CHEMISTRY

JEE (MAIN AND ADVANCED) CHEMISTRY

CHEMICAL THERMODYNAMICS

Lecture Sheet Exercise I

1. The molar heat capacity of water at constant pressure, C, is $75JK^{-1}mol^{-1}$. When 1.0KJ of heat is supplied to 100g of water which is free to expand, the increase in temperature of water is :

A. 1.2 K

B. 2.4 K

C. 4.8 K

D. 6.6 K

Answer: B

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2. Which statement(s) is correct,

A. $\left(\frac{\delta H}{\delta T}\right)_P - \left(\frac{\delta U}{\delta T}\right)_V = R$

B. $\left(\frac{\delta H}{\delta T}\right)_P > \left(\frac{\delta U}{\delta T}\right)_V$

C. $\left(\frac{\delta H}{\delta V}\right)_T$ for ideal gas is zero

D. All of these

Answer: D

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3. For a substance more internal energy is observed in [same quantity]

A. Solid state

B. Liquid state

C. Gaseous state

D. All have same

Answer: C

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4. The expression $[\Delta E / \Delta T]_V$ represent

A. Heat capacity at constant volume

B. Heat capacity at constant at constant pressure

C. Enthalpy change

D. Eantropy change

Answer: A

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5. For which one of the following systems $DE < DH$

A. $2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$

B. $N_{2(g)} + O_{2(g)} \rightarrow 2NO_{(g)}$

C. $2NH_{3(g)} \rightarrow N_{2(g)} + 3H_{2(g)}$

D. $H_{2(g)} + I_{2(g)} \rightarrow 2HI_{(g)}$

Answer: C

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6. A system absorbs 'xJ' heat and does "yJ" work. Its ΔE is +Ve when

A. y gt x

B. x gt y

C. y = 2x

D. x = y

Answer: B

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7. An ideal gas occuping a volume of $2dm^3$ and a pressure of 5 bar undergoes isothermal and irreversible expansion against external pressure of 1 bar. The final volume of the system and work involved in the process is

A. $10dm^3, 1000J$

B. $8dm^3, -800J$

C. $10dm^3, -800J$

D. $10m^3, -1000J$

Answer: C

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8. An ideal gas expands in volume from $10^{-3}m^3$ to $10^{-2}m^3$ at 300 K against a constant pressure of $10^5 Nm^{-2}$. The work done is

A. -$900J$

B. 900kJ

C. 270kJ

D. $-900kJ$

Answer: A

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9. In which of the following sets, all the properties belong to same category (all extensive or all intensive)

A. Mass, volume, specific heat

B. Temperature, pressure, Volume

C. Heat capacity, density, entropy

D. Enthalpy, Internal energy, volume

Answer: D

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10. Which of the following statements is correct ?

A. Only internal energy is a statc function but not work

B. Only work is a state function but not internal energy

C. Both internal energy and work are state functions

D. Neither internal energy nor work is a state function

Answer: A

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11. Two mole of an ideal gas is heated at constant pressure of one atmosphere from $27^\circ C$ to $127^\circ C$. If $C_{v,m} = 20 + 10^{-2}TJK^{-1}mol^{-1}$, then q and ΔU for the process are respectively.

A. 6362.8 J, 4700 J

B. 1522.2 Cal, 1124.4 Cal

C. 7062.8, 5400 J

D. 3181.4 J, 2350 J

Answer: A::B

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12. Assuming that, water vapour is an ideal gas the internal energy (ΔU) when 1 mol of water is vapourised at 1 bar pressure and $100^\circ C$ (given : molar enthalpy of vaporisation of water at 1 bar and $373K = 41kJmol^{-1}$ and $R = 8.3JK^{-1}mol^{-1}$)) will be

A. $41.00 kJ mol^{-1}$

B. $4.100 kJ mol^{-1}$

C. $3,7904 J mol^{-1}$

D. $37,904 kJ mol^{-1}$

Answer: C::D

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13. For gaseous reaction, if ΔH is the change in enthalpy and ΔU that in internal energy then :

A. ΔH is always greater than ΔU

B. ΔH is always less than ΔU

C. $\Delta H < \Delta U$ only if the number of mole of the products is less than that of the reactants

D. $\Delta U < \Delta H$ only if the number of mole of the reactants is less than that of the products

Answer: C::D

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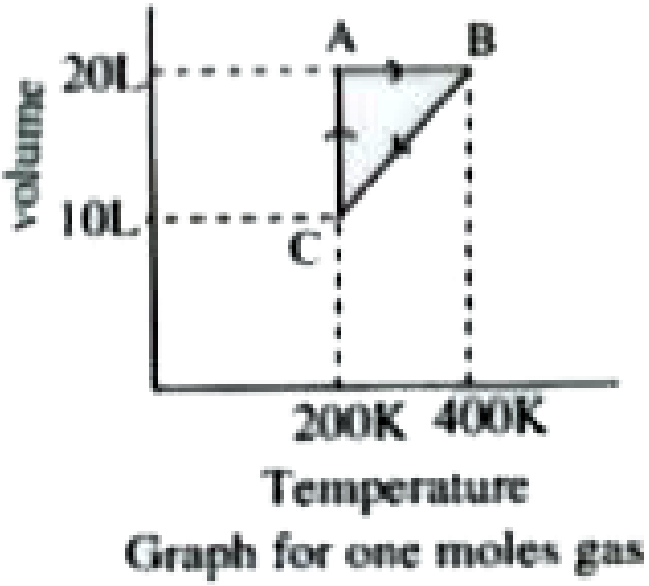
14. Answer the following questions based on the diagram below involving 1 mole of ideal gas:



Graph for one moles gas

Process $A \rightarrow B$ represents :

A. isobaric

B. isochoric

C. isothermal

D. adiabatic

Answer: B

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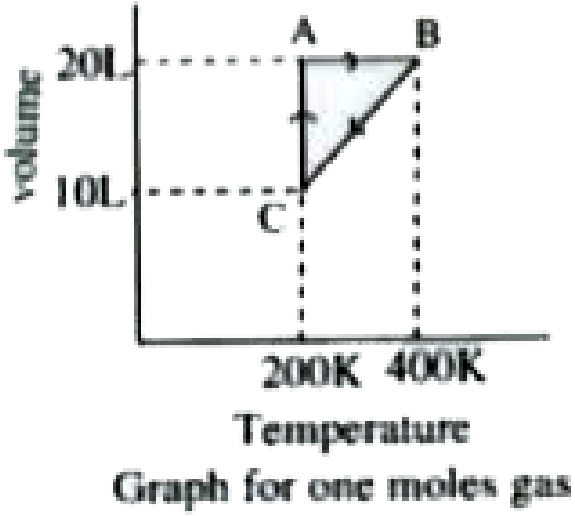
15. Answer the following questions based on the diagram below involving 1 mole of ideal gas:



Graph for one moles gas

Work done in the process $C \rightarrow A$ is

A. zero

B. 11.37 L atm

C. 22.76 L atm

D. unpredictable

Answer: B

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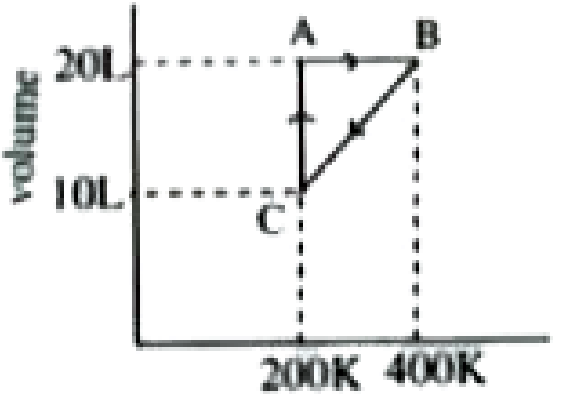
16. Answer the following questions based on the diagram below involving

1 mole of ideal gas:



Graph for one moles gas

The process which occurs in going from $B \rightarrow C$ is

A. isothermal

B. adiabatic

C. isobaric

D. isochoric

Answer: C

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17. Match the following columns

List-I	List-II
A) Reversible cooling of an ideal gas at constant volume	P) $w = 0; q < 0; \Delta U < 0$
B) Reversible isothermal expansion of an ideal gas	Q) $w < 0, q > 0, \Delta U > 0$
C) Adiabatic expansion of non-ideal gas into vacuum.	R) $w = 0; q = 0; \Delta U = 0$
D) Reversible melting of sulphur at normal melting point.	S) $w < 0; q > 0; \Delta U = 0$

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18. Match the following columns

List-I	List-II
A) Reversible isothermal expansion of an ideal gas	P) $W = -2.303nRT\log\left(\frac{V_2}{V_1}\right)$
B) Reversible adiabatic compression of an ideal gas	Q) $PV^{\gamma} = \text{constant}$
C) Irreversible adiabatic expansion of an ideal gas	R) $W = \frac{nR}{(\gamma - 1)}(T_2 - T_1)$
D) Irreversible isothermal compression of an ideal gas	S) $\Delta H = 0$

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19. Match the following columns

List-I	List-II
A) $W_{rev} < W_{irr}$	P) Isothermal expansion
B) $W_{rev} > W_{irr}$	Q) Isothermal compression
C) $(T_f) < T_i$	R) Adiabatic expansion
D) $T_f > T_i$	S) Adiabatic compression

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20. Consider a class room of dimensions $5 \times 10 \times 3m^3$ at atemperature $20^\circ C$ and pressure 1 atm. There are 50 people in the room, each losing energy at an average of 150 watt. Assuming that walls ceiling, floor and furniture are perfectly insulated and none of them absorb heat, what time (in seconds) will be needed for rising the temperature of air in the room to body temperature i.e., $37^\circ C$? (For air $C_P = \frac{7}{2}R$. Loss of air to outside as the temperature rises may be neglected).

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21. 1L of NH_3 at $27^\circ C$ is expanded adiabatically to x litres and final temperature is $-123^\circ C$. What is the value of x?

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22. One mole of a non-ideal gas undergoes a change of state $(2.0atm, 3.0L, 90K) \rightarrow (4.0atm, 5.0L, 245K)$ with a change in internal energy, $\Delta U = 30.0Latm$. The change in enthalpy (ΔH) of the process in L atm is (Give your answer after dividing with 11)

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23. 10 mole of an ideal gas is heated at constant pressure of one atmosphere from $27^\circ C$ to $127^\circ C$. If $C_{v,m} = 21.686 + 10^{-3}T$, then ΔH for the process is $x \times 10^5 J1$. Then x is

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Lecture Sheet Exercise Ii

1. The formation of water from $H_{2(g)}$ and $O_{2(g)}$ is an exothermic reaction because

A. $H_{2(g)}$ and $O_{2(g)}$ have a higher chemical energy that water

B. $H_{2(g)}$ and $O_{2(g)}$ have a lower chemical energy that water

C. $H_{2(g)}$ and $O_{2(g)}$ have higher temperature than water

D. Energy considerations do not arise

Answer: A

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2. Which of the following equation represents standard heat of formation of ethanol?

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3. $C_{\text{graphite}} + O_{2(g)} : \Delta H = -393.5kJ.$ ΔH of the above reaction cannot be

A. Heat of formation of CO_2

B. Heat of combustion of C

C. Heat of reaction

D. Heat of transition

Answer: D

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4. The heat of neutralisation is maximum when

A. Sodium hydroxide is neutralised by acetic acid

B. Ammonium hydroxide is neutralised by acetic acid

C. Ammonium hydroxide is neutralized by hydrochloric acid

D. Sodium hydroxide is neutralized by hydrochloric scid

Answer: D

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5. Calculate the heat of formation of KOH from the following data

$K_{(s)} + H_2O + aq \rightarrow KOH_{(aq)} + \frac{1}{2}H_{2(g)}, \Delta H = -48.4K.Cal$

$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)}, \Delta H = -68.44K.Cal$

$KOH_{(s)} + aq \rightarrow KOH_{aq}, \Delta H = -14.01K.Cal$

A. $+102.83$

B. $+130.85$

C. -102.83

D. -130.85

Answer: C

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6. If $S + O_2 \rightarrow SO_2, \Delta H = -398.2kJ$

$SO_2 + \frac{1}{2}O_2 \rightarrow SO_3, \Delta H = -98.7kJ, SO_3 + H_2O \rightarrow H_2SO_4, \Delta H = -$

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O, \Delta H = -227.3kJ$

The enthalpy of formation of sulphuric acid at 298K will be

A. $+125kJmol^1$

B. $31.25kJmol^{-1}$

C. $62.5kJmol^{-1}$

D. $250kJmol^{-1}$

Answer: A

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7. Given

$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}, \Delta H = -395kJ, S_{(g)} + O_{2(g)} \rightarrow SO_{2(g)}, \Delta H$

$CS_{2(l)} + 3O_{2(g)} \rightarrow CO_{2(g)} + 2SO_{2(g)}, \Delta H = -1110kJ$

The heat of formation of $CS_{2(l)}$ is

A. $+125kJmol^1$

B. $3.25kJmol^{-1}$

C. $62.5kJmol^{-1}$

D. $250kJmol^{-1}$

Answer: A

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8. The standard heat of formation of sodium ions in aqueous solution from the following data :

Heat of formation of $NaOH(aq)$ at $25^{\circ}C = -470.7KJ$:

Heat of formation of OH^{-1} at $25^{\circ}C = -228.8KJ$ is :

A. $-251.9KJ$

B. 241.9 KJ

C. $-241.9KJ$

D. $300Kjmol^{-1}$

Answer: C

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9. The standard enthalpy of formation $\left(\Delta H^0\right)$ at 298K for methane, $CH_{4(g)}$ is 74.8 $kJmol^1$. The additional information required to determine the average energy for C-H bond formation would be

A. The dissociation energy of hydrogen molecule, H_2

B. The dissociation energy of H_2 and enthalpy of sublimation of carbon

C. Latent heat of vaporisation of methane

D. The first four ionisation energies of carbon and electron gain enthalpy of hydrogen

Answer: B

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10. When $50cm^3$ of 0.2N H_2SO_4 is mixed with $50cm^3$ of 1N KOH, the heat liberated is

A. 11.45kJ

B. 57.3kJ

C. 573kJ

D. 573J

Answer: D

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11. Given that the data for neutralization of a weak acid (HA) and strong acid with a strong base is:

$HA + OH^- \Rightarrow A^- + H_2O : \Delta H = -41.80kJ, H^+ + OH^- \Rightarrow H_2O, \Delta$

The enthalpy of dissociation of weak acid would be

A. $-97.20kJ$

B. $+97.70kJ$

C. $-14.10kJ$

D. 14.10kJ

Answer: D

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12. When 1.0g of oxalic acid $(H_2C_2O_4)$ is burned in a bomb calorimeter whose heat capacity is 8.75kJ/K, the temperature increases by 0.312K. The enthalpy of combustion of oxalic acid at $27^\circ C$

A. $-245,7kJ/mol$

B. $-244.452kJ/mol$

C. $-241.95kJ/mol$

D. $-57.86k\text{Cal}mol^{-1}$

Answer: C::D

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13. Consider the following data:

$\Delta_f H^2(N_2H_4, l) = 50kJ/mol, , \Delta_f H^\circ(NH_3, g) = -46kJ/mol,$ B.E. $(N-H) = 393kJ/mol$ and $B.E.(H-H) =$ 436 kJ/mol, also $\Delta_{vap}H(N_2H_4, l) = 18kJ/mol.$ The N-N bond energy in N_2H_4 is

A. 226kJ/mol

B. 154 kJ/mol

C. 190 kJ/mol

D. 54.04 k Cal/mole

Answer: C::D

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14. What is the bond enthalpy of Xe-F bond? $XeF_4(g) \rightarrow Xe^+(g) + F^-(g) + F_2(g) + F(g), \Delta_f H = 292$kcal/mol. Given that I.E of Xenon =279k Cal/mole, B.E of $F_2 = 38$ k Cal/mol. E.A of F=85k Cal/mole.

