{ll} C_{vm} = 20J/\text{mole - }K & b = 0.04L/\text{mole} \\ C_{\pm} = 30J/\text{mole - }K & a = \text{negligible} \end{array}$

Calculate $\Delta H(\text{in}KJ)$.

[Given : $R = 0.08$ litre atm $K^{-1}\text{mol}^{-1}$.,

1 litre atm $= 100J$]

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660. Combustion of sucrose is used by aerobic organisms for providing energy for the life sustaining process. If all the capturing of energy from the reaction is done through electrical process (non P-V work), then calculate, maximum available energy which can be captured by combustion of 34.2 g of sucrose :

(Given : $\Delta H_{\text{combustion}}(\text{sucrose}) = -6000kJmol^{-1}$

$\Delta S_{\text{combustion}} = 180j/K - mol$ and bodyntemperature is 300 K)

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661. For the followinf set of balanced reactions,

$N_2O_5O_2 \rightarrow 2NO_2 + O_3 \quad \Delta H = 200kJ$

$NO_2 + O_2 \rightarrow 2NO + O_3 \quad \Delta H = 20kJ$

10 moles of N_2O_5 and 30 moles of O_2 where taken in a chamber to cause complete conversion of N_2O_5 to $NO_2 . NO_2$ partially reacts with remaining oxygen such that volume percenfagr of O_3 is 50% Calculated overall enthaolpy change kJ.

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662. 1.5 moles of a real gas changes its state from state A (3bar, 2 L, 200 K) to state b $\left(3, \bar{ }5L, 300k\right)$ through isobaric process. It is then taken to state C $\left(4, \bar{ }10L400K\right)$ such that $\Delta U_{BC} = 127$ Joules. Calculate value of ΔU_{AC} in joules.

[Given : $C_{p,m}ofgas = 4R$ and $R = 8.3JK^{-1}mol^{-1}\Big]$

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663. In a particular case of physisorption, magnitude of enthalpy change and entropy change were observed to be 28 kJ/mole and 100 J/mole-K. Calculate the minimum temperature (in $.^{\circ}C$) above which physisorption will become non spontaneous.

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664. 2 moles of an ideal gas A is taken in an adiabatic container fitted with a movable frictionless adiabatic piston always operation at 1 atm. The gas A gets converted to gas B as per the reaction :

$3A(g) \rightarrow 2B(g), \quad \Delta H = \text{-}\ kJ/\text{mole}$

If 75% of A associates under the given conditions and initial temperature of teh vessel was 300 K, then calculate the final temperature of the vessel.

[Given : $C_{p,A(g)} = 20J/K\text{mole}$

$C_{p,B(g)} = 30J/K\text{mole}$]

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665. Melting point of any solid depends on pressure as

$$\left(P_2 - P_1\right) = \frac{\Delta H_{\text{fusion}}}{Vl - V_s} \ln \frac{T_2}{T_1}$$

Calculate freezing point of water $\left(\text{in}\ {}^{\circ}C\right)$ at a pressure of 1001 bar if freezing point of water at 1 bar is $0\,{}^{\circ}C$. Molar volume of ice and liquid water is 19.65 ml and 18 ml respectively and increase in enthalpy due to melting is $6600\text{J}/\text{mole}$

$[In0.975 = -0.025]$

Instruction: Neglect sign of the temperature, therefore if your answer is $-8.65\,{}^{\circ}C$,express answer as 9]

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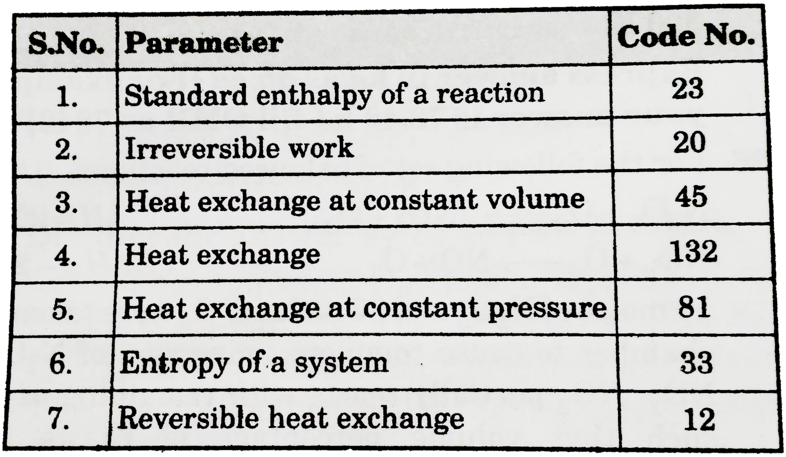
666. Calculate the sum of "code numbers" of all those parameters which are either "path independent" or "stste function".



S.No.	Parameter	Code No.
1.	Standard enthalpy of a reaction	23
2.	Irreversible work	20
3.	Heat exchange at constant volume	45
4.	Heat exchange	132
5.	Heat exchange at constant pressure	81
6.	Entropy of a system	33
7.	Reversible heat exchange	12

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667. A defintie amount of diatomic ideal gas undergoes reversible adiabatic expansion from $10L, 127^{\circ}C$ to $'V'L, -73^{\circ}C$. The molar heat capacity of gas at constant volume is : $\left[Given: R = 8.3JK^{-1}, \ln 2 = 0.7. \ln 30 = 3.4\right]$

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668. Consider the following nine phase transformations.

$H_2O(s, 1atm, 273K) \rightarrow H_2O(l, 1atm, 3273K)$

$H_2O(s, 1atm, 300K) \rightarrow H_2O(l, 1atm, 300K)$

$H_2O(s, 1atm, 200K) \rightarrow H_2O(l, 1atm, 200K)$

$H_2O(s, 0.5atm, 273K) \rightarrow H_2O$(l,0.5 atm 273 K)

$H_2O(s, 2atm, 273K) \rightarrow H_2O(l, 2atm, 273K)$

$H_2O(l, 1atm, 400K) \rightarrow C_6H_6$(g),1atm, 353K)

$C_6H_6(l, 1atm, 400K) \rightarrow C_6H_6(g, 1atm, 400K)$

$C_6H_6(l, 1atm, 300K) \rightarrow C_6H_6$(g,1atm,300K)

$C_6H_6(l, 2atm, 327K) \rightarrow C_6H_6$(g,2atm,323 K)

Given : $T_{nbp}$of $C_6H_6(l) = 353K$

Now a four digit number abcd is fined as follows: Digit a It is number of phase transformations for which $\Delta S_{\rightarrow tal} = 0$

Digit b It is number of phase transformations for which $\Delta S_{\rightarrow tal} < 0$

Digit c It is number of phase transfprmation for which $\Delta S_{\rightarrow tal} > 0$ Digit d It is number of phase transformation for which $\Delta H > 0$

Determine the number abcd

[Note:If a =1, b=2,c=3 and d=4, then answeris 1234]

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669. Find (in terms of a) the amount of energy required to raise the temperature of a substgance from, 3 K to 5 K at constant pressure. At low temperatures, $C_p = aT^3$. Express your answer after dividing by a.

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670. Work done in expansion of anideal gas from 4 litre against a constant external preesure of 2.1 atm was used to heat up 1 mole of water at 293 K. If specific heat of water is 4.2 J $g^{-1}K^{-1}$, what is the final temperature of water (in K) ?

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671. For ag, Cp $(JK^{-1}mol^{-1})$ is given be $24 + 0.006T/K$. Calculate ΔH (in KJ) if 3 mole of silver are raided from $27^{\circ}C$ to its meltiong point $927^{\circ}C$ under 1 atm pressure.

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672. What amount of ice (in g) will remain when 52 g ice is added to 100 g of water at $40^\circ C$? Specific hate of water is 1 cal//g and latent heat of fusion of ice is $80cal/g$ Round off your answer to next interger.

