



CHEMISTRY

VMC MODULES ENGLISH

THERMODYNAMICS

LEVEL-0 (VERY SHORT ANSWER TYPE(1 MARK)

1. The internal energy change (ΔU) for the reaction $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$ is $-885kJmol^{-1}$ at 298K. What is ΔH at 398 K?

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2. When 0.532g of benzene (C_6H_6) , boiling point 353 K, is burnt with excess of oxygen in a constant volume system 22.3 kJ of heat is given out.

Calculate ΔH for the combustion process $(R = 8.31 J K^{-1} mol^{-1})$.



- **3.** $\Delta U^{\,\circ}$ of combustion of methane is $-XkJmol^{-1}$. The value of $\Delta H^{\,\circ}$ is
 - A. $=\Delta U^{\,\Theta}$
 - B. $> \Delta U^{\Theta}$
 - $\mathsf{C}.\ < \Delta U^{\,\Theta}$
 - $\mathsf{D.}\,=0$

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4. The enthalpy change on freezing of 1 mol of water at $5\,^\circ C$ to ice at

 $-5^\circ C$ is:

(Given $\Delta_{
m fus} H = 6kJ{
m mol}^{-1}{
m at}0^{\,\circ}C$,



6. Although heat is a path function but heat absorbed by the system under certain specific conditions is independent of path. What are those conditions ? Explain.



LEVEL-0 (SHORT ANSWER TYPE-I (2 MAKRS))

1. a. A cylinder of gas is assumed to contain 11.2kg of butane. If a normal family needs 20000kJ of energy per day for cooking, how long will the cylinder last? Given that the heat of combustion of butane is $2658kJmol^{-1}$.

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2. 18.0 g of water completely vaporises at $100^{\circ}C$ and 1 bar pressure and the enthalpy change in the process is $40.79kJmol^{-1}$. What will be the enthalpy change for vaporising two moles of water under the same conditions ? What is the standard enthalpy of vaporisation for water ?

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3. Calculate the difference between C_p and C_V for 10 mole of an ideal gas.

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4. An ideal gas is allowed to expand against a constant pressure of 2 bar from 10L to 50 L in one step. Calculate the amount of work done by the gas. If the same expansion were carried out reversibly, will the work done be higher or lower than the earlier case ?

(Give that, 1 L bar = 100 J)

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5. How will you calculate work done on an ideal gas in a compression, when change in pressure is carried out in infinite steps ?

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6. Enthalpy diagram for a particular reaction is given in figure. Is it possible to decide spontaneity of a reaction from given diagram. Explain.



7. (a) A sample of 1.0 mol of a monoatomic ideal gas is taken through a cyclic process of expansion and compression as shown in figure. What will be the value of ΔH for the cycle as a whole?



LEVEL-0 (SHORT ANSWER TYPE-II (3 MAKRS))

1. What will be the work done on an ideal gas enclosed in a cyliner, when it is compressed by a constant external pressure, $p_{\rm ext}$ in a single step as

shown in figure ? Explain graphically.



2. Represent the potential energy/enthalpy change in the following processes graphically.

(a) Throwing a stone from the ground to roof.

(b)
$$rac{1}{2}H_2(g)+rac{1}{2}Cl_2(g) \Leftrightarrow HCl(g)\Delta_r H^{\,\Theta}= -92.32kJmol^{-1}$$

In which of the processes potential energy/enthalpy change is contributing factor to the spontaneity ?



3. 1.0 mol of a monoatomic ideal gas is expanded from state (1) to state (2) as shown in figure. Calculate the work done for the expansion of gas from state (1) to state (2) at 298 K.



4. One moles of an ideal gas which $C_V = 3/2R$ is heated at a constant pressure of 1atm from $25^{\circ}C$ to $100^{\circ}C$. Calculate $\Delta U, \Delta H$ and the entropy change during the process.

A. 223.5 cal an d372.56 cal

B. 356.76 cal and 356.46 cal

C. 437.3 cal and 357.76 cal

D. 396.5 cal and 436.5 cal



5. A gas occupies 2 litre at S.T.P. It is provided 300 joule heat so that its becomes 2.5 litre at 1 atm. Calculate change in its internal energy.

A. 330 J

B. 500 J

C. 356.9 J



6. 100mL of a liquid is contained in an insulated container at a pressure of 1bar. The pressure is steeply increased to 100bar. The volume of the liquid is decreased by 1mL at this constant pressure. Find ΔH and ΔU .

A. 200 bar mL, 8000 bar mL

B. 300 bar mL, 7000 bar mL

C. 100 bar mL, 9900 bar mL

D. 350 bar mL, 870 bar mL

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LEVEL-0 (LONG ANSWER TYPE (5 MARKS))

1. 1mol of an ideal gas undergoes reversible isothermal expansion form an initial volume V_1 to a final volume $10V_1$ and does 10kJ of work. The initial pressure was $1 \times 10^7 Pa$.

a. Calculate V_2 .

b. If there were 2mol of gas, what must its temperature have been?