A. 24k Cal/mol

B. 34k Cal/mol

C. 8.5 k Cal/mol

D. 142.12kJ/mole

Answer: B::D

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15. Change in enthalpy and change in internal energy are state functions. The value of ΔH, ΔU can be determined by using Kirchoff's equation. Calculate ΔH when $10dm^3$ of helium at NTP is heated in a cylinder to $100^\circ C$, assuming that the gas behave ideally.

A. 927.9J

B. 279.2J

C. 729.3J

D. 999J

Answer: A

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16. Change in enthalpy and change in internal energy are state functions. The value of ΔH, ΔU can be determined by using Kirchoff's equation.

I mole of naphthalene $(C_{10}H_8)$ was burnt is oxygen gas at $25^\circ C$ at constant volume. The heat evolved was found to be 5138.8kJ. Calculate the heat of reaction at constant pressure

A. 4770.9kJ

B. 5143.8kJ

C. 6796.6kJ

D. 5791.2kJ

Answer: B

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17. Change in enthalpy and change in internal energy are state functions. The value of ΔH, ΔU can be determined by using Kirchoff's equation. Calculate the heat of formation of methane, given that heat of formation of water $= -286 kJmol^{-1}$, heat of combustion of methane $= -890 kJmol^{-1}$ heat of combustion of carbon $= -393.5 kJmol^{-1}$

A. $90.5 kJmol^{-1}$

B. $-240 kJmol^{-1}$

C. $-75.5 kJmol^{-1}$

D. $95.6 kJmol^{-1}$

Answer: C

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18. The bond dissociation energy depends upon the nature of the bond and nature of the molecule. If any molecule more than 1 bonds of similar nature are present then the bond energy reported is the average bond

energy.

Determine $C-C$ and $C-H$ bond enthalpy (in kJ/mol). Given: $\Delta_f H^0(C_2H_6, g) = -85kJ/mol, \Delta_f H^0(C_3H_8, g) = -104kJ/mo \leq , \Delta_$, B.E. (H-H)= 436 kJ/mol,

A. 414345

B. 345414

C. 287405.5

D. None of these

Answer: B

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19. The bond dissociation energy depends upon the nature of the bond and nature of the molecule. If any molecule more than 1 bonds of similar nature are present then the bond energy reported is the average bond energy.

Heat evolved when 0.75 mol of molten aluminium at its melting point of

$658^{\circ}C$ is solidified and cooled to $25^{\circ}C$. The enthalpy of fusion of aluminium is $76.8 \text{cal} g^{-1}$ and $C_P = 5.8 \text{cal} mol^{-10}C$

A. -4.3 kcal

B. 4.3 kcal

C. $-1.199k$ cal

D. 1.199kcal

Answer: A

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20. The bond dissociation energy depends upon the nature of the bond and nature of the molecule. If any molecule more than 1 bonds of similar nature are present then the bond energy reported is the average bond energy.

If enthalpy of hydrogenation of $C_6H_{6(l)} \text{into} C_6H_{12(l)}$ is $-205kJ$ and resonance energy of $C_6H_{6(l)}$ is $-152kJ/mol$ then enthalpy of hydrogenation of

is ? Answer

ΔH_{vap} of $C_6H_{6(l)}, C_6H_{10(l)}, C_6H_{12(l)}$ all are equal:

A. $-535.5kJ/mol$

B. $-238kJ/mol$

C. $-357kJ/mol$

D. $-119kJ/mol$

Answer: D

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21. Match the following columns

Column-I (Probable Heat released)	Column-II
A) $NaOH + HCl \rightarrow NaCl + H_2O$	P) 5.6 KCal
B) $NaOH + HCN \rightarrow NaCN + H_2O$	Q) 17.2 KCal
C) $NaOH + HF \rightarrow NaF + HN$	R) 13.6 KCal
D) $NH_4OH + H_2CO_3 \rightarrow NH_4HCO_3 + H_2O$	S) 10.2 KCal

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22. 

What is the resonance energy of Benzene in the same units?

What is the resonance energy of Benzene in the same units?

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23. The standard molar enthalpies of formation of cyclohexane (l) and benzene (l) at $25^\circ C$are -156 and $+49kJmol^{-1}$ respectively. The standard enthalpy of hydrogenation of cyclohexene (l) at $25^\circ C$ is

$-119 kJmol^{-1}$. Use these data to estimate the magnitude of the resonance energy of benzene.

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24. Estimate the average S-F bond energy in SF_6. The value of standard enthalpy of formation of $SF_{6(g)}$, $S_{(g)}$ and $F_{(g)}$ are $-1100, 275$ and $80 kJmol^{-1}$ respectively. (Give your answer after divide with 51.5)

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25. Compute the heat of formation of liquid methyl alcohol in kilojoules per mole, using the following data. Heat of vapourisation of liquid methyl alcohol =38 kJ/mol. Heat of formation of gaseous atoms from the elements in their standard states , H= 218kJ/mol, C= 715kJ/mol, O= 249 kJ/mol. Average bond energies :C-H =415kJ/mol, C-O=365 kJ/mol, O-H = 463 kJ/mol.

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Lecture Sheet Exercise Iii

1. For the reaction $I_{2(g)} \Leftrightarrow I_{2(s)}$, $\Delta H = -ve$. Then choose the correct statement from the following

(A) The process is spontaneous at all temperature

(B) The process is accompained by an increase in entropy

(C) The process is accompained by a decrease in entropy

(D) The process is accompained by a decrease in enthalpy

A. Only A, B and C

B. Only B and D

C. Only C and D

D. Only a, C and D

Answer: C

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2. For which of the process, ΔS is negative?

A. $H_{2(g)} \rightarrow 2H_{(g)}$

B. $N_{2(g)}(1\text{atm}) \rightarrow N_{2(g)}(8\text{atm})$

C. $2SO_{3(g)} \rightarrow 2SO_{2(g)} + O_{2(g)}$

D. $C_{(\text{diamond})} \rightarrow C_{(\text{graphite})}$

Answer: B

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3. The process of evaporation of a liquid is accompanised by

(A) Increase in enthalpy (B) Increase in entropy (C) Decrease in Gibbs energy

The correct statement(s) is/are

A. Only A and C

B. Only B and C

C. Only A and B

D. All

Answer: D

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4. A reaction has both DH and DS negative. The rate of reaction

A. Increase with increase of temperature

B. Increase with decrease of temperature

C. Remains unaffected by change of temperature

D. Cannot be predicted for change in temperature

Answer: A

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5. What are the sign of the entropy change (+ or -) in the following:

I : A liquid crystallises into a solid

II: Temperature of a crystalline solid is raised from 0K to 115K

III: $2NaHCO_{3(g)} \rightarrow Na_2CO_{3(g)} + CO_{2(g)} + H_2O_{(g)}$

IV : $H_{2(g)} \rightarrow 2H_{(g)}$

A. $\begin{matrix} I & II & III & IV \\ - & + & + & + \end{matrix}$

B. $\begin{matrix} I & II & III & IV \\ - & - & - & + \end{matrix}$

C. $\begin{matrix} I & II & III & IV \\ - & - & - & + \end{matrix}$

D. $\begin{matrix} I & II & III & IV \\ + & - & - & - \end{matrix}$

Answer: A

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6. At $0^\circ C$ ice and water are in equilibrium and $\Delta H = 6.0KJ \ \text{ then } \ \Delta S$ will be

A. $22JK^{-10mol^{-1}}$

B. $35JK^{-1}mol^{-1}$

C. $48JK^{-1}mol^{-1}$

D. $100JK^{-1}mol^{-1}$

Answer: A

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7. Melting & boiling point of NaCl respectively are 1080 K & 1600K. ΔS for stage -I & II in $NaCl_{(s)} \xrightarrow[\Delta H_{fus}=30kJ]{I} NaCl_{(l)} \xrightarrow[\Delta H_{vap}=160kJ]{II}$ are

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8. ΔS_{says} for $4Fe_{(s)} + 3O_2 \rightarrow 2Fe_2O_{3(s)}$ is $-550J/k/mol$ at 298K. If enthalpy change for same process is $-1600kJ/mol$, DS_{total} (in J/mol/K) is

A. $\left[\frac{1600}{298} \times 10^3\right] + 550 > 0$

B. $550 - \left[\frac{1600}{298}\right] < 0$

C. $\left[\frac{1600}{298} \times 10^3\right] - 550 > 0$

D. $\left[\frac{1600 + 550}{298}\right] > 0$

Answer: C

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9. False statement regarding second law of thermodynamics is

A. It is impossible to construct a machine working in cycles which transforms heat from a lower temperature region to higher temperature region without intervention of any external agency.

B. Heat cannot flow from a colder body to a hotter body on its own

C. For any spontaneous process taking place in an isolated system $\Delta S < O$

D. All spontaneous processes are thermodynamically irreversible & entropy of the system increases in all spontaneous processes.

Answer: C

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10. In an irreversible process taking place at constant T and P and in which only pressure- volume work is being done, the change on Gibb's free energy (dG) and changing in entropy (dS), stisfy the criteria

A. $(dS)_{V,S} < 0, (dG)_{T,P} < 0$

B. $(dS)_{V,E} > 0, (dG)_{T,P} < 0$

C. $(dS)_{V,E} = 0, (dG)_{T,P} = 0$

D. $(dS)_{V,E} = 0, (dG)_{T,P} > 0$

Answer: B

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11. Necessary conditions for spontanity of a reaction _____

A. $(G)_{\text{products}} < (G)_{\text{reactants}}$

B. $(S)_{\text{products}} < (S)_{\text{reactants}}$

C. $\left[(\Delta S)_{\text{reaction}} + (\Delta S)_{\text{surr}}\right] > 0$

D. $\left[-\frac{(\Delta H)_{\text{sys}}}{T} + (\Delta S)_{\text{sys}}\right] > 0$

Answer: A::C::D

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12. Which statements are correct for a process involving an ideal gas?

A. $(\Delta S)_{\text{Isothermal, sys}} = 2.303nR\frac{\log(V_f)}{V_i}$

B. $(\Delta S)_{\text{adiabatic, rev}} = 0$

C. $(\Delta S)_{\text{Total, irr}} < 0$

D. $(\Delta S)_{\text{Total, adiabatic, rev}} = 0$

Answer: A::B::C::D

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13. Combustion of sucrose is used by aerobic organisms for providing energy for the life substaining process. If all the capturing 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 gm of sucrose Given :

$\Delta H_{\text{sucrose}} = -6000 kJ mol^{-1}$, $\Delta S_{\text{combustion}} = 180 J/K mol$ and body temperature is 300 K.

A. 600 kJ

B. 594.6 k Cal

C. 144.83 k Cal

D. 605.4 kJ

Answer: C::D

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14. Consider the following reaction :

$CO_{(g)} + 2H_{2(g)} \Leftrightarrow CH_3OH_{(g)}$

Given :

$\Delta_r H^\circ(CH_3OOH, g) = -201k\frac{J}{m}ol, \Delta_r H^\circ(CO, g) = -114k\frac{J}{m}ol$

$S^\circ(CH_3OOH, g) = 240\frac{J}{K} - mol, S^\circ(H_2, g) = 29JK^{-1}mol^{-1}$

$S^\circ(CO, g) = 198\frac{J}{m}ol - K, C^\circ\_(p, m)(H_2) = 28.8\frac{J}{m}ol - K$

$C^\circ\_(p, m)(CO) = 29.4\frac{J}{m}ol - K, C^\circ\_(p, m)(CH_3OH) = 44\frac{J}{m}ol - K$

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

$\Delta_r S^\circ$ at 300 K for the reaction is :

A. $152.6\frac{J}{K} - mol$

B. $181.6\frac{J}{K} - mol$

C. $-16\frac{J}{K} - mol$

D. None of these

Answer: C

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15. Consider the following reaction :

$CO_{(g)} + 2H_{2(g)} \Leftrightarrow CH_3OH_{(g)}$

Given :

$\Delta_r H^\circ(CH_3OOH, g) = -201k\frac{J}{m}ol, \Delta_r H^\circ(CO, g) = -114k\frac{J}{m}ol$

$S^\circ(CH_3OOH, g) = 240\frac{J}{K} - mol, S^\circ(H_2, g) = 29JK^{-1}mol^{-1}$

$S^\circ(CO, g) = 198\frac{J}{m}ol - K, C^\circ\_(p, m)(H_2) = 28.8\frac{J}{m}ol - K$

$C^\circ\_(p, m)(CO) = 29.4\frac{J}{m}ol - K, C^\circ\_(p, m)(CH_3OH) = 44\frac{J}{m}ol - K$

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

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

A. $-87kJ/mol$

B. 87 kJ/mol

C. $-315kJ/mol$

D. $-288k\frac{J}{m}ol$

Answer: A

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16. Consider the following reaction :

$CO_{(g)} + 2H_{2(g)} \Leftrightarrow CH_3OH_{(g)}$

Given :

$\Delta_r H^\circ(CH_3OH, g) = -201k\frac{J}{m}ol, \Delta_r H^\circ(CO, g) = -114k\frac{J}{m}ol$

$S^\circ(CH_3OOH, g) = 240\frac{J}{K} - mol, S^\circ(H_2, g) = 29JK^{-1}mol^{-1}$

$S^\circ(CO, g) = 198\frac{J}{m}ol - K, C^\circ\_(p, m)(H_2) = 28.8\frac{J}{m}ol - K$

$C^\circ\_(p, m)(CO) = 29.4\frac{J}{m}ol - K, C^\circ\_(p, m)(CH_3OH) = 44\frac{J}{m}ol - K$

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

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

A. 155.18 J/mol-K

B. 150.02 J/mol-K

C. 172 J/mol-K

D. None of these

Answer: D

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17. As per second law of thermodynamics a process taken place spontaneously if and only if the entropy of the universe increases due to the process. Change in entropy is given by

$$\Delta S = \frac{Q_{rev}}{T}$$

What is the change in entropy of the universe due to the following reaction occuring at $27^{\circ}C$?