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673. A sample of an ideal gas is expanded $1m^3$ to $3m^3$ in a reversible process for which $P = KV^2$, with $K = 6\text{bar}/m^6$. What is work done by the gas (in kJ) ?

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674. Find out the heat evolved in combustion if 112 litre (at 1 atm, 273 K) of water gas (mixture of equal volume of $H_2(g)$ and CO(g)) is combusted with excess oxygen.

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g), \Delta = -241.8kJ$$

$$CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g), \Delta = -283kJ$$

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675. Calculate $\Delta H^\circ \left(\text{in} kJmol^{-1}\right)$ for the reaction

$CH_2Cl_2(g) \rightarrow C(g) + 2H(g) + 2Cl(g)$.

The average bond enthalpie of $C - H$ and $C - C1$ bonds are $414 kJmol^{-1}$.

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676. Calculate the enthalpy change (ΔH) in $KJmol^{-1}$, of the follwing reaction

$2C_2H_2(g) + 50_2(g) \rightarrow 4CO_2(g) + 2H_2O(g)$

givin average bond enthalpies of various bonds i.e.,

$C - H, C = C, O = O, O - Has 414, 814, 499, 724$ and `640 kJ mol^(-1) respectively. Express magnitude only.

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677. Calculate free energy change for the reaction:

$H_2(g) + CI_2(g) \rightarrow 2H - CI(g)$ by using the bond energy and entropy data.

Bond energies of $H - H, CI - CI$, and $H - CI$ bonds are $435, 240$, and $430 kJmol^{-1}$, respectively. Standard entropies of H_2, CI_2, and HCI are $130.59, 222.95$, and $186.68 JK^{-1}mol^{-1}$, respectively.

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678. The increase in entropy of 1 kg of ice at 200 K which is heated to 400 K (super heated steam) at constant atmospheric pressure, will be :

Given that : $C_p(\text{ice}) = 2.09 \times 10^3 J/\text{kg degree}$,

$C_p(\text{water}) = 4.18 \times 10^3 J/\text{kg degree}$,

$C_p(\text{steam}) = 2.90 \times 10^3 J/\text{kg degree}$,

$L(\text{ice}, 273K) = 3.34 \times 10^5 J/kg$.

$L(\text{water}, 273K) = 22.6 \times 10^5 J/kg$.

Express your answer $\left(\text{in} JK^{-1}\right)$ by rounding off to the nearset integer.

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679. Calculate the amount of heat evolved during the complete combustion of 100 ml liquid benzene from the following data :

18 gm of graphite on complete combustion evolve 590 kJ heat

15889 kJ heat required to dissociate all the molecules of 1 liter water into H_2 and O_2

The heat of formation of liquide benxene is $50 kJ/\text{mol}$

Density of $C_6H_6(l) = 0.87 gm/ml$

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680. For the real gases reaction,

$2CO(g) + O_2(g) \rightarrow 2CO_2(g), \Delta H = -560 kJ.$ In 10 litre rigid vessel at 500 K the initial pressure is 70 bar and after the reaction it becomes 40 bar. The change in internal energy is :

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681. In a constant volume calorimeter, $3.5g$ of a gas with molecular weight 28 was burnt in excess oxygen at $298.0K$. The temperature of the calorimeter was found to increase from $298.0K \to 298.45K$ due to the combustion process. Given that the heat capacity of the calorimeter is $2.5kJK^{-1}$, find the numerical value for the enthalpy of combustion of the gas in $kJmol^{-1}$

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682. Fixed amount of an ideal monoatomic gas contained in a seeled rigid vessel $(V = 24.6litre)$ at 1.0 bas is change in Gibb's energy (in Joule) if entropy of gas $S = 10 + 10^{-2}T(J/K)$

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683. $At298K, \Delta H^{\circ}_{\text{combustion}}(\text{sucrose}) = -5737\text{kJ/mol}$ and $\Delta G^{\circ}_{\text{combustion}}(\text{sucrose}) = -6333\text{kJ/mol}$. Estimate additional non-PV work that is obtainced by raising bemperature to 310 K. Assume $\Delta_r Cp = 0$ for this temperature change.

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684. What is the total number of intensive properties in the giben list ?

Internel energy

Pressure

Molar entropy

Volume

Density

Boiling point

Molality

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685. For the reaction

$2A(g) + 3B(l) \rightarrow C(g) + 4D(l), \Delta H = 300 \text{cal//mol}$

Calculate ΔU (in calories) of reaction when 3moles of A (g) react with 4 moles of B (l) at $27 ^{\circ} C$. $(R = 2\text{cal//mol} - K)$

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686. One mole of an ideal monoatomic gas at $27 ^{\circ} C$ undergoes the process in which $T\alpha V^3$. Then calculate the heat absorbed (in calories) when gas doubles it's volume $(R = 2\text{cal//mol} - K)$

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687. A certain gas in expanded from $(1L, 10atm)$ to $(4L, 5atm)$ against a constant external pressure of $1atm$. If the initial temperature of gas is $300K$ and heat capacity for the process is $50J ^{\circ} C^{-1}$, the enthalpy change during the process is: (use: $1L - atm = 100J$)

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688. How many times volume of diatomic gas should be expanded reversibly and adiabatically in order to reduce it's RMS velocity to half.

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689. Number of correct statements are :

$\Delta U = nC_{Vm}\Delta T$ is applicable for ideal gas undergoing reversible process but not irreversibe (No chemical and phase change)

$\Delta S = nC_{Vm}\Delta T$ is applicable for ideal gas undergoing reversible process but not irreversible (No chemical and phase change)

$\Delta S = nC_{Vm}\ln\frac{T_2}{T_1} + nR\ln'\frac{V_2}{V_1}$ is applicable for ideal gas undrgoing reversible as well as irreversibel process (No chemical and phase change)

$\Delta H = \Delta U + \Delta(PV)$ isapplicable for chemical and phase change carried out reversibly or irreversibly

PV^{γ} = constant for reversible and irreversible adiabatic process involving ideal gas.

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690. At $0^{\circ}C$ water and ice are at equilibrium at 1 atm pressure. The value of ΔH_{fusion} for ice is (in kJ/mole). Give answer excluding decimal places.

Given: $\Delta S_{\text{freezing}}$ of water at 1 atm and 273 K is $-20JK^{-1}\big)$

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691. Find DeltaG (J/mol) for the reaction at $300kPa$ and $27^{\circ}C$ when all gases are in stoichimetric ratio of moles. $N_2O_4(g) \rightarrow 2NO_2(g)$ $[\ln 2 = 0.7]$

Given : $\Delta G_f^{\circ}\left(N_2O_4\right) = 100\text{kJ/mol}$

$\Delta G_f^{\circ}\left(NO_2\right) = 50\text{kJ/mol}$

$R = 8\text{J/mol - }K$

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692. Calculate the electron affinity of Br from following data :

Lattice energy of NaBr $=-736\text{kJ mole}^{-1}$

$B.E._{(Br.Br)} = 192\text{kJ mole}^{-1}$

$\Delta H_{f(NaBr)} = -376\text{kJmole}^{-1}$

$(I.E.)_{Na} = 490\text{kJ mole}^{-1}$

ΔH_{298K} of sublemation of $Na = 109\text{kJ mole}^{-1}$

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693. At 100 K from tata,

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)\Delta H^\circ = -123.77\text{kJmole}^{-1}$

Substance	N_2	H_2	NH_2
Cp/R	3.5	3.5	4

Calculate the heat of formation of NH_3 to $300K$. writer your answer, excluding the decimal places.