A. 0.003, 275 K

B. 0.00043, 261.13 K

C. 0.0005, 300 K

D. 0.00049, 353 K

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2. The given figure shown a change of state A to state C by two paths

ABC and AC for an ideal gas. Calculate the :



(a) Path along which work done is least.

(b) Internal energy at C if the internal energy of gas at A is 10J and amount of heat supplied to change its state to C through the path AC is 200J.

(c) Amount of heat supplied ot the gas to go from A to B, if internal energy of gas at state B is 10J.



3. 14g oxygen at $0^{\circ}C$ and 10atm is subjected to reversible adiabatic expansion to a pressure of 1atm. Calculate the work done in

- a. Litre atomsphere.
- b. Calorie (given, $C_P / C_V = 1.4$).

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4. A sample of 3.0 mole of perfect gas at 200K and 2.0atm is compressed reversibly and adiabatically until the temperature reaches 250K. Given that molar heat capacity at $27.5JK^{-1}mol^{-1}$ at constant volume calculate $q, W, \Delta U, \Delta H$ and the final pressure and volume.

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5. Calculate the entropy change accompanying the conversion of 1 mole of ice at 273.1 K and 1 atm pressure into steam at 373.1 K and 1 atm pressure. At 273.1 K, the molar heat of fusion of ice, ΔH_f is 6.00 kJ mol^{-1} and at 373.1 K, the molar heat of vapourization of water, ΔH_v , is 40.6 kJ mol^{-1} . Also assume that the molar heat capacities, C_p , in the temperature range 373.1 to 273.1 K remains constant. Given that $C_p = 75.25mmol^{-1}K^{-1}$ and log 13.66 = 1.1354. **6.** A sample of argon gas at 1atm pressure and $27^{\circ}C$ expands reversibly and adiabatically from $1.25dm^3$ to $2.50dm^3$. Calculate the enthalpy change in this process. $C_{v,m}$ for argon is $12.48JK^{-1}mol^{-1}$.

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LEVEL-1

1. The work done during the expansion of a gas from $4dm^3$ to $6dm^3$ against at constant external pressure of 3 atm is (1 L atm = 101.32 J)

A. -6J

 $\mathrm{B.}-608J$

 $\mathsf{C.}\,304J$

 $\mathrm{D.}-304J$

Answer: B



2. In a adiabatic process.

A. $p. \Delta V = 0$

 $\mathsf{B.}\,q=~+~W$

C. $\Delta E = q$

D. q=0

Answer: D



3. In an isothermal process for an ideal gas

A. q=0 and $\Delta E=0$

B. q
eq 0 and $\Delta E = 0$

C. q=0 and $\Delta E
eq 0$

D. q
eq 0 and $\Delta E
eq 0$

Answer: B

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4. A gas can expand from 100mL to 250mL under a constant pressure of

 $2 \mathrm{\,atm}$. The work done by the gas is

A. 30.83 J

B. 25 J

C. 5 kJ

D. 16 J

Answer: A

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5. What is ΔE for system that does 500 cal of work on surrounding and 300 cal of heat is absorbed by the system ?

 $\mathsf{A.}-200 cal$

 $\mathrm{B.}-300~\mathrm{cal}$

 $\mathrm{C.}+200~\mathrm{cal}$

 $\mathrm{D.}+300~\mathrm{cal}$

Answer: A

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6. The reaction A o B , $\Delta H=+24kJ/{
m mole.}$ For the reaction B o C, $\Delta H=-18kJ/{
m mole.}$ The decreasing order of enthalpy of A,~B,~C follow the order

A. A,B,C

B. B,C,A

C. C,B,A

D. C,A,B

Answer: B

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7. The cooking in refrigerator is due to:

A. Reaction of the refrigerator gas

B. Expansion of ice

C. The expansion of the gas in the refrigerator

D. The work of the compressor

Answer: C

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8. Heat required to raise the temperature of 1 mole of a substance by 1°

C is called

A. Specific heat

B. Molar heat capacity

C. Water equivalent

D. Specific gravity

Answer: B

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

 $\mathrm{A.}-900J$

 $\mathrm{B.}-900 kJ$

C. 270 kJ

 $\mathrm{D.}+900kJ$

Answer: A



10. Match the entries of Column-I with appropriate entries of Column-II

and choose the correct option out of the four option (A), (B), (C) and (D).