$A + 2B \rightarrow C + 2D, \Delta H = +1.8kJmol^{-1}$

Molar entropy values of A, B, C and D are 1,2,3 and $4JK^{-1}mol^{-1}$ respectively.

A. 0

B. $6JK^{-1}mol^{-1}$

C. $8JK^{-1}mol^{-1}$

D. $12JK^{-1}mol^{-1}$

Answer: A

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18. As per second law of thermodynamics a process taken place spontaneously if and only if the entropy of the universe increases due to the process. Change in entropy is given by

$$\Delta S = \frac{Q_{rev}}{T}$$

A gas $C_V = (0.2T)CalK^{-1}$. What is the change in its entropy when one mole of it is heated from $27^\circ C$ to $127^\circ C$ at constant volume ?

A. $20calK^{-1}mol^{-1}$

B. $15calK^{-1}mol^{-1}$

C. $35calK^{-1}mol^{-1}$

D. $25calK^{-1}mol^{-1}$

Answer: A

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19. Match the following columns

List - I	List - II
A) $(\Delta G_{system})_{T,P} = 0$	P) Process is in equilibrium
B) $\Delta S_{system} + \Delta S_{surrounding} > 0$	Q) Process is non spontaneous
C) $\Delta S_{system} + \Delta S_{surrounding} < 0$	R) Process is spontaneous
D) $(\Delta G_{system})_{T,P} > 0$	S) System is unable to do useful work

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20. Match the following columns

List - I (Process)	List - II (Entropy Change)
A) Reversible isothermal compression of ideal gas	P) $\Delta S_{system} > 0$
B) Isothermal free expansion ($P_{ext} = 0$) of an ideal gas	Q) $\Delta S_{system} < 0$
C) Reversible adiabatic expansion of an ideal gas	R) $\Delta S_{system} = 0$
D) Reversible expansion of ideal gas	S) Information insufficient

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21. Calculate equilibrium constant (in multiples of 10^{-80}) when sodium reduces Aluminium oxide to aluminium at 298 K. $\Delta G^{\circ}\_(f)$ of $Na_2O_{3(s)}$ at $298K = -377KJ\text{mole}^{-1}$ and $\Delta G^{\circ}\_(f)$ of Al_2O_3 at $298K = -1582KJ\text{mole}^{-1}$)

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22. For a liquid, enthalpy of fusion is $1.435 \times 10^3 calmol^{-1}$ and molar entropy change is $5.26 calmol^{-1}$. Calculate the melting point of the liquid.

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23. Calculate the free energy change in kJ when 1 mole of NaCl is dissolved in water at 298 K, Given

a) U of NaCl (U = lattice energy) $= 778 kJ\text{mole}^{-1}$

b) Hydration energy of NaCl $= -774.3 kJ\text{mole}^{-1}$

(c) Entropy change at 298K = 43mole^{-1}

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Lecture Sheet Exercise Iv

1. For a reaction $R_1, \Delta G = xKJmol^{-1}$. For a reaction $R_2, \Delta G = yKJmol^{-1}$. Reaction R_1 is non-spontaneous but along with R_2 it is spontaneous. This means that

A. x is -ve, y is +ve but in magnitude $x > y$

B. x is +ve, y is -ve but in magnitude $y > x$

C. Both x and y are -ve but not equal

D. Both x and y +ve but not equal

Answer: B

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2. Work done during the combustion of one mole of CH_4 in bomb calorimeter is

A. zero

B. $-101J$

C. $-24.2J$

D. $-1J$

Answer: A

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3. The magniutudes of lattice and hydration energies of salt AB are found to be 764 and 755 kJ respectively. If entropy of dissolution of AB in water is $40JK^{-1}mol^{-1}$ at 298 K. Gibb's energy change for the dissolution of AB will be

A. 9 kJ

B. $-2.92kJ$

C. $-11.2kJ$

D. $-9Kj$

Answer: B

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4. A and B makes an ideal solution. At what mole fraction of A and B, will degree of disorder be maximum with maximum Gibb's energy of mixing ?

A. $X_A = X_B = 0.5$

B. X_A or $X_B = 1$

C. $X_A = 0.75$

D. $X_A = 0.25$

Answer: A

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5. If ΔG_{298K} for the reaction $2H_{2(g.1atm)} + O_{2(g.1atm)} \rightarrow 2H_2O_{(g.1atm)}$ is $-240kJ$, what will be ΔG_{298K} for the reaction $H_2O_{(g.0.2atm)} \rightarrow H_{2(g.4atm)} + \frac{1}{2}O_{2(g.0.26atm)}$

A. 245.7 kJ

B. 239.3 kJ

C. 125.7 kJ

D. $-125.7kJ$

Answer: C

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6. Which of the following are correct statements ?

A. In cyclic process work done is zero

B. If dissociation energy of $CH_{4(g)}$ is 1656 KJ/mole and that of $C_2H_{6(g)}$ is 2812 KJ/mole, then the value of C-C bond energy will be 328 KJ/mole

C. C_{graphite} is thermodynamically more stable than $C_{\diamond}$

D. ΔH dor the reactant $N_{2(g)} + O_{2(g)} \rightarrow 2NO_{(g)}$ is negative

Answer: B::C

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7. Which of following is correct ?

A. Reversible adiabatic process is isoentropic

B. ΔS_{sys} for irreversible adiabatic compression is greater than zero

C. ΔS_{sys} for free expansion is zero

D. ΔS_{sys} for irreversible isothermal compression is greater than zero

Answer: A::B::D

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8. Correct statements among the following are

A. The net change in entropy of system is zero in cyclic process

B. the free energy change of system at freezing point is zero

C. the change in free energy with pressure for one mole of a perfect gas, $\Delta G = RT\ln\frac{P_2}{P_1}$

D. for a spontaneous change $(\Delta G)_{T.P} > 0$

Answer: A

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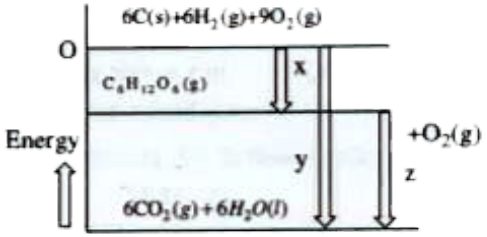
9. Consider the following energy level diagram:



Answer the following question on the basis of the given diagram

The heat of formation of glucose is

A. $-x$

B. $-y$

C. $x - y$

D. $-x + z$

Answer: A

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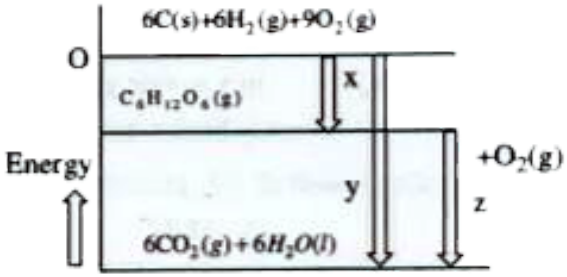
10. Consider the following energy level diagram:



Answer the following question on the basis of the given diagram

In the given diagram z refers to

A. $6 \times \Delta H^0_{f\,(CO_2)}$

B. $\Delta H^0_{f\,(C_6H_{12}O_6)}$

C. $\Delta H^0_{\text{combustion}\,(C_6H_{12}O_6)}$

D. $\Delta H^0_{\text{combustion}\,(C_6H_{12}O_6)} + \Delta H^0_{f\,(H_2O_{(l)})}$

Answer: C

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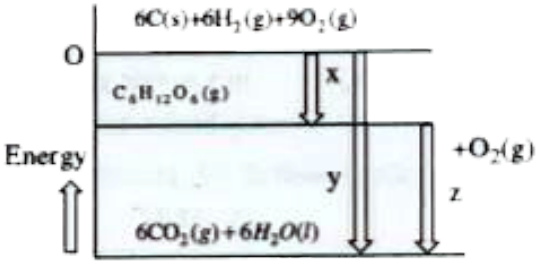
11. Consider the following energy level diagram:



Answer the following question on the basis of the given diagram

The quantity y is equal to

A. $\Delta H_{\text{combustion-C}\,(s)} + \Delta H_{\text{combustion}H_{2(g)}}$

B. $x + z$

C. $x - z$

D. $\Delta H_{fCO_2} + \Delta H_{H_2O}$

Answer: B

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12. Match the following columns

Column-I	Column-II
A) Heating of an ideal gas at constant pressure	P) $\Delta H = nC_{p,m}\ \Delta T \neq 0$
B) Compression of liquid at constant temperature	Q) $\Delta U = 0$
C) Reversible process for an ideal gas at constant T	R) $\Delta G = V\ \Delta P$
D) Adiabatic free expansion of an ideal gas	S) $\Delta G = nRT\ln\left(\frac{P_2}{P_1}\right)$

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13. 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 constainer and expanded reversible and adiabatically from 1 litre of 4 litre starting from initial temperature of 320K. ΔE or ΔU for the process is (in Cal) (Give your answer after divide with 240)

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14. ΔH_{vap} of the process, $A_{(l)} \Leftrightarrow A_{(\text{vap})}$ is 460.6 Cal mol^{-1}. The normal boiling point of the A is 50K. When pressure is increased to 10 atm. Then the boiling point of the A is (50)x K. The value of x is

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15. ΔH in terms of 'x' $\times 10^3$ KJ is if

$M_{(g)} + 2X_{(g)} \rightarrow M^{2+}_{(g)} + 2X^{-}_{(g)}$

Given : $(I.E)_1$ of M (g) = 705.7 kJ mol^{-1}, $(I.E)_2$ of $M(g)$ = 951 kJ mol^{-1} and $(E.A)_1$ of X(g) = $-328kJmol^{-1}$ 'x' is

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16. Standard enthalpy and standard entropy of vaporization of water are $+40kJmol^{-1}$ and $+120Jmol^{-1}K^{-1}$ respectively. Vapour pressure of water $27^{\circ}C$is P_{H_2O} then the value of 5 in P_{H_2O} will be (consider standard temperature to be 300K)

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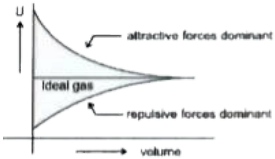
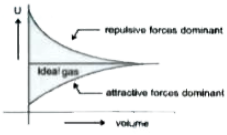
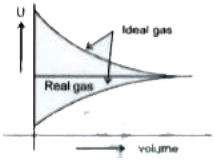
Practice Sheet Exercise I

1. Which of the following diagram correctly represents the variation of internal energy (U) of gas under expansion at constant temperature.

A. 

B. 

C. 

D. None of the above

Answer: B

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2. 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: [R =0.082L atm $mol^{-1}K^{-1} = 8.3Jmol^{-1}K^{-1}$]

A. 0

B. R ln (24.6)

C. R ln (2490)

D. $\frac{3}{2}$ R ln (24.6)

Answer: B

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3. The magnitudes of enthalpy changes for irreversible adiabatic expansion of a gas from 1L 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. $\Delta H_1 = \Delta H_2$ enthalpy being a state function

D. $\Delta H_1 = \Delta E_1 \& \Delta H_2 = \Delta E_2$ where $\Delta E_1 \& \Delta E_2$ are magnitude of change in internal energy of gas in these expansions respectively.

Answer: B

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4. A sample of gas is compressed from an initial volume of $2v_0$ to v_0 using three different processes.

First: Using reversible isothermal

Second: Using reversible adiabatic

Third: Using irreversible adiabatic under a constant external pressure then

A. Final temperature 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

D. Final pressure of gas will be highest at the end of second process.

Answer: A

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5. One mole of an ideal monoatomic gas at temperature T and volume 1L expands to 2L against a constant external pressure of one atm under adiabatic 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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6. Which has maximum internal energy at 298K?

A. helium gas

B. oxygen gas

C. ozone gas

D. equal

Answer: C

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7. A heat engine absorbs heat q_1 from a source at temperature T_1 and heat q_2 from a source at temperature T_2. Work done is found to be $J(q_1 + q_2)$. This is in accordance with

A. First law of thermodynamics

B. Second law of thermodynamics

C. Joules equivalent law

D. None of the above

Answer: C

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8. Assertion: An isothermal process is always an isolated one.

Reason: During an isothermal change, there exists thermal equlibrium between system and surroundings.

A. Statement-I is true, statement-II is true and statement-II is correct explanation for statement-I

B. Statement-I is true, statement-II is true and statement-II is NOT correct explanation for statement-I

C. Statement-I is true, statement-II is false

D. Statement -I is false, statement-II is true.

Answer: D

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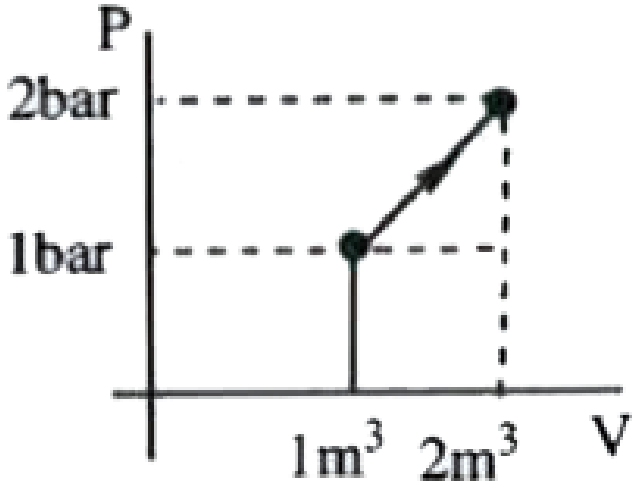
9. What is DU for the process described by figure. Heat supplied during the process q=100kJ.



A. $+50kJ$

B. $-50kJ$

C. $-150kJ$

D. $+150kJ$

Answer: B

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10. 6 what is the change in 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 L atm)= 100J]

A. $-24J$

B. $-84J$

C. $-164J$

D. $-248J$

Answer: B

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11. The heat capacity of liquid water is 75.6 J/mol K, while the enthalpy of fusion of ice is 6.0 kJ/mol. What is the smallest number of ice cubes at $0^\circ C$, each containing 9.0g of water, needed to cool 500g of liquid water from $20^\circ C \ \text{to} \ 0^{\circ 0C}$?