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694. Calculate the proton affinity of NH_3 (g) from the following data (in kJ/mol):

$\Delta H^\circ \text{ dissociation} : H_2(g) \quad = 436$

$\Delta H^\circ \text{ formation} : NH_3(g) \quad = -46$

$\text{Lattic energyof} NH_4Cl(s) \quad = -683$

$\text{Ionisation enorgy of} H \quad = 130$

$\text{Electron affinity of} Cl \quad = 380$

$\Delta H^\circ \text{ dissociation} : Cl_2(g) \quad = 240$

$\Delta H^\circ \text{ formation of} NH_4Cl(s) \quad = -314$

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695. Determine enthalpy change for,

$$C_3H_{8(g)} + H_{2(g)} \rightarrow C_2H_{6(g)} + CH_{4(g)}$$

at 25 $^\circ C$ using heat of combustion values under standard condition.

$Compounds$	$H_{2(g)}$	$CH_{4(g)}$	$C_2H_{6(g)}$	$C_{(Graphite)}$
$\Delta H^\circ inkJ/mol$	-285.8	-890.0	-1560.0	-393.5

The standard heat of formation of $C_3H_{8(g)}$ is $-103.8kJmol^{-1}$.

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696. The commercial production of water gas utilizes the reaction under standard conditions : $C + H_2O_{(g)} \rightarrow H_2 + CO$. The heat required for this endothermic reaction may be supplied by adding a limited amount of air and burning some carbon to CO_{20}. How many gram of carbon must be burnt to CO_2 to provide enough heat for the water gas conversion of $100g$ carbon ? Neglect all heat losses to the environment. Also ΔH_f° of $CO, H_2O_{(g)}$ and CO_2 are -110.53, -241.81 and $-393.51 kJ/mol$ respectively.

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697. Calculate the heat of neutralisation from the following data:

$200mL$ of $1MHCI$ is mixed with $400mL$ of $0.5MNaOH$. The temperature rise in calorimeter was found to be $4.4^{\circ}C$. Water equivalent of calorimeter is $12g$ and specific heat is $1calmL^{-1}degree^{-1}$ for solution.

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698. Find bond enthalpy of C=O (in kJ/mol) using following information :

$\Delta H_{\text{atomisation}}[C(s)] = 700$ kJ/mol

$\Delta H_f\left[CO_2(g)\right]$ = - 400 kJ/mol

$BE_{o=o=500}$ kJ/mol

Resonance energy of CO_2 = - 150 kJ/mol

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699. 1000 gm water is heated from $27^\circ C$ to $47^\circ C$ at a constant pressure of 1 bar. The coefficient of volume expansion of water is $0.002/^\circ C$and the molar volume of water at $0^\circ C$ is $18.00\ cm^3/mol$. The magnitude of work done (in J) by water is :

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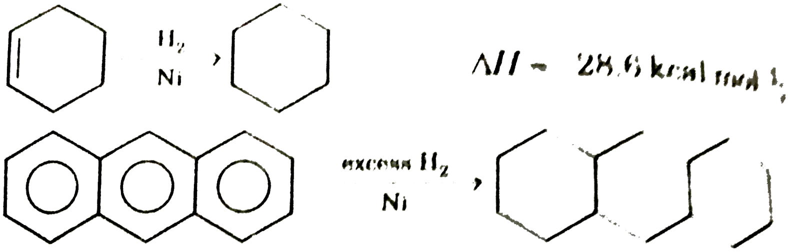
700. Use the following data to answer the question below :



Calculate the resonance energy of anthracene,

s

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701. What is the $S^\circ\left(OH^-\right)$ (in cal/mol K) at $300K$?

Given : $K\omega\left(H_2O\right) = 10^{14}$,

$\Delta H_{\text{neut}}\left(H^+ + OH^-\right) = -13.5\text{kcal}$

Fill OMR excluiding decimaol places.

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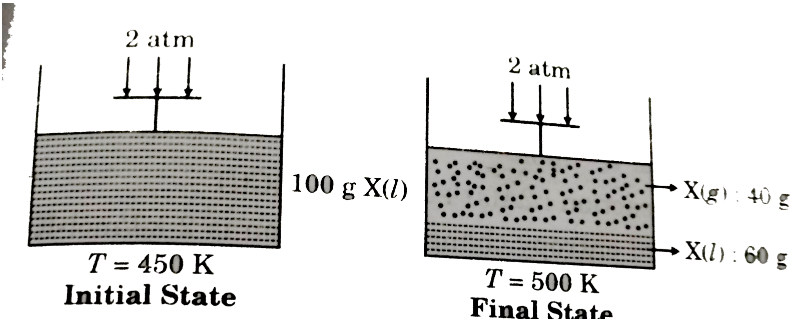
702. The external pressure 2 atm is applied on frictionless movable piston, fitted in a vessel containing 100 g of X(g) at 450 K. now heat is sulplied keeping pressure constant till 40 g of Xis evaporated to to from

X(g) at 500 K (boinling poing). Calculate change in internal (ΔU) energy in kJ for overall process. Assume vapour of X (l) behaves like an ideal gas.



Given : Molar hect capacity of X (l) =60 J/mol K: $\Delta H_{\text{vaporisation}}$=30kJ/mol, $\Delta H_{\text{vaporisation}}$=30kJ/mol,R=8.3J/mol-K

At weight of X = $20 g/mol$.

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703. Some amount of diatomic van der walls' gas is kept in a rigid container of volume 20 liter and subjected to change in temperature from 300 K to 400K. If 30 kacl of heat is required and enthalpy change of the process is observed to be $\frac{310}{9}$ kacl, then estimate the number of moles of the gas.

[Given : b = 0.1 L mol^{-1}, a=1.25 atm -L^2/mol^2]

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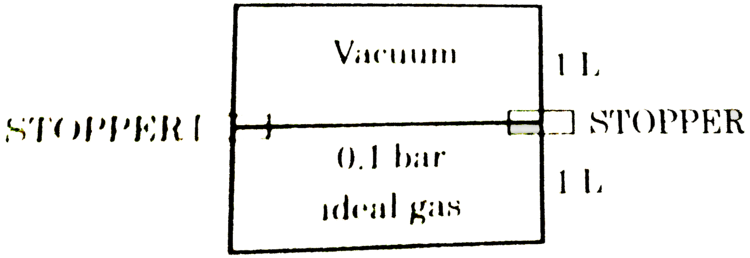
704. A container is separated into two 1 litre compartments by a piston of negligible mass as shown below. In lower compartment 0.1 bar pressure and the other compartment is empty. Now the stoppers are removed so that the gas expands to 2 litre. Heat is supplied to the gas so that finally pressure of gas equals to 0.1 bar. Calculate $\Delta H$of the process in joule. $[1\text{bar}liter = 100J]$



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705. 2 moles of an ideal gas is compressed from (1 bar, 2 L) to 2 bar isothermally. Calculate magnitude of minimum possible work in change (in joules). (Given : 1 bar L = 100 J, ln$2 = 0.7$)

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706. Ram joined Kota test series, where he was asked to calculates ΔS_{sys} for a process as described below.

A diathermic container (containing an ideal gas) fitted with a piston at equilibrium (without any topper) and has initial volume 600 liter. Now the external pressure is suddenly reduced to 1 bar and allowed the piston to move upward isothermally. In this process, system absorb 600 kJ heat.