Cołumn-l		Column-ll	
(a)	Isothermal	(p)	$\Delta T = 0$
(b)	Isobaric	(q)	$\Delta V = 0$
(C)	Adiabatic	(r)	$\Delta F = 0$
(d)	Isochoric	(s)	q = 0

A. a-p, b-q,c-r, d-s

B. a-p, b-r, c-s, d-q

C. a-s, b-p, c-r, d-q

D. a-s, b-p, c-q, d-r

Answer: B

11. Which of the following is true for an adiabatic process:

A. $\Delta H=0$ B. $\Delta W=0$ C. dq=0

D. $\Delta V=0$

Answer: C

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12. Consider the reaction at 300 K

$$C_{6}H_{6}(l)+rac{15}{2}O_{2}(g)
ightarrow 6CO_{2}(g)+3H_{2}O(l), \Delta H=-3271kJ$$

What is ΔU for the combustion of 1.5 mole of benzene at $27^{\,\circ}C$?

 $\mathrm{A.}-3267.25~\mathrm{kJ}$

 $\mathrm{B.}-4900.88~\mathrm{kJ}$

 $\mathrm{C.}-4906.5\,\mathrm{kJ}$

 $\mathrm{D.}-3274.75~\mathrm{kJ}$

Answer: B

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13. An ideal gas expands against a constant external pressure of 2.0 atmosphere from 20 litre to 40 litre and absorbs 10 kJ of heat from surrounding. What is the change in internal energy of the system? (Given : 1 atm-litre = 101.3 J)

A. 4052 J

B. 5948 J

C. 14052 J

D. 9940 J

Answer: B



14. For a closed container containing 100 mole of an ideal gas fitted with movable, frictionless, weightless piston operating such that pressure of gas remains constant at 8.21 atm. Which graph represents correct variation of log V vs. log T where V is in litre and T in kelvin?





Answer: A

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15. 10 mole of ideal gas expand isothermally and reversibly from a pressure of 10 atm to 1atm at 300 K. What is the largest mass which can lifted through a height of 100 meter?

A. 31842 kg

B. 58.55 kg

C. 342.58 kg

D. None of these

Answer: B



16. Under which of the following condition is the relation $\Delta H = \Delta U + P \Delta V$ valid for a closed system at

A. constant pressure

B. constant temperature

C. constant temperature and pressure

D. constant temperature, pressure and composition.

Answer: A

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17. The work done in ergs for the reversible expansion of one mole of an ideal gas from a volume of 10 litres to a volume of 20 litres at $25^{\circ}C$ is

A. $-2.303 imes 298 imes 0.082 \log$ 2

 $\texttt{B.}-298\times10^7\times8.31\times2.303\log2$

 $\text{C.}-2.303\times298\times0.082\log0.5$

D. $-8.31 imes 10^7 imes 298 - 2.303 \log 0.5$

Answer: B

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18. The molar heat capacities at constant pressure (assumed constant with respect to temperature) of A, B and C are in ratio of 3: 1.5: 2.0. The enthalpy change for the exothermic reaction $A + 2B \rightarrow 3C$ at 300 K is ΔH_{300} and ΔH_{310} and respectively then :

- A. $\Delta H_{300} > \Delta H_{310}$
- B. $\Delta H_{300} < \Delta H_{310}$

C. $\Delta H_{300} = \Delta H_{310}$

D. If $T_2 > T_1$ then $\Delta H_{310} > \Delta H_{300}$ and if $T_2 < T_1$ then

 $\Delta H_{310} < \Delta H_{300}$

Answer: C



19. Consider the reaction at 300 K

$$C_{6}H_{6}(l)+rac{15}{2}O_{2}(g)
ightarrow 6CO_{2}(g)+3H_{2}O(l), \Delta H=-3271kJ$$

What is ΔU for the combustion of 1.5 mole of benzene at $27^\circ C$?

 $\mathrm{A.}-3271~\mathrm{kJ}$

 $\mathrm{B.}-9813~\mathrm{kJ}$

 $\mathrm{C.}-4906.5\,\mathrm{kJ}$

D. None of these

Answer: D

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20. Give the name of the following reaction:

 $C_2H_5Br+C_2H_5ONa
ightarrow C_2H_5OC_2H_5+NaBr$

A. - 64.81

B. - 190.71

C. - 209.41

 $\mathsf{D.}-224.38$

Answer: C

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21. One mole of solid Zn is placed in excess of dilute H_2SO_4 at $27^{\circ}C$ in a cylinder fitted with a piston . Find the work done for the process of the area of piston is $500cm^2$ and it moves out by 50 cm against a pressure of 1 atm during the reaction.

$$Zn(s)+2H^+(aq) \Leftrightarrow Zn^{2+}(aq)+H_2(g)$$

 $\mathsf{A.}-1.53kJ$

 $\mathrm{B.}-2.53kJ$

C. zero

 $\mathsf{D}.\,2.53KJ$

Answer: B

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22. The enthalpy change (ΔH) for the reaction

 $N_2(g)+3H_2(g)
ightarrow 2NH_3(g)$

is -92.38 kJ at 298 K. What is ΔU at 298 K ? $\left(R=8.314 j K^{-1} mol^{-1}
ight)$

A. - 0.3024

 $\mathsf{B.}-0.6048$

 $\mathsf{C.}-0.12$

D. None

Answer: A



23. When 1 g of ice at $0^{\circ}C$ melts to form 1 g of water at $0^{\circ}C$ then, is the latent heat absorbed by the ice or given out by it?