A. 1

B. 7

C. 14

D. None of these

Answer: C

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12. Statement -I : There is no change in enthalpy of an ideal gas during compression at constant temperature.

Statement-II: Enthalpy of an ideal gas is a function of temperature and pressure.

A. Statement-I is true, statement-II is true and statement-II is correct explanation for statement-I

B. Statement-I is true, statement-II is true and statement-II is NOT correct explanation for statement-I

C. Statement -I is false, statement-II is true.

D. Statement-I is true, statement-II is false

Answer: D

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13. Molar heat capacity of water in equilibrium with ice at constant pressure is:

A. zero

B. Infinity (∞)

C. $40.45 KJK^{-1}mol^{-1}$

D. $5.48 JK^{-1}mol^{-1}$

Answer: B

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14. Which of the following statements is false?

A. Work is a state function

B. Temperature is a state function

C. Change of state is completely defined when initial and final states are specified

D. Work appears at the boundary of the system

Answer: A

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15. On which of the following factors does internal energy depend upon

A. Mass of the system

B. Temperature of the system

C. Nature of the system

D. All the above

Answer: D

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16. The enthalpy is maximum for

A. 10 gram of water

B. 10 gram of ice

C. 10 gram of steam

D. same for all

Answer: C

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17. The different between ΔH and ΔE for the reaction $BaCl_{2(aq)} + K_2SO_{4(aq)} \rightarrow BaSO_{4(s)} \downarrow + 2KCl_{(aq)}$

A. RT

B. 2RT

C. (1/2)RT

D. zero

Answer: D

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18. For the gaseous reaction involving the complete combustion of isobutane

A. $\Delta H = \Delta E$

B. $\Delta H > \Delta E$

C. $\Delta H = \Delta E = 0$

D. $\Delta H < \Delta E$

Answer: D

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19. During a process work equivalent to 400J is done on a system, which gives out of 125J of energy. The change in internal energy is

A. 525J

B. 375J

C. 275J

D. 200J

Answer: C

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20. A system absorbs 10kJ of heat at constant volume and its temperature rises from $27^0C \text{ to } 37^0C$. The DE of reaction is

A. 100kJ

B. 10kJ

C. 0

D. 1kJ

Answer: B

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21. Which of the following come under the view of thermodynamics?

A. Predicting the feasibility of chemical change

B. Predicting the extent of completion of the chemical change

C. Rate at which chemical change occurs at a particular set of conditions

D. Effect of temperature on the rate of reaction

Answer: A

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22. During expansion of a gas into vaccum $(P_{\text{ext}} = 0)$, Work done is zero if the process is

(A) Reversible (B) Irreversible (C) Isothermal

A. B & C are true

B. A, B & C are false

C. A & C are true

D. B & C are false

Answer: A

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23. In the isothermal expansion of an ideal gas

A. $\Delta U = 0$

B. $\Delta T = 0$

C. q=0

D. $W = -q$

Answer: A::B::D

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24. Which has/have a positive value of ΔH?

A. $H_{2(g)} \rightarrow 2H_{(g)}$

B. $H_{(g)} \rightarrow H^{+}_{(g)} + e$

C. $H_2O_{(l)} \rightarrow H_2O_{(g)}$

D. $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O$

Answer: A::B::C

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25. The following is/are extensive property/properties

A. internal energy

B. temperature

C. concentration

D. heat capacity

Answer: A::B::C::D

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26. If the boundary of system moves by an infinitesimal amount, the work involved is given by $dw = -P_{\text{ext}}dV$, for irreversible process $W = -P_{\text{ext}}\Delta V$ (where $\Delta V = V_f - V_i$). For reversible process. $P_{\text{ext}} = P_{\text{int}} \pm dP \cong P_{\text{int}}$, so for reversible isothermal process $W = -nRT\text{In}\frac{V_f}{V_i}$

2 mole of an ideal gas undergoes isothermal compression along three different paths:

(i) reversible compression from $P_i = 2$ bar and $V_i = 8L$ to$P_f = 20$ bar

(ii) a single stage compression against a constant external pressure of 20 bar

(iii) a two stage compression consisting initially of compression against a constant external pressure of 10 bar until $P_{\text{gas}} = P_{\text{ext}}$, followed by compression aganist a constant pressure of 20 bar until $P_{\text{gas}} = P_{\text{ext}}$

Work done (in bar -L) on the gas in reversible isothermal compression is:

A. 9.212

B. 36.848

C. 18.424

D. None of these

Answer: B

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27. If the boundary of system moves by an infinitiesimal amount, the work involved is given by $dw = -P_{\text{ext}}$ dV, for irreversible process $W = -P_{\text{ext}}\Delta V$ (where $\Delta V = V_f - V_i$). For reversible process $P_{\text{ext}} = P_{\text{int}} \pm dP \approx P_{\text{int}}$, so for reversible isothermal process $W = -nRT\ln \frac{V_f}{V_i}$. 2 mole of an ideal gas undergoes isothermal compression along three different paths:

(i) reversible compression from $P_i = 2$ bar and $V_i = 8$ to $P_f = 20$ bar

(ii) a single stage compression against a constant external pressure of 20 bar

(iii) a two stage compression consisting initially of compression against a constant external pressure of 10 bar until $P_{\text{gas}} = P_{\text{ext}}$, followed by compression against a constant pressure of 20 bar until $P_{\text{gas}} = P_{\text{ext}}$.

Total work done on the gas in two stage compression is

A. 40

B. 80

C. 16

D. None of these

Answer: B

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28. One mole of an ideal gas for which $C_V = 3/2R$ heated at a constant pressure of 1 atm from $25^0 C \text{to} 100^0 C$

What will be the amount of heat change at constant pressure?

A. 223.53 cal

B. 372.56 Cal

C. 155.8 Cal

D. 355.68 Cal

Answer: B

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29. One mole of an ideal gas for which $C_V = 3/2R$ heated at a constant pressure of 1 atm from $25^0 C \text{to} 100^0 C$

What will be the amount of work done in the process?

A. -62.32 Cal

B. -140.925 Cal

C. -142.27 Cal

D. -149.025 Cal

Answer: D

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30. Match the following columns

List - I	List - II
A) X + Y	P) Extensive property
B) $\frac{X}{Y}$	Q) Intensive property
C) $\frac{\partial X}{\partial Y}$	R) Intensity factor
D) P_{Ext}	S) Capacity factor

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31. 4.48 L of an ideal gas at STP requires 12 cal to raise the temperature by 15^0C at constant volume. The C_P of the gas is ____ cal

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32. Calculate the maximum work done (in multiple of 10^3) in expanding 16g of oxygen at 300K and occupying a volume of $5dm^3$ isothermally, until the voume becomes $25dm^3$ (Give you anwer as nearest integer)

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33. Calculate the work done by the system in an irreversible (sing step) adiabatic expansion of 2 mole of a polyatomic gas $(\gamma = 4/3)$ from 300K and pressure 10atm to 1 atm: (in KJ) (Give your answer after multiplying with 2.08).

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Practice Sheet Exercise Ii

1. Assertion: Under adiabatic free expansion, $\left(\frac{dU}{dV}\right)_T$ is +ve when attractive forces are dominant between gas molecules [U,V,T respresent internal energy, volume and temperature of gas respectively]

Reason: Internal energy is a state function.

A. Statement-I is true, statement-II is true and statement-II is correct explanation for statement-I

B. Statement-I is true, statement-II is true and statement-II is NOT correct explanation for statement-I

C. Statement-I is true, statement-II is false

D. Statement-I is false, statement-II is true

Answer: D

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2. Statement-I : The amount of work done in the isothermal expansion is greater than work done in the adiabatic system for same final volume.

Statement-II: In the adiabatic expansion of a gas temperature and pressure both decrease due to decrease in internal energy of the system.

A. Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1

B. Statement-1 is true, statement-2 is true and statement-2 is NOT 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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3. 1 mole of CaC_2, Mg_2C_3 and Al_4C_3 react with water in separate flask. Work done by the system in the three cass respectively are w_1, w_2 and w_3. Then which one of the following are incorrect.

A. $w_3 > w_2$

B. $w_1 > w_3$

C. $w_3 > w_1$

D. $w_1 = w_2$

Answer: B

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4. Assertion: Heat of neutralization of HF acid is more than that of HCl acid by a strong base.

Reason : HCl is stronger acid than HF

A. Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1

B. Statement-1 is true, statement-2 is true and statement-2 is NOT 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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5. At 375K and at a total pressure of one atmosphere sulphuryl chloride (SO_2Cl_2) undergoes dissociation according to the equation :

$SO_2Cl_2(g) \Leftrightarrow SO_2(g) + Cl_2(g)$ to the extent of 90%. Hence the work done in the process at the same temperature:

A. $-4.95kJ$

B. $-2.8kJ$

C. $+53.6kJ$

D. $-1.4kJ$

Answer: B

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6. Statement -I: Heat of neutralization of HCl and NaOH is same as that of H_2SO_4 with NaOH.

Statement-II : HCl, H_2SO_4 and NaOH are all strong electrolyte.

A. Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1

B. Statement-1 is true, statement-2 is true and statement-2 is NOT 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. Which are of the following is an exothermic reaction?

A. $N_{2(g)} + O_{2(g)} + 180.9kJ \rightarrow 2NO_{(g)}$

B. $N_{2(g)} + 3H_{2(g)} - 292k.\ J \rightarrow 2NH_{3(g)}$

C. $C_{\text{graphite}} + H_2O_{(g)} \rightarrow CO_{(g)} + H_{2(g)} - 131.3kJ$

D. $C_{\text{graphite}} + 2S_{(s)} \rightarrow CS_{2(l)} - 91.9k.\ J$

Answer: B

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8. For which of the following elements, the standard enthalpy is not zero?

A. C(Diamond)

B. C (Graphite)

C. Liquid mercury

D. Rhombic sulphur

Answer: A

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9. The enthalpy of elements in their standard states are taken as zero. Hence the enthalpy of formation of a compound is

A. always negative

B. always positive

C. positive (or) negative

D. equal to zero

Answer: C

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10. Enthalpy of neutralisation of all strong acids and strong bases has the same value because

A. Neutralisation leads to the formation of a salt and water

B. Strong acid and bases are ionic substances

C. Acids always furnish H^+ ions and bases always furnish OH^- ions

D. The net chemical change involves the combination of 1 mol of H^+ ions and 1 mol OH^- ions to form water.

Answer: D

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11. The heats of combustion of carbon,hydrogen and acetylene are $-394kJ, -286kJ$ and $-130kJ$ respectively. Calculate heat of formation of C_2H_2

A. 621 kJ

B. 454 kJ

C. $-227kJ$

D. 227 kJ

Answer: D

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12. The standard enthalpies of formation of $H_2O_{2(l)}$ and $H_2O_{(l)}$ are $-187.8kJ\text{mole}^{-1}$ and $-285.8kJ\text{mole}^{-1}$ respectively. The ΔH^0 for the decomposition of one mole of $H_2O_{2(l)}$ to$H_2O_{(l)}$ and $O_{2(g)}$ is

A. $-473.6kJmol^{-1}$

B. $-98.9kJmol^{-1}$

C. $+473.6kJmol^{-1}$

D. $+187.8kJmol^{-1}$

Answer: B

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13. Given

$C+2S\rightarrow CS_2, \Delta Hf^0 = +117.0KJmol^{-1}, C+O_2\rightarrow CO_2, \Delta Hf^0 =$

. The heat of combustion of $CS_2+3O_2\rightarrow CO_2+2SO_2$ is

A. $-807KJmol^{-1}$

B. $-1104KJmol^{-1}$

C. $+1104KJmol^{-1}$

D. $+807KJmol^{-1}$

Answer: B

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14. The lattice energy of solid NaCl is 180K. Call per mol. The dissolution of the solid in water in the form of ions is endothermic to the extent of 1K, Cal per mol. If the solvation energies of Na^+ and Cl^- ions are in ratio $6:5$, what is the enthalpy of hydration of sodium ion?

A. 85.6K.Cal/mol

B. -97.5 K.Cal/mol

C. 82.6 K.Cal/mol

D. $+100$ K.Cal/mol

Answer: B

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15. The enthalpy of solution of $BaCl_2(s)$ and $BaCl_2.2H_2O(s)$ are -20.6 and 8.8 KJ mol^{-1},

respectively, The enthalpy change for the reaction $BaCl_{2(s)} + 2H_2O \rightarrow BaCl_2, 2H_2O_{(s)}$ is:

A. 29.8KJ

B. $-11.8KJ$

C. $-20.6KJ$

D. $-29.4KJ$

Answer: D

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16. Hess's law states that

A. The standard enthalpy of an overall reaction is the sum of the enthalpy chages in individual reactions

B. enthalpy of formation of a compound is same as the enthalpy of decomposition of the compound into constituent elements, but

with opposite sign

C. at constant temperature the pressure of gas is inversely propoortional to its volume

D. the mass of a gas dissolved per lit of a solvent is proportional to the pressure of the gas in equilibrium with the solution.

Answer: A

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17. Equal volumes of equi molar HCl and H_2SO_4 are separately neutralised by dilute NaOH solution, then heats liberated and x kCal and y kCal respectively. Which of the following is true.

A. x=y

B. x=y/2

C. x=2y

D. x=y/3

Answer: B

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18. The bond dissociation energies for Cl_2, I_2 and Icl are 242.3, 151 and 211.3 kJ/mol respectively. The enthalpy of sublimation of iodine is 62.8 kJ/mol. What is the standard enthalpy of formation of $ICl_{(s)}$?