He calculated ΔS_{sys} =2kJ//K but was awarded zero marks. To identify his mistake he contacted his Kota feiend Shyam and explained his problem.When shyam asked how Ram calculated ΔS_{sys}, Ram said simple !by q/T. If you are Shyam, then help Ram in getting crrect answer (in kJ/K). [In 11 = 2.4]

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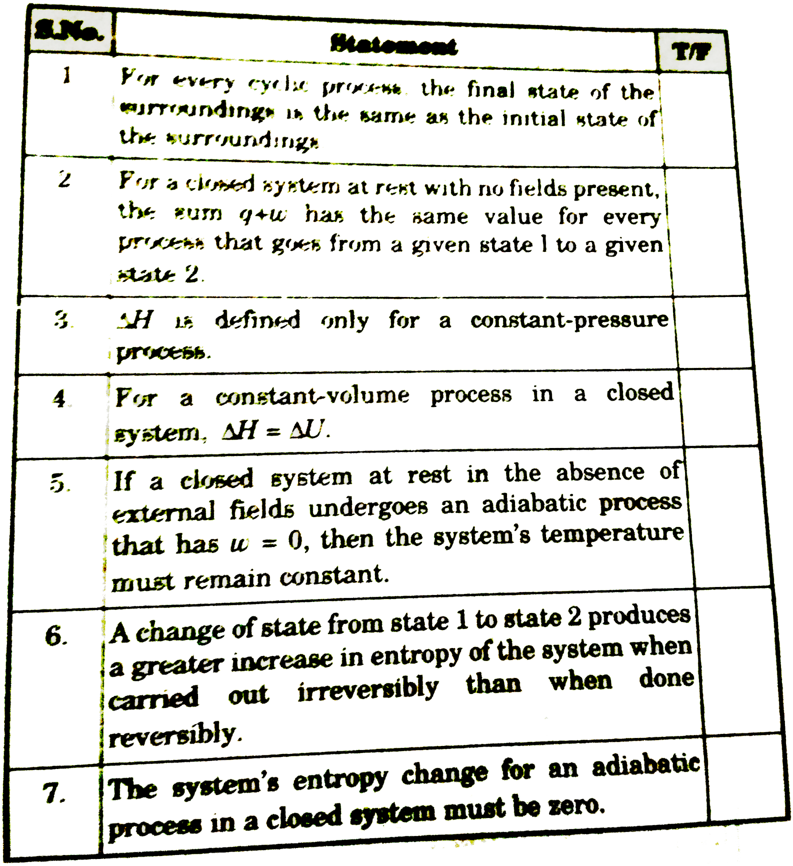
707. Mark as true or false :



S.No.	Statement	T/F
1	For every cyclic process, the final state of the surroundings is the same as the initial state of the surroundings	
2	For a closed system at rest with no fields present, the sum $q+w$ has the same value for every process that goes from a given state 1 to a given state 2.	
3.	ΔH is defined only for a constant-pressure process.	
4	For a constant-volume process in a closed system, $\Delta H = \Delta U$.	
5.	If a closed system at rest in the absence of external fields undergoes an adiabatic process that has $w = 0$, then the system's temperature must remain constant.	
6.	A change of state from state 1 to state 2 produces a greater increase in entropy of the system when carried out irreversibly than when done reversibly.	
7.	The system's entropy change for an adiabatic process in a closed system must be zero.	

Find the number of false statements.

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708. Calculate the equilibrium pressure (in Pascal) for the conversion of graphite to diamong at $25^\circ C$. The densities of graphite and diamond may be takes to be 2.20 and 3.40 g//cc respectively independent of pressure. (Express your answer in scientific notation x $\times 10y$ and write the value of y.)

[Given : $\Delta G^{\circ}_{298}\left(C_{\text{graphite}} \rightarrow C_{\text{diamond}}\right) = 2900 J/mol\,\Big]$

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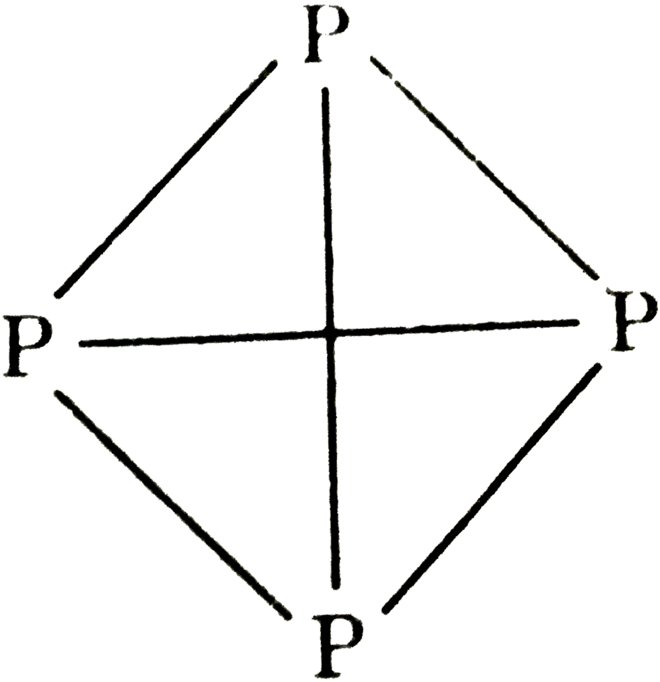
709. White phosphorus is a tetra-atomic solid P_4(s)at room temperature.



find bond enthalpy (P-P) in kJ//mol.

Given : $\Delta H_{\text{sublimation}}$ of P_4 (s)=61 kL//mol

DeltaH_("atomisation") of P_4(s)=1321 kJ//mol]

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710. molar standard enthalpy of combusion of ethanol is -1320 kJ, malor standard enthalpy of formation of water and $CO_2(g)$ are -286 kJ//mole and -393 kJ//mole respectively. Calculate the magnitude of molar standard enthalpy of formation of ethanol.

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711. $1LN_2$ (g) and $3LH_2$ (g) at 1 bar pressurre is allowed to react at constant pressure. The temperature of 100 gm water surrounding reaction vessel rose by $\left(\frac{1}{14}\right)^{\circ}C$ find the magnitude of change in internal energy in joules for the process in reaction vessel. [Specific heat of $H_2O(l) = 4.2J/^{\circ}C/g,$ 1litre atm=100 J]

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712. AB, A_2 and B_2 are diatomic molecules.If the bond enthalpy of $A_{2,}$ AB from A_2 and B_2 od $-100 kJ/\text{mol}$, what is the bond enthalpy of A_2 $\text{in} kJ/mol.$`

?

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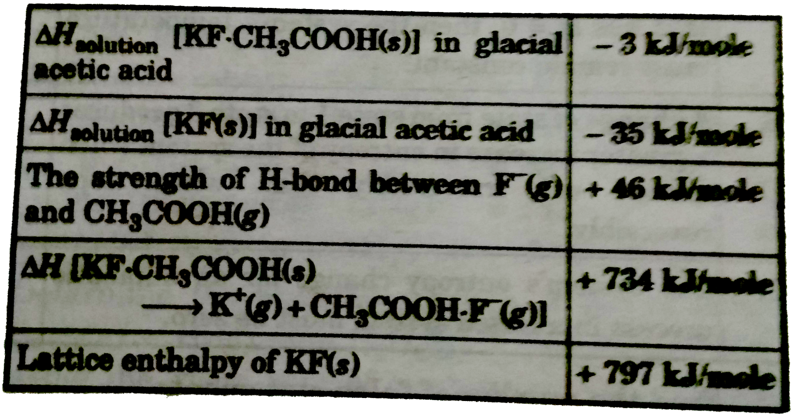
713. Calculate the $\Delta H_{\text{vaporization}}$ $\left[CH_3COOH(l)\right]$ in kJ/mol. Given data :



$\Delta H_{\text{solution}}$ $[KF \cdot CH_3COOH(s)]$ in glacial acetic acid	-3 kJ/mole
$\Delta H_{\text{solution}}$ $[KF(s)]$ in glacial acetic acid	-35 kJ/mole
The strength of H-bond between $F^-(g)$ and $CH_3COOH(g)$	$+46$ kJ/mole
ΔH $[KF \cdot CH_3COOH(s) \longrightarrow K^+(g) + CH_3COOH \cdot F^-(g)]$	$+734$ kJ/mole
Lattice enthalpy of $KF(s)$	$+797$ kJ/mole

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714. For the given real gas reaction,

$2A(g) + B(g) \rightarrow D(g)$

carried out in a 10 liter rigid vesses, the initial pressure is 50 bar which decreases to 20 bar, during the course of reaction. If heat liberated in the reaction is 400 kJ then what is the change in magnitude of internal energy of the reaction (in kJ) ?