A. $\Delta H=720$ J

- $\mathrm{B.}\,\Delta H=1440\,\mathrm{cal}$
- $\mathrm{C.}\,\Delta H=1.4Kcal$
- D. $\Delta H=0$

Answer: B



24. 130 g of Zn is dissolved in dilute sulphuric acid in an open beaker .

Find the work done in the process assuming isothermal operation at

300K.

 $\mathrm{A.}-1200~\mathrm{cal}$

 $\mathrm{B.}-1800~\mathrm{cal}$

 $\mathrm{C.} + 1800~\mathrm{cal}$

D. none

Answer: A

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25. The ammount of heat required to raise the temperature of 1 mole of diatomic gas by $1^{\circ}C$ at constant pressure is 60cal. The amount of heat which goes as internal energy of the gas is nearly.

A. 60 cal

B. 30 cal

C. 42.8 cal

D. 49.8 cal

Answer: C

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26. Calculat average molar heat capacity at constant volume of gaseous mixture contained 2 mole of each of two ideal gases $A\left(C_{v,m}=\frac{3}{2}R\right)$ and $B\left(C_{v,m}=\frac{5}{2}R\right)$:

A. R

B. 2R

C. 3R

D. 8R

Answer: B

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27. In the isothermal reversible compression of 52.0m mol of a perfect gas at 260K, the volume of the gas is reduced to one – third of its initial value. Calculate w of this process.

A. 0

 $\mathsf{B.}+123\,\mathsf{J}$

 $\mathrm{C.}-123\,\mathrm{J}$

 $\mathsf{D.}+246\,\mathsf{J}$

Answer: B



28. A sample of oxygen gas expands its volume from 3L to 5L against a constant pressure of 3 atm. If work done during expansion be used to heat 10 mole of water initially present at 290K, its finally temperature will be (specific heat capacity of water = 4.18J/k - g):

B. 298.0 K

C. 290.8 K

D. 293.7 K

Answer: C

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29. A : Work done by a gas in isothermal expension is more than the work done by the gas in the same expasion adiabatically.R : Temperature remains constant in isothermal expansion and not in

adiabatic expansion.

A. Volume and temperature will be higher

B. Volume and temperature will be lower

C. Temperature will be lower but the final volume will be higher

D. Volume will be lower but the final temperature will be higher.

Answer: B



30. Determine $\Delta U^{\,\circ}\,$ at 300 K for the following reaction using the listed enthalpies of reaction :

$$egin{aligned} 4CO(g)+8H_2(g)&
ightarrow 3CH_4(g)+CO_2(g)+2H_2O(l)\ C(ext{graphite})+1/2\operatorname{O}_2(g)&
ightarrow CO(g), \Delta H_1^\circ = -110.5kJ\ CO(g)+1/2\operatorname{O}_2(g)&
ightarrow CO_2(g), \Delta H_2^\circ = -282.9kJ\ H_2(g)+1/2\operatorname{O}_2(g)&
ightarrow H_2O(l), \Delta H_3^\circ = -285.8kJ\ C(ext{graphite})+2H_2(g)&
ightarrow CH_4(g), \Delta H_4^\circ = -74.8kJ \end{aligned}$$

 $\mathrm{A.}-653.3~\mathrm{kJ}$

 $\mathrm{B.}-686.2~\mathrm{kJ}$

 $\mathrm{C.}-747.4~\mathrm{kJ}$

D. None of these

Answer: D


31. From the given table answer the following questions:

	CO (g)	CO2(g)	H ₂ O(g)	H ₂ (g)
∆ ₂ H [∧] ₂₃₈ (kcal∂mole)	- 26.42	- 94.05	- 57.8	0
A _z G [™] ₂₃₈ (kca∂mole)	- 32.79	- 94.24	- 54.64	0
$\Lambda_{\rho}S^{\nu}_{236}$ (Cal/K mol)	47.3	51.1	?	31.2

Reaction: $H_2O(g)+CO_2(g), H_2(g)+CO_2(g).$ Calculate $S_{298}^{\,\circ}H_2O$ (g)

A. -119.47 Cal/K mole

B.+119.47 Cal/K mole

 ${
m C.}-45.13~{
m Cal/K}~{
m mole}$

D. +45.13 Cal/K mole

Answer: D



32. Calculate the free energy change at 298 K for the reaction,

 $Br_2(l)+Cl_2(g) o 2BrCl(g)$. For the reaction $\Delta H^\circ=29.3$ KJ & the entropies of $Br_2(l), Cl_2(g)$ & BrCl(g) at the 298 K are 152.3,223.0,239.7 J $mol^{-1}K^{-1}$ respectively.