A. 211.3 kJ/mol

B. 4019 Cal/mol

C. $-16.8kJ/mol$

D. 33.5kJ/mol

Answer: B::C

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19. Enthalpy of neutralisation of H_3PO_3 acid is $-106.68kJ/mol$ using NaOH. If enthaly of neutralisation of HCl by NaOH is -55.84 kJ/mol. Calculate $\Delta H_{\text{ionization}}$ of H_3PO_3 into its ions

A. 50.84kJ/mol

B. 5 kJ/mol

C. 2.5 kJ/mol

D. 5000 J/mol

Answer: A::B::C

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20. If ΔH_f^0 for $H_2O_{2(l)}$ and $H_2O_{(l)}$ are $-188kJmol^{-1}$ and $-286kJmol^{-1}$, what will be the enthalpy change of the reaction $2H_2O_{2(l)} \rightarrow 2H_2O_{(l)} + O_{2(g)} = ?$

A. $146 kJ mol^{-1}$

B. $-196 kJ mol^{-1}$

C. $-494 kJ mol^{-1}$

D. -46.88 kCal mole^{-1}

Answer: B::D

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21. Chemical reactions are invariably associated with the transfer of energy either in the form of hear or light. In the laboratory, heat changes in physical and chemical processes are measured with an instrument called calorimeter. Heat change in the process is calculated as: q= ms ΔT, s= Specific heat = $c\Delta T$= Heat capacity. Heat of reaction at constant pressure is measured using simple or water calorimeter. $Q_v = \Delta U$= Internal energy change, $Q_P = \Delta H, Q_P = Q_V + P\Delta V$ and $\Delta H = \Delta U + \Delta nRT$. The amount of energy released during a chemical change depends on the physical

state of reactants and products, the condition of pressure, temperature and volume at which the reaction is carried out. The variation of heat of reaction with temperature and pressure is given by Kirchoff's equation: $\frac{\Delta H_2 - \Delta H_1}{T_2 - T_1} = \Delta C_P$ (At constant pressure), $\frac{\Delta U_2 - \Delta U_1}{T_2 - T_1} = \Delta C_V$ (At constant volume)

The enthalpy change (ΔH) for the reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ is $-92.38kJ$ at 298 K. The internal energy change ΔU at 298 K is

A. $-92.38kJ$

B. $-87.42kJ$

C. 97.34 kJ

D. $-89.9kJ$

Answer: B

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22. Chemical reactions are invariably associated with the transfer of energy either in the form of hear or light. In the laboratory, heat changes in physical and chemical processes are measured with an instrument called calorimeter. Heat change in the process is calculated as: q= ms ΔT, s= Specific heat = $c\Delta T$= Heat capacity. Heat of reaction at constant pressure is measured using simple or water calorimeter. $Q_v = \Delta U$= Internal energy change, $Q_P = \Delta H, Q_P = Q_V + P\Delta V$ and $\Delta H = \Delta U + \Delta nRT$. The amount of energy released during a chemical change depends on the physical state of reactants and products, the condition of pressure, temperature and volume at which the reaction is carried out. The variation of heat of reaction with temperature and pressure is given by Kirchoff's equation: $\frac{\Delta H_2 - \Delta H_1}{T_2 - T_1} = \Delta C_P$ (At constant pressure), $\frac{\Delta U_2 - \Delta U_1}{T_2 - T_1} = \Delta C_V$ (At constant volume)

The specific heat of I_2 in vapoour and solid state are 0.031 and 0.055 cal/g respectively. The heat of sublimation of iodine at $200^\circ C$ is 6.096 kcal mol^{-1}. The heat of sublimation of iodine at $250^0 C$ will be

A. $3.8\text{k cal} mol^{-1}$

B. $4.8\text{k cal} mol^{-1}$

C. $2.28\text{k cal} mol^{-1}$

D. $5.8\text{k cal} mol^{-1}$

Answer: D

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23. Chemical reactions are invariably assocated with the transfer of energy either in the form of heat or light. In the laboratory, heat changes in physical and chemical processes are measured with an instrument called calorimeter. Heat change in the process is calculated as: q= ms ΔT, s= specific heat = $c\Delta T$, c= heat capacity

Heat of reaction at constant volume is measured using bomb calorimeter. $qv = \Delta U =$ internal energy change.

Heat of reaction at constant pressure is measured using simple or water calorimeter. $q_p = \Delta H$, $q_p = q_v + P\Delta V$, $\Delta H = \Delta U + \Delta nRT$

The amount of energy released during a chemical change depnds on the

physical state of reactants and products, the condition of pressure, temperature and volume at which the reaction is carried out. The variation of heat of reaction with temperature and pressure is given by Kirchhoff's equation: $\frac{\Delta H_2 - \Delta H_1}{\top_2 - T_1} = \Delta C_P$ (At constant pressure), $\frac{\Delta U_2 - \Delta U_1}{\top_2 - T_1} = \Delta C_V$ (At constant volume)

The heat capacity of bomb calorimeter (with its contents) is 500J/K. When 0.1g of CH_4 was burnt in this calorimeter the temperature rose by $2^\circ C$. The value of ΔU per mole will be

A. $+1kJ$

B. $-1kJ$

C. $+160kJ$

D. $-160kJ$

Answer: D

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24. Chemical reactions are invariably assocated with the transfer of energy either in the form of heat or light. In the laboratory, heat changes in physical and chemical processes are measured with an instrument called calorimeter. Heat change in the process is calculated as: q= ms ΔT, s= specific heat = $c\Delta T$, c= heat capacity

Heat of reaction at constant volume is measured using bomb calorimeter. $qv = \Delta U =$ internal energy change.

Heat of reaction at constant pressure is measured using simple or water calorimeter. $q_p = \Delta H$, $q_p = q_v + P\Delta V$, $\Delta H = \Delta U + \Delta nRT$

The amount of energy released during a chemical change depnds on the physical state of reactants and products, the condition of pressure, temperature and volume at which the reaction is carried out. The variation of heat of reaction with temperature and pressure is given by Kirchhoff's equation: $\frac{\Delta H_2 - \Delta H_1}{\top_2 \ - T_1} = \Delta C_P$ (At constant pressure), $\frac{\Delta U_2 - \Delta U_1}{\top_2 \ - T_1} = \Delta C_V$ (At constant volume)

ΔC_P for a reaction is given by 0.2T cal/deg. Its enthalpy of reaction at 10K is -14.2 kcal. Its enthalpy of reaction at 100K in kcal will be

A. -13.21

B. -15.31

C. 16.02

D. 7.08

Answer: A

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25. Match the following columns

List - I	List - II
A) $C_{(s,\ graphite)} + O_{2(g)} \rightarrow CO_{2(g)}$	P) $\Delta H^{\circ}_{combustion}$
B) $C_{(s,\ graphite)} \rightarrow C_{(g)}$	Q) $\Delta H^{\circ}_{formation}$
C) $CO_{(g)} + \frac{1}{2}O_{2(g)} \rightarrow CO_{2(g)}$	R) $\Delta H^{\circ}_{atomization}$
D) $CH_{4(g)} \rightarrow C_{(g)} + 4H_{(g)}$	S) $\Delta H^{\circ}_{sublimation}$

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26. Heats of atmoisation of ozone and oxygen are 25 units and 30 units respectively. What is the heat of ozonisation of one mole of oxygen is the

same units?

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27. Compute the heat of formation of liquid methyl alcohol in kilojoules per mole, using the following data. Heat of vapourisation of liquid methyl alcohol= 38 kJ/mol. Heat of formation of gaseous atoms from the elements in their standard states, H= 218kJ/mol, C= 715 kJ/mol, O= 249 kJ/mol. Average bond energies, C-H = 415 kJ/mol, C-O = 365 kJ/mol, O-H= 463 kJ/mol

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28. The bond dissociation energies of gaseous H_2, Cl_2 and HCl are 104, 58 and 103 kCal/mole respectively. Calculate the heat of formation of HCl

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29. Heat of formation of 2 moles of $NH_3(g)$ is $-90kJ$l bond energies of H-H and N-H bonds are 435 kJ and $390kJmol^{-1}$ respectively. The value of the bond energy of $N \equiv N$ is $\left(1000-\left(x^2+x+25\right)\right)$ kJ/mol What is x ?

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30. If $S+O_2 \rightarrow SO_2, \Delta H=-398.2kJ$

$SO_2+\frac{1}{2}O_2 \rightarrow SO_3, \Delta H=-98.7kJ, SO_3+H_2O \rightarrow H_2SO_4, \Delta H=-$

$H_2+\frac{1}{2}O_2 \rightarrow H_2O, \Delta H=-227.3kJ$

The enthalpy of formation of sulphuric acid at 298K will be

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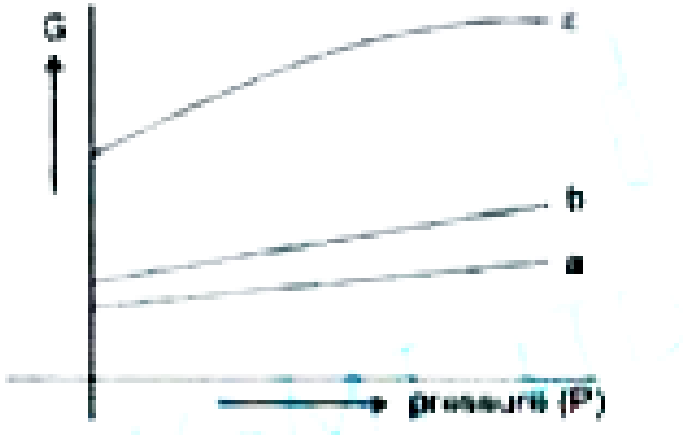
Practice Sheet Exercise Iii

1. The following curve represents the variation of Gibbs function 'G' with pressure at constant temperature. Correct match of given plots with the

physical state of a substance is



A. c — solid, a- gas, b- liquid

B. c- gas, b- liquid, a- solid

C. a- liquid, b- solid, c- gas

D. c- gas, b- solid, a - liquid

Answer: B

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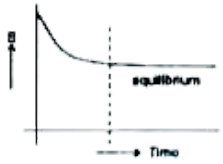
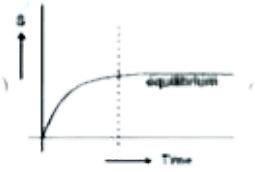
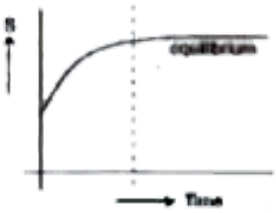
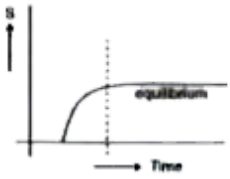
2. Which correctly represents the entropy (s) of an isolated system during a process.

A. 

B. 

C. 

D. 

Answer: C

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3. At 1000K water vapour at 1 atm. Has been found to be dissociated into H_2 and O_2 to the extent of 3×10^{-5} %. Calculate the free energy

decrease of the system, assuming ideal behaviour.

A. $-DG = 90,060$ cal

B. $-DG$=20cal

C. $-DG = 480$ cal

D. $-DG = -45760$ cal

Answer: D

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4. For which process will DH° and DG° be expected to be most similar

A. $2Al(s) + Fe_2O_3(s) \rightarrow 2Fe(s) + Al_2O_3(s)$

B. $2Na(s) + 2H_2O(1) \rightarrow 2NaOH(aq) + H_2(g)$

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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5. Statement-I: At low temperature, DH is the dominant factor for spontaneity of a reaction.

Statement-II: The opposing factor TDS remains very small, at low temperature.

A. Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1

B. Statement-1 is true, statement-2 is true and statement-2 is NOT 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. For which process will DH° and DG° be expected to be most similar

A. $2Al(s) + Fe_2O_3(s) \rightarrow 2Fe(s) + Al_2O_3(s)$

B. $2Na(s) + 2H_2O(1) \rightarrow 2NaOH(aq) + H_2(g)$

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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7. Pick out the correct statement from among the four:

A. When a liquid boils work is done on the system

B. In case of Boiling of a liquid $\Delta H = \Delta U$

C. When a liquid boils at its boiling temperature, $Q_P = \Delta H$

D. For the process of boiling of a liquid, Q=0

Answer: C

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8. For a reaction, $A_2 + B_2 \Leftrightarrow 2AB$, ΔG and ΔS values are 20 kJ/mol and -20 J/K/mol respectively at 200k. ΔC_P is $20JK^{-1}$. Then identify the correct property of the reaction.

A. The reaction is spontaneous at 200k and ΔH at that temperature is 20kJ/mol

B. The reaction is exothermic and ΔH at 200k is 22 kcal/mol

C. ΔS of the reaction is zero and ΔH of the reaction is 440J/mol at 400k

D. The reaction is endothermic and ΔH of the reaction is 20kJ/mol at 400k

Answer: D

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9. Statement-I Due to adiabatic free expansion, temperature of a real gas always increases

Statement-II : If a real gas is at inversion temperature then no change in temperature is observed in adiabatic free expansion

A. Statement-I is true, statement-II is true and statement-II is correct explanation for statement-I

B. Statement-I is true, statement-II is true and statement-II is NOT correct explanation for statement-I

C. Statement-I is true, statement-II is false

D. Statement-I is false, statement-II is true

Answer: D

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10. Which of the following process has negative value of ΔS?

A. Dissolution of sugar in water

B. Stretching of rubber band

C. Decomposition of lime stone

D. Evaporation of water

Answer: B

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11. Some statements are given with regard to entropy. The incorrect statement(s) are

(A) The absolute entropy of substances cannot be determined

(B) In standard state entropy of elements is always positive

(C) The entropy of universe always decreases

(D) In a spontaneous process, for an isolated system the entropy of the system generally increases

A. A,B

B. B,C

C. A,C

D. Only C

Answer: C

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12. $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}, \Delta H = -ve$ and $\Delta G = -ve$. Then the reaction is

A. Spontaneous

B. Spontaneous and endothermic

C. Spontaneous and slow

D. Non spontaneous and slow

Answer: C

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13. Based on the third law of themodynamics, the entropy can be obtained using the equation.

A. $\Delta S = \frac{\Delta H}{T}$

B. $\int_0^T T.\, C_P^{-1} dT = S$

C. $\Delta S = T\Delta S$

D. $\int_0^T C_P T^{-1} dT = S$

Answer: D

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14. When charcoal burns in air signs of ΔH and $\Delta S$are $2C_{(s)} + O_{2(g)} \rightarrow 2CO_{(g)}$

A. $\underset{+}{\Delta H}\underset{-}{\Delta S}$

B. $\underset{-}{\Delta H}\underset{+}{\Delta S}$

C. $\underset{+}{\Delta H}\underset{+}{\Delta S}$

D. $\underset{-}{\Delta H}\underset{-}{\Delta S}$

Answer: B

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15. ΔS_{surr} for $H_2 + 1/2O_2 \rightarrow H_2O, \Delta H - 280kJ$ at 400K is

A. 700J/g/K

B. 700 kJ/mol/K

C. 700 J/mol/K

D. 0.7 J/mol/K

Answer: C

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16. The direct conversion of A to B is difficult, hence it is carried out by the following shown path $A \to C \to D \to B$. Given $\Delta S_{A \to C}$= 50 eu, $\Delta S_{C \to D}$ = 30 eu, $\Delta S_{B \to D}$= 20eu

A. $+100$ eu

B. $+60$ eu

C. -100 eu

D. -60 eu

Answer: B

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17. The incorrect statement according to second law of themodynamics is

A. Heat cannot flow from colder body to a hotter body of its own

B. All spontaneous processes are thermody-namically irreversible

C. Heat can be converted into work completely without causing some permanent change in the system (or) surroundings

D. Perpetual motion machine of second kind is not possible

Answer: C

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18. Entropy of a system depends upon

A. Volume only

B. Temperature only

C. Pressure only

D. Pressure, Volume and temperature

Answer: D

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19. Which processes involve increase in entropy?