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715. Calculate DeltaH (in kcal) for the following phase transformation :

A (s,1 bar, 200K) rarr A (g, 1 bar ,200 K)

Standard melting poing of A = 200 K

Standard boioling poing of A = $300K$

Standard boiling ping of A = 300 K

Latent heat of fusion of A at 200 K = $60cal/g$

Latent heat of vaporisation of A at $300K = 410cal/$g Molar mass of A = $50g/$mole

C_{Vm} of A (s)= 5cal K^{-1} mol^{-1}

C_{Vm} of A (l) = $10calK^{-1}mol^{-1}$

C_{Vm} of A (g)=$3calK^{-1}mol^{-1}$

$R = 2calK^{-1}mol^{-1}$

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716. For a reaction : $2A(s) + B(g) \rightarrow 3C(l)$

standard entropy change of reaction is $2kJ/mol - K$ and standard enthalpy of combustion of A,B and C are $-100, -60, 285$ kJ/mol respectively, them find the maximum useful work that can be obtained at $27^{\circ}C$ and 1 bar pressure for reaction (in kJ/mol).

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717. The heat of neturalisation between weak acid (HNC) and strong base (NaOH) is (-56.1) kJ/mole. The neutralisation between strong acid (HCl)and strong base (NaOH) is (-57.3) kJ/mol. If the weak acid (HNC) is 80% ionised in the above solution then calculate the heat of ionisation (in J/mol) for 100% ionisation of HCN in the above solution.

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718. The increase in Gibbs' free energy in (kJ) of 20 g of water (density $= gcm^{-3}$) ,when the pressure is increased (at constant temperature) from 1 bar to 2001 bar ,is :

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719. The entropy change of orgon is given to a good approximation by the expression :

$S_m / JK^{-1}mol^{-1} = 36 + 20\ln T / K$

Calculate the change in Gibbs free energy of one mole of argon gas when it is heated from 300 K to 400 K at constant pressure. Express your answer excluding sing and decimal places.

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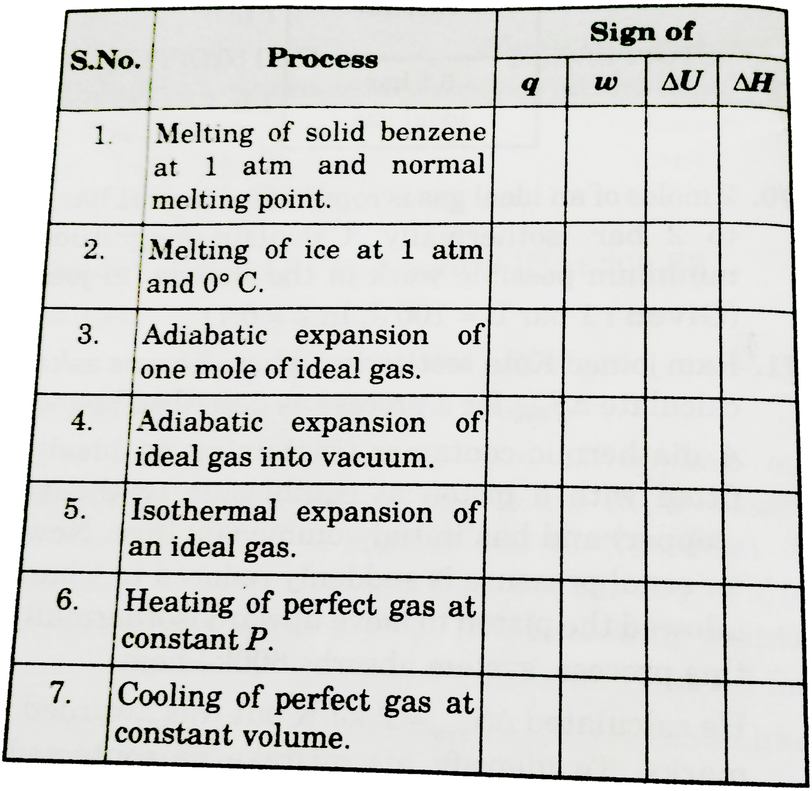
720. Predict the sign of q, w ,DeltaU and DeltaH for given processes.



S.No.	Process	Sign of			
		q	w	ΔU	ΔH
1.	Melting of solid benzene at 1 atm and normal melting point.				
2.	Melting of ice at 1 atm and 0° C.				
3.	Adiabatic expansion of one mole of ideal gas.				
4.	Adiabatic expansion of ideal gas into vacuum.				
5.	Isothermal expansion of an ideal gas.				
6.	Heating of perfect gas at constant P.				
7.	Cooling of perfect gas at constant volume.				

Hence, find number process for which at least one of $q, \omega. \Delta U, \Delta H$ are zero

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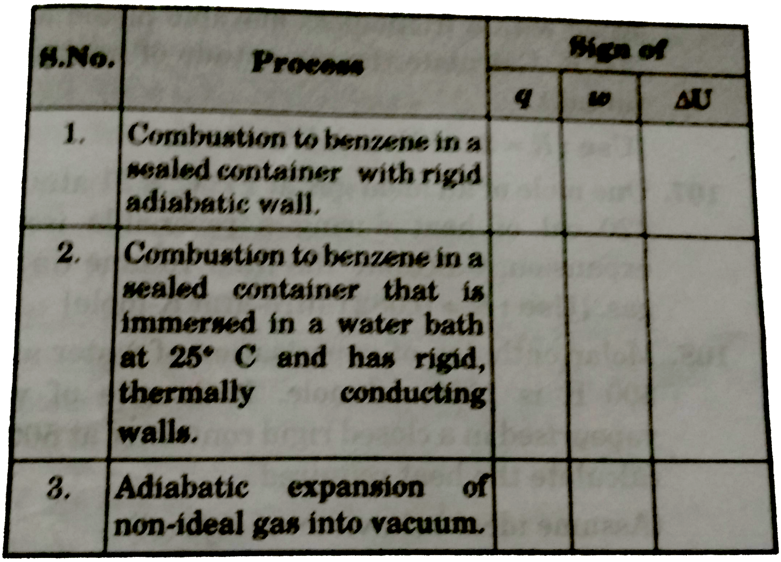
721. Predict the sign of q, w andΔU for given process.



S.No.	Process	Sign of		
		q	w	ΔU
1.	Combustion to benzene in a sealed container with rigid adiabatic wall.			
2.	Combustion to benzene in a sealed container that is immersed in a water bath at 25° C and has rigid, thermally conducting walls.			
3.	Adiabatic expansion of non-ideal gas into vacuum.			

Hence , find number of process for which at least one of q,w, ΔU, ΔH are zero.

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722. In how many option (s), enthalpy change is marked incorrectly?

$CuSO_4(s) + 5H_2O(g) \rightarrow CuSO_4.5H_2O(s), \Delta_{solution}H^\circ\left[CuSO_4(s)\right]$

$2NH_3(g) \rightarrow N_2(g) + 3H_2(g), H^\circ_{atm}\left[NH_3\right]$

$MgCl_2(s) \rightarrow Mg(s) + Cl_2(g), \Delta_{\text{lattice}}H^\circ \left[MgCl_2(s)\right]$

$\frac{1}{4}P_4(g) \rightarrow P(g), \Delta_{P-P}H^\circ$

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723. A reversible cyclic process involves 6 steps. In step -1 and 3 system absorbs 500 , 800 J of heat from a heat reservoir at temperature 250 K and 200 K respectively. Step 2,4,6 are adiabatic such that the temperature of one reservior changes to that of next. Total work done by the the system in whole cycle is 700 J. Find the temperature during step 5 if it exchanges heat from a reservoir at temperature T_5

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724. A Magic solution was prepared by a Kota Teacher such that :

$A(g) + 10(aq) \rightarrow A.10(aq), \quad \Delta H = -10kJ/mol$

[Magic solution]

For 1 mole of H_2O added to this Magic solution enthalpy of dilution is

$-5kJ/mol$, for 2nd mole it becomes $-\frac{5}{2}kJ/mol$, for 3rd mole it becomes $-\frac{5}{2^2}kJ/mol$ and so on.