 $\mathrm{A.}-1721.8\,\mathrm{J}$

 $\mathrm{B.}-60321.8\,\mathrm{J}$

 $\mathrm{C.}+60321.8\,\mathrm{J}$

 $\mathrm{D.}+1721.8\,\mathrm{J}$

Answer: A

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33. One mole of an ideal gas is expanded from a volume of 3L to 5L under

a constant pressure of 1 atm. Calculate the work done by the gas.

A.
$$\Delta E=0$$

 $\mathrm{B.}\,\Delta H=0$

C. PV is constant

D. $\Delta S < 0$

Answer: D

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34. For the reaction $2HgO(s)
ightarrow 2Hg(l) + O_2(g)$

A. $\Delta H > 0$ and $\Delta S < 0$

B. $\Delta H > O$ and $\Delta S > 0$

C. $\Delta H < 0$ and $\Delta S < 0$

D. $\Delta H < 0$ and $\Delta S > 0$

Answer: B

35. Predict which of the following reaction(s) has a positive entropy change?

I. $Ag^+(aq)+Cl^-(aq) o AgCl(s)$ II. $NH_4Cl(s) o NH_3(g)+HCl(g)$ III. $2NH_3(g) o N_2(g)+3H_2(g)$

A. I and II

B. III

C. II and III

D. II

Answer: C

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36. Which of the following is/are state function?

A. Enthalpy

B. Heat

C. Entropy

D. Gibb's fre energy (G)

Answer: A::C::D

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37. The enthalpy of vaporisation of a liquid is $30kJmol^{-1}$ and entropy of vaporisation is $75Jmol^{-1}K^{-1}$. The boiling point of the liquid at 1atm is

A. 250 K

:

B. 400 K

C. 450 K

D. 600 K

Answer: B



38. When the gas is ideal and process is isothermal, then

A.
$$P_1V_1 = P_2V_2$$

B. $\Delta H=0$

 $\mathsf{C}.\,\Delta W=0$

D. $\Delta H_1 = \Delta H_2$

Answer: A::B::D

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39. A system absorbs 300cal of heat , its volume doubles and temperature rises from 273 to 298k, the work done on the surrounding is 200cal. ΔE for the above reaction is :

A. 100 cal

B. 500 cal

 $\mathrm{C.}-5.00~\mathrm{cal}$

 $\mathrm{D.}-100~\mathrm{cal}$

Answer: A

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40. Temperature of one mole of a gas is increased by 1° C at constant

pressure. The work done on the system is



A. R

B. 2R

 $\mathsf{C.}\,R\,/\,2$

 $\mathsf{D.}-R$

Answer: D

41. P-V plot for two gases (assuming ideal) during adiabatic processes are given in the Fig. Plot A and plot B should correspond respectively to:



A. He and H_2

B. H_2 and He

C. He and Ne

D. H_2 and Cl_2

Answer: B



42. Calculate the final temperature of a monoatomic ideal gas that is compressed reversible and adiabatically from 16L to 2L at 300K:

A. 600 K

B. 1044.6 K

C. 1200 K

D. 2400 K

Answer: C

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43. The adsorption of vapours on a clean surface is a spontaneous

process because

A. change in the entropy of the process is highly positive

B. enthalpy change is highly positive

C. change in entropy is zero

D. change in enthalpy is highly negative

Answer: D

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44. Column-I and Column-II contains four entries each. Entries of Column-I

are to be matched with some entries of Column-II.

One or more than one entries of Column-I may have the matching with

the same entries of Column-II and select the correct answer using the

code given below the Columns

Column-I		Column-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; $\alpha > 0$; $\Delta U > 0$	
(C)	Adiabatic expansion of non-ideal gas into vaccum	(r)	$w = 0; q = 0; \Delta U = 0$	
(D)	Reversible melting of sulphur at normal melting point	(s)	$w_{\rm c} < 0 \; j \; q > 0 \; j \; \Delta U \; = \; 0$	

A. a-p, b-s, c-r, d-q

B. a-p, b-s, c=s, d-q

C. a-s,b-p, c-r, d-q

D. a-p, b-r, c-r, d-q

Answer: A

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45. Match Column-I with Column-II and select the correct answer using

the code given below the Columns

Column-I		Column-II	
(A)	Adiabatic process	(p)	q = 0
(B)	Isothermal process	(q)	$\Delta H = 0$
(C)	Isoenthalpic process	(r)	$\Delta T = 0$
(D)	Isoentropic process	(5)	$\Delta \Xi = 0$