A. $PCl_5 \rightarrow PCl_3 + Cl_2$ (Gases)

B. $\underset{(s)}{C} + \frac{1}{2}\underset{(g)}{O_2} \rightarrow \underset{(g)}{CO}$

C. $\underset{(g)}{CO} + \frac{1}{2}\underset{(g)}{O_2} \rightarrow \underset{(g)}{CO}$

D. $\underset{(s)}{Mg} + \frac{1}{2}\underset{(g)}{O_2} \rightarrow \underset{(s)}{MgO}$

Answer: A::B

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20. Which statements are correct as per laws of thermodynamics?

A. Third law explains criteria for spontanity of a process

B. In adiabatic irreversible process $(\Delta S)_{\text{Total}} > 0$

C. In isothermal reversible process $(\Delta S)_{\text{total}} = 0$

D. At $100^\circ C$, 1 atm water $\Leftrightarrow$ steam $\Delta G = 0$

Answer: B::C::D

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21. For $A \to B, \Delta H = 3.5$ kcal $mol^{-1}, \Delta S = 10$ cal $mol^{-1}K^{-1}$. Reaction is non spontaneous at

A. 400K

B. $27^{\circ}C$

C. $77^{\circ}C$

D. 350K

Answer: B::C::D

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22. The change in Gibbs free energy of the system along provides a criterion for the spontaneity of a process at constant temperature and

pressure. A change in the free energy of a sytem at constant temperature and pressure will be: $\Delta G_{\text{system}} = \Delta H_{\text{system}} - T\Delta S_{\text{system}}$

The free energy for a reaction having $\Delta H = 31400$ cal, $\Delta S = 32$ cal $K^{-1}mol^{-1}$ at $1000^{\circ}C$ is

A. -9336 cal

B. -7386 cal

C. -1936 cal

D. $+9336$ cal

Answer: A

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23. The change in Gibbs free energy of the system along provides a criterion for the spontaneity of a process at constant temperature and pressure. A change in the free energy of a sytem at constant temperature and pressure will be: $\Delta G_{\text{system}} = \Delta H_{\text{system}} - T\Delta S_{\text{system}}$

For a spontaneous reaction ΔG, equilibrium constant K and E^0_{cell} will be respectively:

A. $-ve,\ >1,\ +ve$

B. $+ve,\ >1,\ -ve$

C. $-ve,\ <1,\ -ve$

D. $-ve,\ >1,\ -ve$

Answer: A

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24. The thermodynamic property that measures the extent of molecular disorder is called entropy. The direction of a spontaneous process for which the energy is constant is always the one that increases the molecular disorder. Entropy change of phase transformation can be calculated using Trouton's formula $\left(\Delta S = \frac{\Delta H}{T}\right)$. In the reversible adiabatic process, however, ΔS will be zero. The rise in temperature in isobaric and isochoric conditions is found to increase the randomness or

entropy of the system. $\Delta S = 2.303C\log(T_1/T_2)$, $(C = C_P \text{ or } C_V)$

The entropy change in an adiabatic process is

A. zero

B. always positive

C. always negative

D. sometime positive and sometimes negative

Answer: A

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25. The thermodynamic property that measures the extent of molecular disorder is called entropy. The direction of a spontaneous process for which the energy is constant is always the one that increases the molecular disorder. Entropy change of phase transformation can be calculated using Trouton's formula $\left(\Delta S = \frac{\Delta H}{T}\right)$. In the reversible adiabatic process, however, ΔS will be zero. The rise in temperature in isobaric and isochoric conditions is found to increase the randomness or

entropy of the system. $\Delta S = 2.303C\log(T_1/T_2)$, $(C = C_P \text{ or } C_V)$

If water in an insulated vessel at $-10^\circ C$, suddenly freezes, the entropy change of the system will be

A. $+10JK^{-1}mol^{-1}$

B. $-10JK^{-1}mol^{-1}$

C. zero

D. equal to that of sourroundings

Answer: C

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26. The thermodynamic property that measures the extent of molecular disorder is called entropy. The direction of a spontaneous process for which the energy is constant is always the one that increases the molecular disorder. Entropy change of phase transformation can be calculated using Trouton's formula $\left(\Delta S = \frac{\Delta H}{T}\right)$. In the reversible adiabatic process, however, ΔS will be zero. The rise in temperature in

isobaric and isochoric conditions is found to increase the randomness or entropy of the system. $\Delta S = 2.303C\log(T_1/T_2)$, $(C = C_P \text{ or } C_V)$

The melting point of a solid is 300K and its latent heat of fusion is 600 cal mol^{-1}. The entropy change for the fusion of 1 mole of the soli (in cal K^{-1}) at the same temperature would be:

A. 200

B. 2

C. 0.2

D. 20

Answer: B

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27. Match the following columns

List – I	List – II
A) Heating of an ideal gas at constant pressure	P) $\Delta H = nC_{p,m}\ \Delta T \neq 0$
B) Compression of liquid at constant temperature	Q) $\Delta U = 0$
C) Reversible process for an ideal gas at constant T	R) $\Delta G = V\ \Delta P$
D) Adiabatic free expansion of an ideal gas	S) $\Delta G = nRT\ln\left(\frac{P_2}{P_1}\right)$

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28. Match the following columns

List - I	List - II
A) $(\Delta G_{system})_{T,P}$	P) $nR \ln\left(\frac{V_2}{V_1}\right)$
B) Work done in reversible isothermal ideal gas expansion	Q) $nRT \ln\left(\frac{P_2}{P_1}\right)$
C) ΔG for reversible isothermal expansion of an ideal gas	R) $-nFE$
D) ΔS_{gas} for isothermal expansion of an ideal gas	S) $nR \ln\left(\frac{P_1}{P_2}\right)$

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29. A quantity of 4.0 moles of an ideal gas at $20^\circ C$ expands isothermally against a constant pressure of 2.0 atm from 1.0 L to 10.0L. What is the entropy change of the system (in cals)?

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30. In how many of the following entropy increases?

$(a) N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$

$(b) PCl_{5(g)} \rightarrow P$

$(c) H_2O_{(s)} \rightarrow H_2O_{(g)}$

$(d) H_2O_{(l)} \rightarrow H$

$(e) 2NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + H_2O_{(g)} + CO_{2(g)}$

$(f) NH_2CO_2NH$

$(g) H_2O_{(l)} \rightarrow H_2O_{(s)}$

$(h) CO_{2(s)} \rightarrow C$

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Practice Sheet Exercise Iv

1. For a perfectly crystalline solid $C_{p.m} = aT^3$, where a is constant. If $C_{p.m}$ is 0.42 J/K $-$ mol at 10K, molar entropy at 10K is

A. 0.42 J/K-mol

B. 0.14 J/K-mol

C. 4.2 J/K-mol

D. zero

Answer: B

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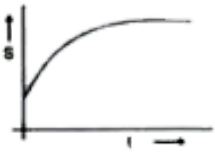
2. A copper block of mass 'm' at temperature $'T_1'$ is kept in the open atmosphere at temperature $'T_2'$ where $T_2 > T_1$. The variation of entropy of the copper block with time is best illustrated by

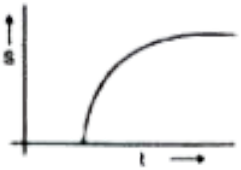
A.

B.

C.



D.



Answer: C

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3. The ratio of P to V at any instant is constant and is equal to 1. for a monoatomic ideal gas under going 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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4. Which of the following statements are incorrect

A. The net increase in entropy of the system is zero in any reversible cyclic process *

B. For a spontaneous change $(\Delta G)_{T.F} > 0$

C. The isothermally available energy present in a system is called free energy

D. The change of free energy with pressure for one mole of a perfect gas at constant temperature $\Delta G = RT \log_e \left(\frac{P_2}{P_1} \right)$

Answer: B

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5. A diatomic ideal gas initially at 273K is given 100cal heat due to which system did 209J work. Molar heat capcity (Cm) of gas for the process is:

A. $\frac{3}{2}R$

B. $\frac{5}{2}R$

C. $\frac{5}{4}R$

D. 5R

Answer: D

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6. For an ideal monoatomic gas during any process T=kV, find out the molar heat capacity of the gas during the process. (Assume vibrational degree of freedom to be active)

A. $\frac{5}{2}R$

B. 3R

C. $\frac{7}{2}$

D. 4R

Answer: A

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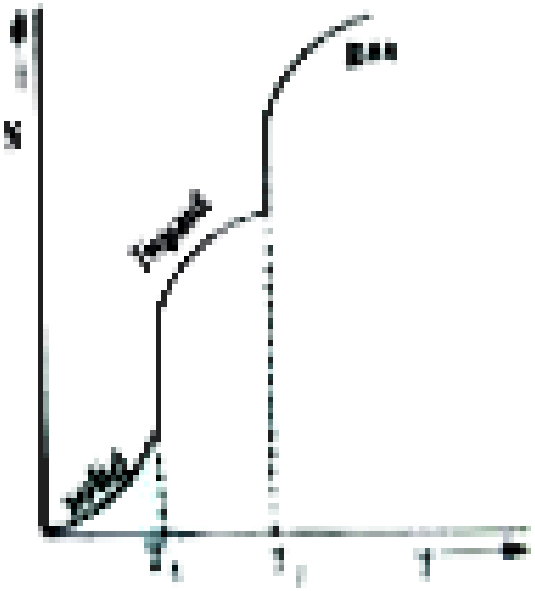
7. Here T_1 and T_2 are



A. M.P, B.P

B. B.P, B.P

C. B.P, M.P

D. M.P, M.P

Answer: A

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8. (A): Entropy of a perfect crystalline substance at absolute zero is zero

(R): At absolute zero translation kinetic energy of a system is zero.

A. A and R are true, R explains A

B. A and R are true, R does not explain A

C. A is true, but R is false

D. A is false, but R is true

Answer: A

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9. Which of the following statement is incorrect?

A. The entropy of the universe increases and tends towards the maximum value in irreversible process.

B. All the natural spontaneous processes are irreversible in nature

C. For the isothermal expansion of an ideal gas, ΔH and ΔE are not equal

D. The heat of formation of an element in the standard state is zero

Answer: C

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10. The entropy change of x_2 gas, during the following irreversible process, approximately is how much? x_2 gas ($27^\circ C$, 1 atm, 5 moles) $\rightarrow$ x_2 gas ($117^\circ C$, 5 atm, 5 moles) (C_P of x_2 = 6.95 cal/mol/$^\circ C$), log 1.3= 0.1139

A. $-6.86\text{cal}/^\circ C$

B. $+3.26\text{cal}/^\circ C$

C. $+1.86\text{cal}/^\circ C$

D. $-9.82\text{cal}/^\circ C$

Answer: A

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11. For polytropic process PV^n = constant, C_m (molar heat capacity) of an ideal gas is given by

A. $C_{v,m} - \frac{R}{(n-1)}$

B. $C_{v,m} + \frac{R}{(1-n)}$

C. $C_{v,m} + R$

D. $\frac{R}{(\gamma - 1)} + \frac{R}{(1-n)}$

Answer: B::D

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12. 2 mole of an ideal mono atomic gas undergoes a reversible process for which $PV^2 = C$. The gas is expanded from initial volume of 1L to a final

volume of 3L starting from initial temperature of 300K. Find ΔH for the process

A. $-600R$

B. $-1000R$

C. $-3000R$

D. $-2k\text{cal mol}^{-1}K^{-1}$

Answer: B::D

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13. Which of the following representation is not correct for the change below? (Consider all substances at 0k are perfect crystals)

$$pA+qB \xrightarrow{\Delta_r S_1^9} \underset{(298K)}{rC=sD}$$

$$\downarrow \Delta_r S_4 \quad \xrightarrow{\Delta_r S_3} \quad \uparrow \Delta_r S_2$$

$$\underset{(0K)}{pA+qB} \qquad \underset{(0K)}{rC=sD}$$

A. $\Delta_r s_1^0 = \left(rs_C^0 + sS_D^0\right) - \left(ps_A^0 + qs_B^0\right)$

B. $\Delta_r s_3 = 0$

C. $\Delta_r s_2 = -\left(rs_C^0 + ss_D^0\right)$

D. $\Delta_r s_4 = +\left(ps_A^0 + qs_B^0\right)$

Answer: C::D

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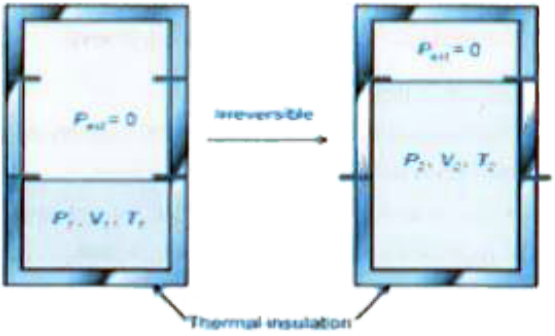
14. An ideal gas in a thermally insulated vessel at internal pressure = P_4, volume =V_1 and absolute temperature =T_1 expands irreversibly against zero external pressure, as shown in the diagram. The final internal pressure, volume and absolute temperature of the gas are P_2, V_2 and T_2 , respectively. For this expansion.



A. q=0

B. $T_2 = T_1$

C. $P_2V_2 = P_1V_1$

D. $P_2V_2^{\gamma} = P_1V_1^{\gamma}$

Answer: A::B::C

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15. Match the following columns

List-I (One mole ideal gas)	List-II
A) $\left[\frac{\partial(\Delta H)}{\partial T}\right]$	P) ΔV
B) $\left[\frac{\partial(\Delta E)}{\partial T}\right]$	Q) $-\Delta S$
C) $\left[\frac{\partial(\Delta G)}{\partial T}\right]_P$	R) ΔC_V
D) $\left[\frac{\partial(\Delta G)}{\partial P}\right]_T$	S) ΔC_P

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16. For a perfectly cyrstalline solid $C_{p,m} = aT^3 + bT$, where a and b are constants. If $C_{p,m}$ is 0.40 J/K mol at 10K and 0.92 J/K mol at 20K, then molar entropy at 20K is $0.2x \times R$ joules. Then the value of x is

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17. The molar entropies of $HI_{(g)}, H_{(g)}$ and $I_{(g)}$ at 298K are 206.5, 114.6, and $180.7 Jmol^{-1}K^{-1}$ respectively. Using the ΔG° given below, calculate the bond energy of HI.