To mark the celebration rank-1 of IIt JEE-2016, KOTA CLASSES asked the top ranker to add a very large amount of water to this Magic solution. The hat energy released is 40% converted to useful work of buring fire crackers for celebration. Find the magnitude of useful work obtained (in kJ/mol) from such Magic solution containing 1 mole of A.

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725. An ideal monoatomic gas following the process $\frac{P}{V^2} = \text{ constant will have heat capacity } \frac{11R}{X}$. Find the value of X.

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726. The heat of combustion of C(graphite) and CO(g) are $-390kJ/\text{mole and } -280kJ/\text{mole}$ respectively.

$CO(g) + Cl_2(g) \rightarrow COCl_2(g)\Delta H = +208kJ$

Calculate heat of formation $(\text{in kJ}/\text{mole})$ of $COCl_2(g)$ (in kJ/mole)

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727. $2A(s) \Leftrightarrow B(g) + 2C(g) + 3D(g)$

Total pressure developed in closed container by decomposition of A at equibrium is 12 atm at $727\,^{\circ}C$. Calculate ΔG° (in kcal), of the reaction at $727\,^{\circ}C$.

$(R = 2cal/\text{mole} - K, In2 = 0.7, In = 1.1)$ Round off your answer to integer (without sign).

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728. If enthalpy of neutralisation of a weak acid with strong base is -10.87 kacl mole then calculate enthalpy of ionisation of weak acid.

[Given : $H^+(aq) + OH^-(aq) \rightarrow H_2O(l) \quad \Delta H = -13.7kcal$]

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729. 3 moles of an ideal gas is heated and compressed simultaneously from 300 K, 1 atm to 400 K, P atm. If change in entropy of gas is $-3.3 cal/K$ then calculate value of P(in atm).

$C_P = \frac{7R}{2}, R = 2cal/\text{mole} - K$

[In 2=0.7, In 3=1.1, In 5=1.6]

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730. Certain amount of an ideal gas is expanded isobarically to double its volume. Work obtained in the process is -20 kJ. If same expantion in volume is carried out isothermally irreversibly in single step, calculate the magnitude of work (in kJ).

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731. For the reaction

$A(g) + 2B(s) \rightarrow C(l) + D(g), \quad \Delta H = -40kJ/\text{mole}$

10 mole of each A and B are mixed in a closed rigid container and allowed to react at 300 K. Calculate the heat transfer (in kJ) occurs in the process.

[Use : $R = 8.3 \text{J}/\text{K-mole}$]

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732. One mole of an ideal gas is heated from 300 K to 700 K at constant pressure. The change ininternal energy of the gas for this process is 8 kJ. What would be the change in enthalpy (in kJ) for the same process? ($R = 8\ \text{J}/\text{mole - }K$)

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733. A substance A has a normal melting point of 250 K of 250 K and normal boiling point 300 K. Using this information and other information given below calculate $\Delta S_{\text{sublimation}}$ at $250K$[in cal/K-mole]

Information -1: Entropy of vapourisation at 300 K is 21 cal/K-mole

Information-2 : Latest heat of fusion at 250 K is 2.5 kcal/mole

Information -3: C_p is liquid A and gaseous A is

$20cal/\text{K moleand}10\text{cal}/K$ - mole

Information -4: $In\frac{6}{3} = 0.18$

[Round off your answer to nearest integer.]

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734. Calculate ΔH (in atm-litre) for a real gas undergoing a change from (10 L, 20 atm) to (50 L,40 atm)

Given : $\left(\frac{\partial H}{\partial P}\right)_v = 10litre, \left(\frac{\partial H}{\partial V}\right) = 5atm$

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735. An ideal gas undergoes a process such that $P \propto \frac{1}{T}$. If molar heat capacity for this process is $C = 33.24\ \text{J/mole-K}$, then calculate A. Where $A = 2\gamma$ and γ is adiabatic index of gas.

$(R = 8.31\text{J/mole-K})$

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736. A Carnot engine converts one-fifth of heat given into work. If temperature of sink is reduced by 80°, efficiency gets doubled. If temperature of sourceand sink is $T_1$and T_2 respectively then calculate value of $\frac{T_1 - T_2}{10}$

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737. One mole of an ideal monoatomic gas at 1 atm, 300 K undergo a process in which pressure of gas is 8 atm then calculate W (in cal).

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738. For the reaction : $2A(g) + B(g) \rightarrow C(g)$

Change in enthalpy is $30\text{kcal}/\text{mole whereas}\Delta U$ is $32\text{kcal}/\text{moleat}$ certain temperature. Calculate the work done (in kcal) when 4 mole of A reacts with excess of B at constant pressure and same temperature.

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739. If enthalpy change for hydrogention of ethylene is $-132\text{kJ}/\text{mole}$ and enthalpy of formation 1,3-butadience (g) and butane are 115 kJ and $-140\text{kJ}/\text{mole}$ respesctively then calculte resonance energy of 1,3-budadiene (in kJ).

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740. How much energy (in joule) can be released during the following reaction if 11.2 ml of $B_2H_6(g)$ and 67.2 ml of $Cl_2(g)$ at 1 atm, are allowed to react as

$$B_2H_6(g) + 6Cl_2(g) \rightarrow 2BCl_3(g) + 6HCL(g), \quad \Delta H = -184\text{kJ}/\text{mole}$$

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741. 1 mole of $CaCO_3$is heated in a closed container fitted with a frictionless movable piston at 1 atm, 300 K. Calculate the magnitude of work obtained (in cal)

[Use :$R = 2\text{cal}/\text{K-mole}$]

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742. One mole of an ideal gas at 27° ,8.21 atm absorbs 420 cal of heat during a reversible isothermal expansion. Calculate the final volume (in litre) of gas. [Use:$R = 0.0821 \text{ litre-atm}/\text{K-mole}$]

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743. Molar enthalpy of vaporisation of water at $1atm, 500K \text{ is} 1100 \text{ cal}/\text{mole}$. If 2 mole of water is vapourised in a closed rigid container at 500 K then calculate the heat required.

(Assume ideal behaviour of $H_2O(g)$)

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744. Which of the following are intensive properties?

Boiling point

Melting point

Heat capacity

Volume

Enthalpy

Mass

Internal energy

Molar volume

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745. For a reaction $2A(g) + 3B(g) \rightarrow 2C(g) + D(g)$, calculate the magnitude of ΔH°_{400K} of the reaction from the given data.

$\Delta H_f^{\circ} A = \left(200 + 10^{-2}T^2\right)J$

$\Delta H_f^{\circ} B = \left(100 + 2 \times 10^{-3}T^2\right)J$

$\Delta H_f^{\circ} C = \left(200 + 2 \times 10^{-2}T^2\right)J$

$\Delta H_f^\circ D = \left(100 + 2 \times 10^{-3} T^2\right) J$

Express your answer in kJ and round off to nearest integer.

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746. 12.5 millinmole of NH_4NO_3 dissolved in enough water to make 25.0 mL of solution. The initial temperature is $25.8\,^\circ C$ and temperature after solid dissolves is $21.8\,^\circ C$. Calculate the enthalpy of solution for the $NH_4NO_3(s)\text{in kcal/mole}$.

[Given : Density of the solution $= 1\text{gm/ml}$ and heat capacity of solution $\frac{1cal}{gm - K}$]

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747. A gas expands from a valume of $3dm^3$ to $30dm^3$ against a constant pressure of 7 bar at initially $27\,^\circ C$. The work done during expansion is used to heat, 50 moles of water. Calculate rise in temperature (K) of water.