A. a-r, b-r, c-q, d-s

B. a-p, b-r, c-q, d-q

C. a-p, b-r, c-q, d-s

D. a-p, b-r, c-s, d-s

Answer: C



46. A process is taking place at constant temperature and pressure. Then

- A. $\Delta H = \Delta E$
- B. $\Delta H = T\Delta S$
- $\mathsf{C.}\,\Delta H=0$
- D. $\Delta S=0$

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

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47. In view of the signs of $\Delta_r G^\circ$ for the following reactions

 $PbO_2+Pb
ightarrow 2PbO, \Delta_r G^\circ\ < 0$

 $SnO_2+Sn
ightarrow 2SnO, \Delta_r G^\circ > 0$

Which oxidation states are more characteristic for lead and tin?

A. For lead +4, for tin +2

B. for lead +2, for lin +2

C. for lead +4, for tin +4

D. for lead +2, for tin +4

Answer: D

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48. A plot of ln k against $\frac{1}{T}$ (abscissa) is expected to be a straight line with intercept on coordinate axis equal to

A.
$$\frac{\Delta S^{\circ}}{2.303R}$$

B.
$$\frac{\Delta S^{\circ}}{R}$$

C.
$$-\frac{\Delta S^{\circ}}{R}$$

D. $R imes\Delta S^{\,\circ}$

Answer: B



49. The correct relationship between free energy change in a reaction and the corresponding equilibrium constant, K_c is

- A. $\Delta S RT$ in K_c
- $\mathsf{B.} \Delta G = RT \ln K_c$
- C. $\Delta G^\circ = RT \ln \ln K_C$
- D. $-\Delta G^\circ = RT \ln K_c$

Answer: D

50. For the reaction at 298K

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

If $\Delta H^{\,\circ}\,=\,29.8$ Kcal and $\Delta S^{\,\circ}\,=\,0.1 K cal K^{-1}$ then calculate reaction constant (k)

A. 1

B. 0

C. 2

D. 4

Answer: B

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51. एंटोपि का मात्रक है ---

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

B. $Jmol^{-1}$

C. $J^{-1}R^{-1}mol^{-1}$

D. $JRmol^{-1}$

Answer: A

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52. For a system in equilibrium, $\Delta G=0$, under conditions of constant

A. Temperature and pressure

B. Temperature and volume

C. Pressure and volume

D. Energy and volume

Answer: A

53. Calculate the entropy change for the following reaction $H_2(g) + CI_2(g) \rightarrow 2HCI(g)at298K$ Given $S^{\Theta}H_2 = 131JK^{-1}mol^{-1}, S^{\Theta}CI_2 = 233JK^{-1}mol^{-1}$, and $S^{\Theta}HCI = 187JK^{-1}mol^{-1}$ A. $10JK^{-1}mol^{-1}$ B. $-20JK^{-1}mol^{-1}$ C. $167JK^{-1}mol^{-1}$

D. $-167 J K^{-1} mol^{-1}$

Answer: A

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

 $\mathsf{A.}-9336~\mathsf{cal}$

 $\mathrm{B.}-7386~\mathrm{cal}$

 $\mathrm{C.}-1936~\mathrm{cal}$

 $\mathrm{D.}+9336~\mathrm{cal}$

Answer: A

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55. Spontaneous adsorption of a gas on solid surface is an exothermic

process because

- A. ΔH increase for system
- B. ΔS increases for gas
- C. ΔH decreases for gas
- D. ΔG increases for gas

Answer: C

56. The enthalpy change for transition of liquid water to steam is 40.8 kJ mol^{-1} at 373K. Calculate ΔS for the process.

A. 209.4

B. 109.4

C. 250

 $\mathrm{D.}-209~\mathrm{A}$

Answer: B

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57. Which of the following statements is true?

A. ΔG is always less than ΔH

B. ΔG is always more than ΔH

C. ΔG is always proportional to ΔH

D. ΔG may be lesser, greater or equal to ΔH

Answer: D



58. In a reversible process, the value of $\Delta S_{sys} + \Delta S_{surr} is$

- A. > 0
- $\mathsf{B.}\ < 0$
- $\mathsf{C.}\ \geq 0$
- $\mathsf{D.}\ =0$

Answer: D

59. Consider the following cyclic process.



I. Isothermal, II. Adiabatic, (III) constant pressure process

Sum of the work and heat in the above is:

A. zero

B. pV

C. R

 $\mathsf{D.} - pV$

Answer: A

60. The following diagram represents the (p-V) changes of gas. Thus, total work done is:



A. $P_2(V_2 - V_1) + P_3(V_3 - V_2)$ B. $P_1(V_2 - V_1) + P_3(V_3 - V_2)$ C. $P_2(V_3 - V_1) + P_3(V_2 - V_1)$ D. $P_2(V_3 - V_2) + P_3(V_2 - V_1)$