$HI_{(g)} \rightarrow H_{(g)} + I_{(g)}, \Delta G^{\circ} = 271.8kJ$ (Give your answer after divide with 49.7)

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18. The enthalpy changes of some process are given below

$\alpha - D\text{glucose}_{(s)} + H_2O \rightarrow \alpha - D - \text{glucose}_{(aq)}$ Heat of dissolution =10.84kJ

$\beta - D\text{glucose}_{(s)} + H_2O \rightarrow \beta - D - \text{glucose}_{(aq)}$ Heat of dissolution =

4.68kJ

$\alpha - D\text{glucose}_{(aq)} \rightarrow \beta - D - \text{glucose}_{(aq)}$ Heat of mutarotation $= -1.16kJ$

The $\Delta H^0$for $\alpha - D\text{glucose}_{(s)} \rightarrow \beta - D\text{glucose}_{(s)}$ is

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19. The number of correct statements among the following

1 The expansion work for a gas into vacuum is equal to zero.

2. 1 mole of a gas occupying 3 litre volume on expanding to 15 litre at constant pressure of 1 atm does expansion work 1.215kJ.

3. The maximum work done by the gas during reversible expansionof 16g O_2 at 300K from $5dm^3$ to $25dm^3$ is 2.0074 kJ.

4. The $\Delta S$for $s \rightarrow l$ is almost negligible in comparison to ΔS for $l \rightarrow g$.

5. $\Delta S = 2.303nR\log\frac{V_2}{V_1}$ (at constant T)

6. Reversible isothermal work done $= -2.303nRT\log_{10}\frac{V_2}{V_1}$

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20. In a particular experiment, a gas undergoes adiabatic expansion satisfying the equation $VT^3 =$ constant. The ratio of specific heats is g then the value of 3g is

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Additional Practice Exercise

1. Which among the following is not an exact differential?

A. Q(dQ= heat absorbed)

B. U(dU= change in internal energy)

C. S (dS= entropy change)

D. G(dG= Gibbs free energy change)

Answer:

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2. A system consisting of one mole of an ideal diatomic gas absorbs 200J of heat and does 50J of work on surroundings. What is the change in temperature if vibrational modes of motion are inactive?

A. $\frac{150Jmol^{-1}}{8.314 \times \frac{5}{2}}$

B. $\frac{150Jmol^{-1}}{8.314 \times \frac{3}{2}}$

C. $\frac{150Jmol^{-1}}{8.314 \times \frac{7}{2}}$

D. $\frac{150Jmol^{-1}}{8.314 \times \frac{4}{3}}$

Answer:

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3. A mono atomic ideal gas undergoes a process in which the ratio of P to V at any instant is constant and equal to 1. What is molar heat capacity of the gas.

A. $\frac{4R}{2}$

B. $\frac{3R}{2}$

C. $\frac{5R}{2}$

D. 0

Answer:

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4. 1 mole each of CaC_2, Mg_2C_3 reacts with excess water in separate open flasks work done by the gas during the dissolution shows the order:

A. $CaC_2 = Mg_2C_3 < Al_4C_3$

B. $CaC_2 = Mg_2C_3 = Al_4C_3$

C. $Mg_2C_3 < CaC_2 < Al_4C_3$

D. $Mg_2C_3 < Al_4C_3 < CaC_2$

Answer:

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5. The temperature of 5 moles of a gas is decreased by 2K at constant pressure of 1 atm. Indicate the correct statement

A. Work done by gas is =5R

B. Work done over the gas is= 10R

C. Work done by the gas= 6R

D. Work done=0

Answer:

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6. When an ideal gas at a pressure P, temperature T and volume V is isothermally compressed to $\left(\frac{V}{n}\right)$, its pressure becomes P_{iso} and if the same process is carried out adiabatically and reversibly, its pressure becomes P_{adia}. Which of the following is correct for $\frac{P_{\text{iso}}}{P_{\text{adia}}}$?

A. 1

B. n

C. n^{γ}

D. $n^{1-\gamma}$

Answer:

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7. Which of the following statement is incorrect?

A. The entropy of the universe increases and tends towards the maximum value in irreversible process

B. All the natural spontaneous processes are irreversible in nature

C. For the isothermal expansion of an ideal gas, ΔH and ΔE are not equal

D. The heat of formation of an element in the standard state is zero.

Answer:

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8. A gas absorbs 100 calories of heat energy and is compressed from 10L to 5L by applying an external pressure of 2 atm. Change in internal energy in calories will be nearly.

A. 312

B. 342

C. 426

D. 562

Answer:

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9. The enthalpy of neutralization of weak monoprotic acid, HA in 1M solution with a strong base is -55.95 KJ/mol if the unionised acid requires 1.4 KJ/mol heat for its complete ionization and enthalpy of neutralisation of the strong monobasic acid with a strong monoacidic base is $= -57.3$ KJ/mol. What will be $\%$ ionization of weak acid in molar solution is

A. $1.2\,\%$

B. 0.0357

C. 0.0607

D. 0.1201

Answer:

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10. The heat of combustion of hydrocarbon C_xH_y is "a" calories and heat of formation of CO_2 and H_2O are "b" and 'c' calories respectively then

the heat of formation of hydrocarbon C_8H is (in calories)

A. $xa + yc - b$

B. $xb + yc - a$

C. $b + xc - xa$

D. $xb + \frac{y}{2}c - a$

Answer:

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11. The standard enthalpy of formation of hypothetical MgCl is $-125kJmol^{-1}$ and for $MgCl_2$ is -642 kJ mol^{-1}. What is the enthalpy of the disproportionation of MgCl ?

A. $-492kJmol^{-1}$

B. $-392kJmol^{-1}$

C. $-767kJmol^{-1}$

D. $-517kJmol^{-1}$

Answer:

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12. Calculate the resonance energy of N_2O from the following data ΔH_f of $N_2O = 82$ kJ mol^{-1}. Bond energies of $N \equiv N, N = N, O = O$ and $N = O$ bond are 946, 418 and 607 kJ mol^{-1} respectively

A. $-88kJmol^{-1}$

B. $-170kJmol^{-1}$

C. $-82kJmol^{-1}$

D. $-258kJmol^{-1}$

Answer:

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13. The maximum entropy of mixing ocuurs when hexane and heptane are mixed respective in the proportion

A. 8.6 gr and 10 gr

B. 8.6 gr and 8.6 gr

C. 10gr and 8.6gr

D. 10gr and 10 gr

Answer:

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14. When 3.0 mole of an ideal diatomic gas is heated and compressed simultaneously from 300K, 1.0 atm to 400K and 5.0atm, the change in entropy is (Use $C_P = \frac{7}{2}R$ for the gas)

A. $-20JK^{-1}$

B. $-5JK^{-1}$

C. $-15JK^{-1}$

D. $-2.8JK^{-1}$

Answer:

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15. $\underset{P_1, V_1, T_1}{\text{State } A} \xrightarrow{\text{Rev}} \underset{P_2, V_2, T_2}{\text{State B}}$: If $P_1 = P_2$ then

A. $\underset{\text{universe}}{\Delta S} = 0$

B. $\underset{\text{universe}}{\Delta S} = 1$

C. $\underset{\text{universe}}{\Delta S} > 0$

D. $\underset{\text{universe}}{\Delta S} < 0$

Answer:

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16. During winters, moisture condenses 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 possess lesser disorder as compared to gases. With reference to the second law, which statement in correct, for the above process?

A. The randomness of the universe decreases

B. The randomness of the surroundings decreases

C. Increase in randomness of surroundings equals the decrease in randomness of system.

D. The increase in randomness of the surroundings is greater as compared to the decrease in randomness of the system.

Answer:

17. Assuming ΔH^0 and ΔS^0 do not change with temperature the boiling point of liquid "A" (the thermodynamics data given below) is

Thermodynamics	A (liq)	A (gas)
ΔH^0 (kJ/mol)	-130	-100
S^0 ($JK^{-1}mol^{-1}$)	100	200

A. 300K

B. 13K

C. 150K

D. 50K

Answer:

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18. For the reaction $X_2O_{4(l)} \rightarrow 2XO_{2(g)}$, $\Delta U = 2.1\text{kcal}$, $\Delta S = 20\text{cal}\ K^{-1}$ at 300K, Hence ΔG is

A. 2.7 kcal

B. -2.7 kcal

C. 9.3 kcal

D. -9.3 kcal

Answer:

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19. The correct signs of ΔS for the following four processes respectively are

(i) Devitrification of glass (ii) Desalination of sea water (iii) N_2 (g, 10 atm) $\rightarrow$ N_2(g, 2 atm) (iv) C (s, graphite) $\rightarrow$ C (s, daimond)

A. $-, -, +, -$

B. $+, -, +, -$

C. $+, -, -, -$

D. $-, -, -, -$

Answer:

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20. Assume that C_6H_6 and $C_6H_5CH_3$ form an ideal solution then $\Delta G, \Delta H$ and ΔSat25^0C for the addition of 1 mole of C_6H_6 to an infinity large sample of solution with a mole fraction of 0.35 for C_6H_6 is

A. $\Delta G = \Delta H = \Delta S = 0$

B. $\Delta H = 0, \Delta G = \Delta S = -4582.57J$

C. $\Delta H = 0, \Delta G = -4582.57J, \Delta S = +15.38j/k$

D. $\Delta H = +15.38J/k\Delta G = -4582.57J, \Delta S = +15.38J/k$

Answer:

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21. One mole of Ideal monatomic gas taken through Isochoric heating for 100K to 1000K then correct Match is

A.

$\Delta S_{\text{sys}}(Rev)$	$\Delta S_{\text{sys}}(\text{Irr})$	$\Delta S_{\text{sur}}(\text{Irr})$	$\Delta S_{\text{total}}(\text{Irr})$
$\frac{3}{2}R\ln 10$	$\frac{3}{2}R\ln 10$	$\frac{-3}{2}R(0.9)$	$\frac{-3}{2}R(1.403)$

B.

$\Delta S_{\text{sys}}(Rev)$	$\Delta S_{\text{sys}}(\text{Irr})$	$\Delta S_{\text{sur}}(\text{Irr})$	$\Delta S_{\text{total}}(\text{Irr})$
$\frac{3}{2}R\ln 10$	$\frac{-3}{2}R\ln 10$	$\frac{-3}{2}R(0.9)$	$\frac{-3}{2}R(1.403)$

C.

$\Delta S_{\text{sys}}(Rev)$	$\Delta S_{\text{sys}}(\text{Irr})$	$\Delta S_{\text{sur}}(\text{Irr})$	$\Delta S_{\text{total}}(\text{Irr})$
$\frac{3}{2}R\ln 10$	$\frac{3}{2}R\ln 10$	$\frac{-3}{2}R(1.403)$	$\frac{3}{2}R(0.9)$

D.

$\Delta S_{\text{sys}}(Rev)$	$\Delta S_{\text{sys}}(\text{Irr})$	$\Delta S_{\text{sur}}(\text{Irr})$	$\Delta S_{\text{total}}(\text{Irr})$
$\frac{3}{2}R\ln 10$	$\frac{-3}{2}R(1.403)$	0	0

Answer:

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22. Work (W) is the path function. Which of the following order is incorrect?

A. $W_{\text{adiabatic}} > W_{\text{Isothermal}}$

B. $W_{\text{reversible}} > W_{\text{irreversible}}$

C. $W_{\text{Isobaric}} > W_{\text{Isochoric}}$

D. For a cyclic process W= area of cycle

Answer:

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23. Standar entropies of x_2, y_2 and xy_3 are 60,40 and $50JK^{-1}mol^{-1}$ respectively for the reaction to be at equilibrium, the temperature should be

$$\frac{1}{2}x_2 + \frac{3}{2}y_2 \Leftrightarrow xy_3 \Delta H = -30kJ$$

A. 750 K

B. 1000K

C. 1250K

D. 500K

Answer:

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24. Temperature of an ideal gas increases in:

A. Adiabatic expansion

B. adiabatic compression

C. Isothermal expansion

D. isobaric expansion

Answer:

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25. As a rubber band is stretched, it gets warmer, when released, it gets cooler. The correct sign of thermodynamic parameters for stretching of rubber band is

A. 'H= $-ve$

B. 'H= $+ve$

C. 'S= $-ve$

D. 'S = $+ve$

Answer:

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26. A system undergoes two cyclic process 1 and 2. Process 1 is reversible and process 2 is irreversible. The correct statement relating to the two processes is

A. ΔS (for process 1)= 0, while ΔS (for process2) $\neq 0$

B. q_{cyclic}= 0 for process 1 and $q_{\text{cyclic}} \neq 0$ for process 2

C. More heat can be converted to work in process 1 than in process 2

D. More work can be converted to heat in process 1 than in process 2

Answer:

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27. A certain gas is expanded from (1L, 10atm) to (4L, 5atm) against a constant external pressure of 1 atm. If the initial temperature of gas is 300K and heat capacity for the process is $50 J^{\circ} C^{-1}$ (use 1L atm = 100J), then

A. |W| = 0.3 kJ

B. |q| = 15 kJ

C. $\Delta U = 14.7 kJ$

D. $\Delta H = 15.7 kJ$

Answer:

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28. The standard enthalpies of formation of CO_2 gas and $HCOOH_{(l)}$ are -393.7 kJ mol^{-1} and $-409.2 kJ mol^{-1}$ respectively. Which of the following are correct?

A. $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)} \Delta H = -393.7 kJ mol^{-1}$

B. $CO_{2(g)} + H_{2(g)} \rightarrow HCOOH_{(l)} \Delta H = -15.5 kJmol^{-1}$

C. $H_2O_{(l)} + CO_{(g)} \rightarrow HCOOH_{(l)} \Delta H = -409.2 kJmol^{-1}$

D. $C_{(s)} + H_{2(g)} + O_{2(g)} \rightarrow H_2CO_{2(l)} \Delta H = -409.2 kJmol^{-1}$

Answer:

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29. For this process (overall change) which is correct

A. q = 0, W = 0

B. $q = +ve, W = -ve$

C. $q = -ve, W_{\text{on the system}} = +ve$

D. $\Delta S_{sys} = 0, \Delta U_{sys} = 0, \Delta H_{sys} = 0$

Answer:

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30. P and Q are two arbitrarily chosen intensive variables then

A. $(P + Q)$ is extensive property

B. $\frac{P}{Q}$ is an intensive variable

C. PQ is an intensive variable

D. $\frac{dP}{dQ}$ = intensive variable

Answer:

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31. Assume that C_6H_6 and $C_6H_5CH_3$ form an ideal solution then $\Delta G, \Delta H$ and $\Delta S \text{at} 25^0C$ for the addition of 1 mole of C_6H_6 to an infinity large sample of solution with a mole fraction of 0.35 for C_6H_6 is

A. $\Delta G = \Delta H = \Delta S = 0$

B. $\Delta H = 0, \Delta G = \Delta S = -4582.57J$

C. $\Delta H = 0, \Delta G = -4582.57J, \Delta S = +15.38\frac{J}{k}$

D. $\Delta H = +15.38\frac{J}{k} \Delta G = -4582.57J, \Delta S = +15.38\frac{J}{k}$

Answer:

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32. A flask of 1L having $NH_3(g)$ at 2.0atm and 200K is connected with another flask of vol 800ml having HCl(g) at 8atm & 200K through tube of negligible volume. The two gases reacts to form $NH_4Cl(s)$ with evolution of 43 KJ/mol heat. If heat capacity of at constant volume is 20J/K/mol and neglecting heat capacity of flask and solid, volume of solid

formed and its pressure (R = 0.08).