(Take specific heat capacity of H_2O as $4.2\text{J}/\text{gram-K}$ and 1 litre bar $= 100J\Big)$

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748. Calculate ΔG (in bar-L) when a definite mass of a monoatomic ideal gas at 1 bar and $27\,^\circ C$ is expanded adiabatically against vacuum from 10 L to 20 L (In 2=0.7).

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749. In how many of the following processes, heat of neutralization released is less than 13.7 kcal (if 1gram equivalent of each is taken)?

$HCL(aq) + NAOH(aq)$

$HI(aq) + NaOH(aq)$

$HCN(aq) + KOH(aq)$

$C_6H_5COOH(aq) + NaOH(aq)$

$HCl(aq) + NH_4OH(aq)$

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750. How much heat (in kJ) should be supplied to a rigid conducting vessel of volume V litres, so that 0.5 mole of C is formed in the reaction :

$A(g) + B(g) \rightarrow C(g), \Delta H = +7.6 kJ$

Take $R = 8 \text{J/K mole}$, T=300 K

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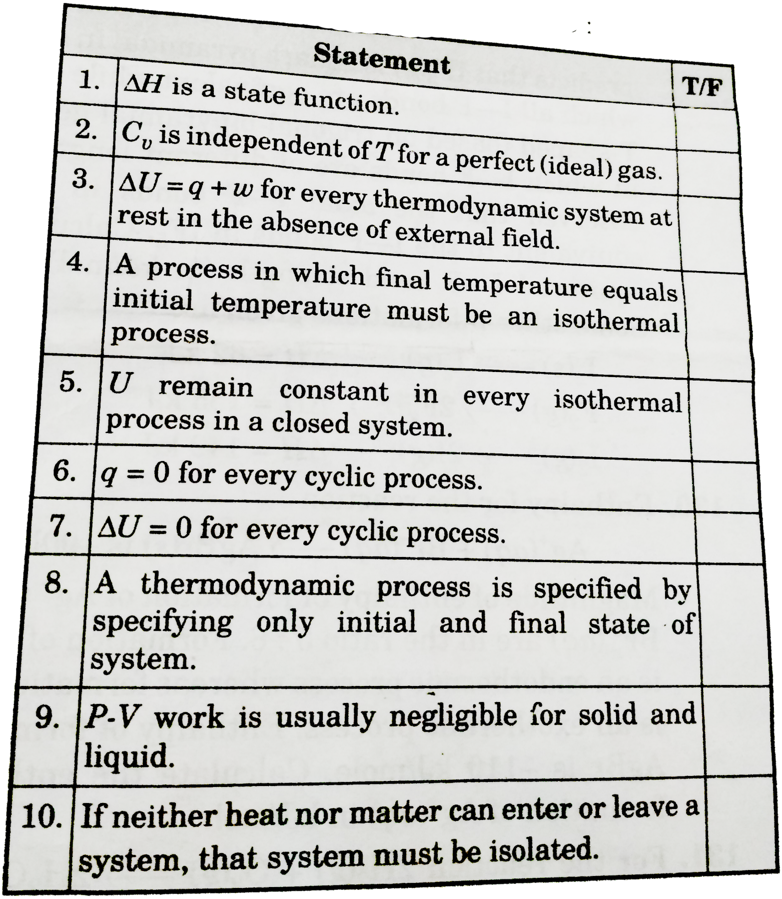
751. Find the number of *False*statements :



	Statement	T/F
1.	ΔH is a state function.	
2.	C_v is independent of T for a perfect (ideal) gas.	
3.	$\Delta U = q + w$ for every thermodynamic system at rest in the absence of external field.	
4.	A process in which final temperature equals initial temperature must be an isothermal process.	
5.	U remain constant in every isothermal process in a closed system.	
6.	$q = 0$ for every cyclic process.	
7.	$\Delta U = 0$ for every cyclic process.	
8.	A thermodynamic process is specified by specifying only initial and final state of system.	
9.	P-V work is usually negligible for solid and liquid.	
10.	If neither heat nor matter can enter or leave a system, that system must be isolated.	

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752. A gaseous reaction $A(g) \Leftrightarrow B(g)$ is at equilibrium under standard condition and 200 K. Calculate the equilibrium constant of the reaction at

400 K if $\Delta S^{\circ}_{\text{reaction}} = 6 \times 10^{-5} T^2 cal/K$, where T is temperature in kelvin.

[Given : R = $2cal/molK$ and $\text{In } 2 = 0.7$]

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753. At 500 kbar pressure density of diamond and graphite are $3\text{g}/\text{cc}$ and $2\text{g}/\text{cc}$ respectively, at certain temperature T. Find the value of |DeltaH-DeltaU|$(\text{in kJ}/\text{mole})$for the conversion of 1 mole of graphite 1 mole of diamond at 500 kbar pressure.

(Given : $1\text{bar} = 10^5\text{N}/\text{m}^2\Big)$

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754. Calculate $\Delta G_{reaction}(\text{kJ}/\text{mol})$ for the given reaction at 300 K

$A_2(g) + B_2(g) \Leftrightarrow 2Ab(g)$

and at particle pressure of 10^{-2}bar and 10^{-4}

Given :

$\Delta H_f^{\circ} AB = 180kJ/mol, \quad \Delta H_f^{\circ} A_2 = 60kJ/mol$

$\Delta H_f^\circ B_2 = 29.5 kJ/mol, \quad \Delta S_f^\circ AB = 210 J/K\text{ - }mol$

$\Delta S_f^\circ A_2 = 190 kJ/mol, \quad \Delta S_f^\circ B_2 = 205 J/K\text{ - }mol$

Use :$2.303R \times 300 = 5750\text{J/mole}$

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755. An imaginary engine, is capable of expanding the gas upto 10^{13} times. If the engine expands the gas upto the maximum possible extent isothermally at 300 K, then work done by gas is x, whereas if the engine expands upto the maximum possible extent adiabatically, at an initial temperature of 300 K, the temperature falls to -160.6 Kand the work done by gas is y. If the gas is He and all process are reversible in nature, calculate by how many times x is greater than y.

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756. The heat evolved on combustion of 1 gm of starch, $\left(C_6H_{10}O_5\right)x$, into $CO_2(g)$ and $H_2O(l)$ at constant pressure, is 4.00 kcal. Standard Ethalpy of formation of $CO_2(g)$ and $H_2O(l)$ are -94.00 and $-65.40\text{kcal}/\text{mol}$. The magnitude of standard enthalpy of formation of starch (in al/gm)is :

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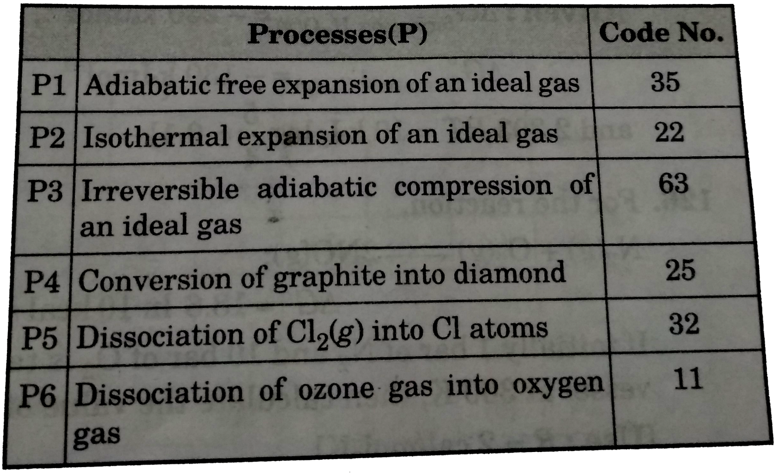
757. Identify the four digit number abcd if it is equal to sum of code numbers of all those processes in which $\Delta S > 0$.