Answer: A

61. Which of the following proces is (are) expected to be spontaneous at higher temperature but non-spontaneous at lower temperature?

$$egin{aligned} &\mathsf{A}.\, N_2(g) + 3H_2(g) o 2NH_3(g) \ &\mathsf{B}.\, H_2(g) o 2H(g) \ &\mathsf{C}.\, CO_2(g) + C(s) o 2CO(g) \ & \left[\Delta H_f^{\,\Theta}, m, CO_2 = \,-\, 394kJ/mol, CO = \,-\, 212kJ/mol
ight] \ &\mathsf{D}.\, Na(s) o Na^+(g) + e^- \end{aligned}$$

Answer: B::D



62. Which of the plots of ln K vs $\left(\frac{1}{T}\right)$ is/are correct?



A.



Β.



C.



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



63. The value of $\Delta H_{\text{transition}}$ of C (graphite) \rightarrow C (diamond) is 1.9 kJ/mol at $25^{\circ}C$. Entropy of graphite is higher than entropy of diamond. This implies that :

A. C(diamond) is more thermodyanically stable than C (graphite) at

 $25\,^\circ\,$ C

B. C(graphite) is more thermodyanically stable than C (diamond) at

 $25^{\,\circ}\,$ C

- C. Diamond will provide more heat on complete combustion at $25^{\,\circ}\,$ C
- D. $\Delta G_{ ext{transition}}$ of C (diamond) ightarrow C (graphite) is -ve.

Answer: B::C::D



64. Among the following , the state funcation (s) is (are)

A. Internal energy

B. Molar enthalpy

C. Reversible expansion work

D. Irreversible expansion work

Answer: A::B

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65. For an endothermic reaction, ΔH represents the enthalpy of the reaction in kJ mol^{-1} . The mininum amount of activation energy will be

A. Less than ΔH

B. zero

C. more than ΔH

D. equal to ΔH

Answer: C

66. Match the following:

Column I		Column II		
(A)	$CO_2(g) + C(g) \longrightarrow 2CO(g)$ $[\Delta_2 \hat{H}^0: CO_2 = -394 \text{ and } CO = -220 \text{ kJ/m cl}]$	(1)	$\mathbb{A}_{\underline{r}}\mathbb{S}>0$	
(B)	so₂cl₂kg)→ so₂kg)+cl₂kg)	(2)	$\Delta_{\tau} H > \Delta_{\tau} U$	
(C)	$\mathbb{C} \odot (\mathfrak{g}) + \mathbb{C} \mathfrak{l}_2 (\mathfrak{g}) \longrightarrow \mathbb{C} \odot \mathbb{C} \mathfrak{l}_2 (\mathfrak{g})$	(3)	$\Delta_{\underline{r}} H < \Delta_{\underline{r}} U$	
(D)	$Cl_2(g) \longrightarrow 2Cl(g)$	(4)	$\Delta_r G > 0$	

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67. Match the Column:

Column I			Column II		
(A)	H ⁺ (aq)	(1)	$A_{t}H^{\alpha} = 0$		

(B)	H (g)	(2)	$\Delta_{\ell} \mathbb{H}^{*} \neq 0$
(C)	H ₂ (gr)	(3)	$\Lambda_{q}G^{\alpha}=0$
(D)	C (s, diam ond)	(4)	$\Delta_{\underline{f}} S^{\circ} < 0$



68. For the gas phase reaction,

 $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$

Which of the following conditions are correct ?

- A. $\Delta H < 0$ and $\Delta S < 0$
- B. $\Delta H > 0$ and $\Delta H < 0$
- C. $\Delta H=0$ and $\Delta S<0$
- D. $\Delta H > 0$ and $\Delta S > 0$

Answer: D

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69. The Haber's process of production of ammonia involves the equilibrium:

 $N_2(g)+3H_2(g) \Leftrightarrow 2NH_2(g)$

Assuming $\Delta H^{\,\circ}\,$ and $\Delta S^{\,\circ}\,$ for the reaction do not change with temperature, which of the statements is true?