The final pressure in the flask is

A. 5.375 KJ

B. 4.375 KJ

C. 6.8 KJ

D. 6.375J

Answer:

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33. A flask of 1L having $NH_3(g)$ at 2.0atm and 200K is connected with another flask of vol 800ml having HCl(g) at 8atm & 200K through tube of negligible volume. The two gases reacts to form $NH_4Cl(s)$ with evolution of 43 KJ/mol heat. If heat capacity of at constant volume is 20J/K/mol and neglecting heat capacity of flask and solid, volume of solid formed and its pressure (R = 0.08).

The final pressure in the flask is

A. 14.39atm

B. 1.49atm

C. 16.39atm

D. 15.39atm

Answer:

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34. `pK for the hydrolysis of ATP is

A. -12.3

B. 90

C. 100

D. 10

Answer:

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35. If $\Delta G = -177Kcal$ for (1) $2Fe(s) + \frac{3}{2}O_2(g) \rightarrow Fe_2O_3(s)$ and $\Delta G = -19Kcal$ for (2) $4Fe_2O_3(s) + Fe(s) \rightarrow 3Fe_3O_4(s)$

What is the Gibbs free energy of formation of Fe_3O_4 ?

A. $+229.6\frac{kcal}{mol}$

B. $-242.3\frac{kcal}{mol}$

C. $-727\frac{kcal}{mol}$

D. $-229.6\frac{kcal}{mol}$

Answer:

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36. Consider the reactions

(i)

$S(\text{rhombic}) + 3/2O_2(g) \rightarrow SO_3(g), \Delta H_1 (ii) S(\text{monoclinic}) + 3/2O_2(g) -$

(iii) $S(\text{rhombic}) + O_3(g) \rightarrow SO_3(g), \Delta H_3$ (iv) S ("monoclinic") + O_(3)(g) rarr SO_(3)(g), DeltaH_(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. $\Delta H_1 + \Delta H_4 = \Delta H_2 + \Delta H_3$

D. All

Answer:

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37. $C_2H_{6(g)} + 3.5O_{2(g)} \rightarrow 2CO_{2(g)} + 3H_2O_{(g)}$

$\Delta S_{\text{vap}}(H_2O, l) = x_1$ calK^{-1} (boiling point is T_1)

$\Delta H_f(H_2O, l) = x_2, \Delta H_f(CO_2) = x_3, \Delta H_f(C_2H_6) = x_4$ 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:

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38. Select the correct set of statement/s:

I. Work done by the surrounding in case of infinite stage expansion is more than single stage expansion

II. Irreversible work is always greater than reversible work.

III. On an ideal gas in case of single stage expansion and compression system as well as surrounding are restored back to their original states

IV. If gas is in thermodynamic equilibrium is taken from A to state B, by four successive single stage expansions. Then we can plot 4 points on the P-V indicator diagram.

A. II

B. I,II,III,IV

C. I,IV

D. I,II,IV

Answer:

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39. Reactions involving gold have been of particular interest to alchemists. Consider the following reactions,

$Au(OH)_3 + 4HCl^3 /_4 ® HAuCl_4 + 3H_2O, DH = -28kcal Au(OH)_3 + 4$

,

$DH = -36.8kcal$

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 of $HAuBr_4$ converted into $HAuCl_4$ (percentage conversion)

A. 0.05

B. 0.06

C. 0.07

D. 0.08

Answer:

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40. 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 workdone (lwl) by the surrounding on the system.

Statement (b) : In an irreversible process, the cyclic integral of work is not zero.

Statement (c) : For thermodynamic changes in adiabatic process $_T\left(\frac{C_{p.m}}{R}\right)$. P = constant

Statement (d) : ΔS_{system} is zero for reversible adiabatic expansion of an ideal gas.

A. Statement c

B. Statement a,b,c

C. Statement a,b,d

D. All

Answer:

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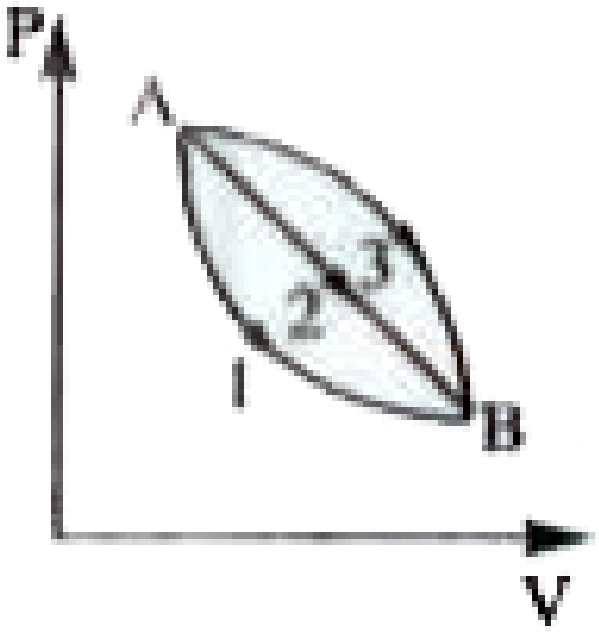
41. A given mass of gas expands from the state A to the state B by three paths 1,2 and 3 as shown in the figure. If w_1, w_2 and w_3 respectively be the work done by the gas along three paths then:



A. $w_1 > w_2 > w_3$

B. $w_1 < w_2 < w_3$

C. $w_1 = w_2 = w_3$

D. $w_2 < w_3 < w_1$

Answer:

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42. Determine which of the following reactions at constant pressure represent systems that do work on the surrounding environment

I. $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$ II. $NH_4Cl(s) \rightarrow NH_3(g) + HCl(g)$

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

A. I

B. III

C. II and III

D. I and II

Answer:

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43. A rigid and insulated tank of $3m^3$ volume is divided into two compartments. One second compartment of volume of $2m^3$ contains an ideal gas at 0.8314 Mpa and 400K and while the second compartment of volume $1m^3$ contains the same gas at 8.314 MPa and 500K. If the partition between the two compartments isruptured. the final temperature of the gas is:

A. 420K

B. 450K

C. 480K

D. None of these

Answer:

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44. 0.5 mole each of two ideal gases $A\left(C_{v.m}=\frac{5}{2}R\right)$ and $B(C_{v.m}=3R)$ are taken in a container and expanded reversibly and adiabtically, during this process temperature of gaseous mixture decreases from 350K and 250K. Find DH (in cal/mol) for the process

A. $-100R$

B. $-137.5R$

C. $-375R$

D. None of these

Answer:

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45. The enthalpy of tetramerization on X in gas phase $(4X(g)®X_4(g))$ is -100 kJ/mol at 300K. The enthalpy of vaporisation

for liquid X and X_4 are respectively 30kJ/mol and 72 kJ/mol respectively. DS for tetramerization of X in liquid phase is -125 J/K mol at 300K. What is the DG at 300K for tetramerization of X in liquid phase?

A. -52kJ/mol

B. -89.5 kJ/mol

C. -14.5 kJ/mol

D. None of these

Answer:

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46. The molar heat capacity, C_v, of helium gas is 3/2 R and is independent of temperature. For hydrogen gas, C_v approaches 3/2R at very low temperature, equal 5/2R at moderate temperature and is higher than 5/2 R at high temperatures. The statement(s) which explain this variation is/are

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 vibration motion are not counted

D. Cann't defined

Answer:

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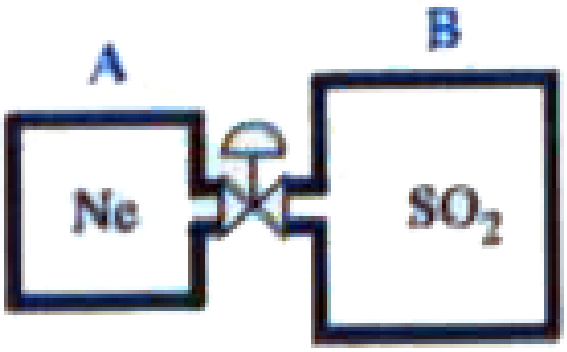
47. Two rigid adiabatic vessels A and B which initially, contain two gases at different temperature are connected by pipe line with value of negligible volume. The vessel 'A' contain 2 moles Ne gas $\left(C_{p.m} = \frac{5}{2}R\right)$ at 300K, vessel 'B' contain 3 moles of SO_2 gas $(C_{p.m} = 4R)$ at 400K. The volume of A & B vessel is 4 and 6 litre respectively. The final total pressure (in

atm) when value is opened and 12 Kcal heat supplied through it to vessels. [Use: R= 2 cal/mol, K and R= 0.08L. atm/mol K as per desire]



A. 3.5 atm

B. 7 atm

C. 35 atm

D. 70 atm

Answer:

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48. From the following data at $25^\circ C$

Reaction	$\Delta_r H^\circ kJ/mol$
$\frac{1}{2}H_2(g) + \frac{1}{2}O_2(g) \rightarrow OH(g)$	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:

Statement (a): $\Delta_r H^\circ$ for the reaction $H_2O(g) \rightarrow 2H(g) + O(g)$

Statement (b): $\Delta_r H^\circ$ for the reaction $OH(g) \rightarrow H(g) + O(g)$ is

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,d

Answer:

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49. A sample of an ideal gas with initial pressure 'P' and volume 'V' is taken through an isothermal process during which entropy change is found to be DS. The work done by the gas is

A. $\frac{PV\Delta S}{nR}$

B. $nR\Delta S$

C. PV

D. $\frac{P\Delta S}{nRV}$

Answer:

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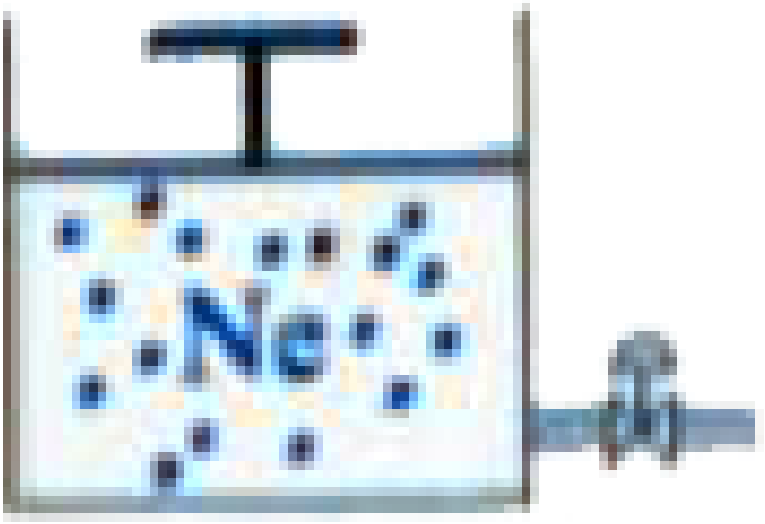
50. A piston cylinder device initially contains $0.2m^3$ neon (assume ideal) at 200kPa inside at $T_1{}^\circ C$. A valve is now opened and neon is allowed to escape until the volume reduces to half the initial volume. At the same time heat transfer with outside at $T_2{}^\circ C$ ensures a constant temperature

inside. Select correct statement(s) for given process



A. ΔU must be zero

B. ΔU can not be zero

C. q may be +ve

D. q may be -ve

Answer:

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51. Which of the following statement(s) is/are correct?

A. the system of constant entropy and constant volume will attain the equilibrium in a state of minimum energy

B. the entropy of the universe is on the increase

C. the process would be spontaneous when $(\Delta S)_{E.V} < 0, (\Delta E)_{S.V} > 0$

D. the process would be spontaneous when $(\Delta S)_{E.V} > 0, (\Delta E)_{S.V} < 0$

Answer:

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52. Which of the following statements are correct?

A. For the reaction $CaCO_3$ (calcite) $\rightarrow CaCO_3$ (aragonite) given: $\Delta_f G^\circ_{298}$ (calcite)= -1128.8 kJ/mol, $\Delta_f G^\circ_{298}$ (aragonite)= -1127.75 kJ/mol, then calcite form is more stable at standard conditions

B. For the reaction (1) C (diamond) $+2H_2(g) \rightarrow CH_4(g)\Delta H_1$

(2) C (graphite) $+4H(g) \rightarrow CH_4(g) + H_2$. Then more heat is evolved in reaction

C. $\Delta_f H^0(I_2, g) = \Delta_{\text{sub}} H^0(I_2, s)$ at $25^\circ C$

D. For the exothermic reaction $2Ag(s) + 1/2O_2(g) \rightarrow 2Ag_2O(s)$ at $298K$. $\Delta H < \Delta U$

Answer:

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53. The normal boiling point of a liquid 'A' is 350K. ΔH_{vap} at normal boiling point is 35 kJ/mole. Pick out the correct statement(s). (Assume ΔH_{vap} to be independent of pressure)

A. $\Delta S_{\text{vaporisation}} > 100 J/K$ mole at 350K and 0.5 atm

B. $\Delta S_{\text{vaporisation}} < 100 J/K$ mole at 350K and 0.5 atm

C. $\Delta S_{\text{vaporisation}} < 100 J/K$ mole at 350K and 2 atm

D. $\Delta S_{\text{vaporisation}} = 100100 J/K$ mole at 350K and 2 atm

Answer:

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54. Choose the correct statements:

A. Temperature, enthalpy and entropy are state functions

B. For reversible and irreversible both isothermal expansion of an ideal gas, change in internal energy and enthalpy is zero.

C. For a reaction in which $\Delta n_g = 0$, entropy change is not always zero.

D. The entropy change associated with reversible isothermal expansion of an ideal gas is equal to $2.303R \log_{10} \frac{P_1}{P_2}$

Answer:

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