	Processes(P)	Code No.
P1	Adiabatic free expansion of an ideal gas	35
P2	Isothermal expansion of an ideal gas	22
P3	Irreversible adiabatic compression of an ideal gas	63
P4	Conversion of graphite into diamond	25
P5	Dissociation of $Cl_2(g)$ into Cl atoms	32
P6	Dissociation of ozone gas into oxygen gas	11

[For example if only process P1 satisfies the condition then fill 0035 if both P1 and P6 satisfy then fill 0046.]

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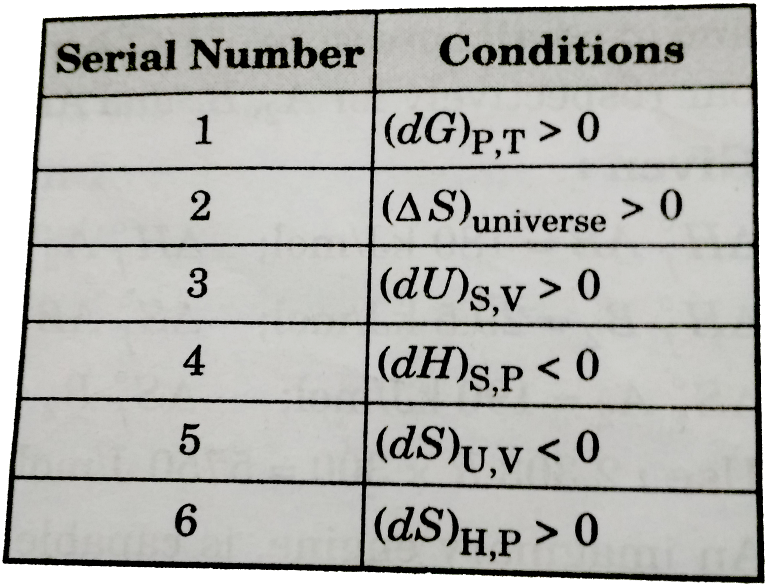
758. Consider the following six conditions. (Serial number 1 to6). Select those conditions which represent criteria for spontaneity. Answer the system to be closed.

[Report your answer by adding the serial number of selected conditions. For example if serial number 1 and satisfy then answer would be 0003.]



Serial Number	Conditions
1	$(dG)_{P,T} > 0$
2	$(\Delta S)_{universe} > 0$
3	$(dU)_{S,V} > 0$
4	$(dH)_{S,P} < 0$
5	$(dS)_{U,V} < 0$
6	$(dS)_{H,P} > 0$

All notations have their usual meaning.

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759. Calculate ΔG (in joule) for the reaction

$2A(g) \rightarrow B(g) + C(g)$

when mixture contains 1 mole of A, 2 moles of B and 1 mole of C at total pressure of 10 atm and 300 K.

[Given : $G^{\circ}_{m}, A(g) = 40\text{kJ mol}^{-1}$,

$G^{\circ}_{m}, B(g) = 60\text{kJ mol}^{-1}$,

$G^{\circ}_{m}, C(g) = 20\text{kJ mol}^{-1}$,

$R = 8.3JK^{-1}mol^{-1}$ and $\text{In}\ 2 = 0.7$]

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760. 4 mole $H_2O(g)$, 2.5mole H_2, 2.5 mole CO(g) and 1 mole inert gas He are kept at a total pressure of 10 bar in a flask containing C (graphite) at temperature T. Calculate ΔG (inkJ) of the following reaction at the abovecondition :

$C_{\text{graphite}} + H_2O(g) \rightarrow H_2(g) + CO(g)$

[Given : $\Delta G^{\circ}_{\text{formation}, H_2O(g)} = -230\ \text{kJmol}^{-1}$,

$\Delta G^{\circ}_{\text{formation}, CO(g)} = -130\ \text{kJmol}^{-1}$ and $2.303RT = 10kJ, \log\frac{5}{4} = 0.1$]

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761. For the reaction,

$N_2(g) + O_2(g) \Leftrightarrow 2NO(g), \quad \Delta G^\circ = 18.6 \text{ In } 10\text{kcal at } 300K.$

If initially 1 bar of N_2 and 10 bar of O_2 is taken in a vessel at 300 K, then calculate the value of abcd. [Use : $R = 2\text{cal}/\text{mol-K}$]

where ab $=$ two digit number such that K_{eq}(equilibrium constant of above reactio

and cd = two digit number such tht $P_{NO} = 10^{-(cd)}$bar.

[For example if K_{eq}(equilibrium constant) $= 10^{-10}$

$\therefore ab = 10$ and if $P_{NO} = 10^{-12}$ bar

$\therefore cd = 12$ hence abcd $= 1012$]

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762. Calculate the magnitude of ring strain energy in (kJ/mol) of cyclopropane from the following data :

$\Delta_f H\left[C_3H_6(g)\right] = 55, \Delta_f H[C(g)] = 715.0,$

$\Delta_f H[H(g)] = 220, Be(C - C) = 355, \text{ BE } (C - H) = 410(\text{all in kJ/mole})$

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763. The standard molar enthalpies of formation of $H_2O(l)$ and $H_2O_2(l)$ are -286 and -188 "kJ"//"mol", respectively. Molar enthalpies of vaporisation of $H_2O(l)$ and $H_2O_2(l)$ are 44 and 53 kJ respectively. The bond dissociation enthalpy of $O_2(g)$ is $498\text{kJ}/\text{mol}$. calculate the bond dissociation enthalphy (inkJ/mol) of O - O bond in H_2O_2, assuming that the bond dissociation ethalpy of O - H bond is same in both H_2 and H_2O_2.

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764. The standard molar enthalpies of formation of $IF_3(g)$ and $IF_5(g)$ are -470 kJ and -847 kJ, respectively. Valence shell electron-pair repulsion theory predicts that $IF_3(g)$ is square pyramidal in shape in which all I-F bonds are equivalent while $IF_3(g)$ is T-shaped (based on trigonal-bipyramial geometry) in which I-F bonds are of different lengths. It is observed that the axial I-F bonds in IF_3 are equivalent to the I-F bonds in

IF_5. Calculate the equitorial I-F bond strength (inkJ/mol) in IF_3.

Some other informations given are :

$I_2(s) \rightarrow I_2(g), \quad \Delta H = 62kJ$

$F_2(g) \rightarrow 2F(g), \quad \Delta H = 155kJ$

$I_2(g) \rightarrow 2I(g), \quad \Delta H = 149kJ$

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765. Ethalpy for the reaction

$Ag^+(aq) + Br^-(aq) \rightarrow AgBr(s)$ is $-90kJ$.

Magnitude of enthalpy of formation of $Ag^+(aq)$ and $Br^-(aq)$ in the ratio 5:6 Formation of $Ag^+(aq)$ is an endothermic process whereas formation of Br^- is an exothermic process. Enthalpy of formation of AgBr is $-110\text{kJ}/\text{mole}$. Calculate the enthalpy of formation of $Ag^+(aq)$ in kJ/mol.

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766. For the reaction $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$. The standard entropies of

$H_2(g), O_2(g)$ and $H_2O(l)$ at $27^\circ C$ are $30\text{cal K}^{-1}mol^{-1}, 50calK^{-1}$ and $15calK^{-1}$

.

Assuming H_2 and O_2 to behave as ideal gas (without vibrational degree of freedom) and $C\left(PmH_2O(l)\right) = 15.5calK^{-1}mol^{-1}$. Determine magnitude of standard entropy (in $calK^{-1}$) change for the reaction at $177^\circ C$. ltbrlt [Given : $R = 2calK^{-1}mol^{-1}$, In $1.5 = 0.4$]

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767. Enthalpy of neutralization of $H_3PO_3$with $NaOH$ is -106.68kJ/mol. If enthalpy of neutralization of HCL with NaOH is -55.84kJ/mole, then calculate enthalpy of ionization of H_3PO_3 in to its ions in kJ.

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