 $ig(\Delta H^{\,\circ} = \,-\,95kJ\,\, ext{and}\,\,\Delta S^{\,\circ} = \,-\,198JK^{-1}ig)$

A. Ammonia dissociates spontaneously below 500 K

B. Ammonia dissociates spontaneously above 500 K

C. Ammonia dissociates at all temperatures.

D. Ammonia does not dissociates at any temperatures.

Answer: B

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70. If a gas, at constant temperature and pressure expands, then its

A. Entropy increases and then decreases

B. Internal enery increases

C. Internal energy remains the same

D. Internal energy decreases

Answer: C

71. Considering the reaction,

 $C(s)+O_2(g)
ightarrow CO_2(g)+393.5kJ$

the signs of ΔH , ΔS and ΔG respectively are:

A. +, -, -B. -, +, -

- C.-, -, -
- D.-, +, 1

Answer: D

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72. Considering entropy (S) as a thermodynamic parameter, the criterion

for the spontaneity of any process is

A.
$$\Delta S_{
m system} + \Delta (S)_{
m surrounding} > 0$$

B.
$$\Delta S_{
m system} - \Delta S_{
m surroundings} > 0$$

C. $\Delta S_{
m system} > 0$ only

D. $\Delta S_{
m surrounding} > 0$ only

Answer: A



73. Assuming $\Delta H^{\,\circ}\,$ and $S^{\,\circ}\,$ do not change with temperature. Calculate,

the boiling point of liquid A using the thermodynamic data given below.

Thermodynamic data	A €)	A (g)
$\Delta_{\underline{r}} H^{\circ} \big(k \mathbb{J} \neq \mathfrak{m} \mathfrak{ol} \big)$	-130	-100
S°(JK ⁻¹ mol ⁻¹)	100	200

A. 300 K

B. 130 K

C. 150 K

D. 50 K

Answer: A

74. For a phase change:

 $H_2O(l) \Leftrightarrow H_2O(s)$

 $0^{\,\circ}\,C$, 1 bar

A. $\Delta G=0$

 $\mathrm{B.}\,\Delta S=0$

C. $\Delta H=0$ and $\Delta S<0$

D. $\Delta U=0$

Answer: A

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75. For the process $H_2O(l)(1\mathrm{bar},373K) o H_2O(g)(1\mathrm{bar},373K)$ the

correct set of thermodynamic parameters is

A.
$$\Delta G=0,$$
 $\Delta S=+ve$

- B. $\Delta G=0, \Delta S=-ve$
- C. $\Delta G=\,+\,ve,\,\Delta S=0$
- D. $\Delta G = -ve, \Delta S = +ve$

Answer: A

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LEVEL-2

1. Which of the following regarding the said processes is (are) correct?

A. Expansion of an ideal gas against vaccum is always reversible

B. A spontaneous proces is always irreversible

C. In a reversible thermodynamic process, system always remains in

equilibrium with surroundings

D. If a system containing ideal gas in a piston udergoes expansion

from a given initial state to the same final volume, the surroundings

loses more heat if expansion is carried out irreversibly rather

reversibly

Answer: B::C::D



2. Match the following:

Column I		Column II	
(A)	Isothermal processes	(1)	$\Delta U = 0$
(B)	Reversible adiabatic process	(2)	$\Delta H = 0$
(C)	Cyclic process	(3)	$\Delta S = 0$
(D)	Isochoric process	(4)	w = 0



3. A gas expands isothermally against a constant external pressure of 1 atm from a volume of 10 dm^3 to a volume of 20 dm^3 . It absorbs 800 J of

thermal energy from its surroundings. The ΔU is

 $\mathrm{A.}-312~\mathrm{J}$

 $\mathsf{B.}+123J$

 ${\rm C.}-213~{\rm J}$

 $\mathsf{D.}+231J$

Answer: C

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4. In which of the following reactions, the enthalpy is the least ?

A. $CH_{3}COOH + NaOH
ightarrow CH_{3}COONa + H_{2}O$

B. $HCl + NH_4OH \rightarrow NH_4Cl + H_2O$

 $\mathsf{C}.\,HCl + NaOH \rightarrow NaCl + H_2O$

D. $HCN + NH_4OH \rightarrow NH_4CN + H_2O$

Answer: D
5. Molar entropy change is 16 J $mol^{-1}K^{-1}$, the boiling points of the liquid is if molar heat of vaporization is 6 kJ/mol.

A. $375^{\,\circ}\,$ C

B. 375 K

C. 273 K

D. $102\,^\circ\,$ C

Answer: B

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6. For the reaction of one mole of zinc dust with one mole of sulphuric acid in a bomb calorimeter, ΔU and w corresponds to

A. $\Delta U < 0, w = 0$

B. $\Delta U < 0, w < 0$

C. $\Delta U > 0, w > 0$

D. $\Delta U > 0, w > 0$

Answer: A

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

A. $41.00 k Jmol^{-1}$

B. $4.100 k Jmol^{-1}$

C. $3.7904 k Jmol^{-1}$

D. $37.904 k Jmol^{-1}$

Answer: D



8. A sample of oxgyen gas expands its volume from 3 L to 5 L against a constant pressure of 3 atm. If work done during expansion to used to heat 10 mole of water initially present at 290 K, its final temperature will be (specific heat capacity of water = 4.18 J//K-g)

A. 292,0 K

B. 290.8 K

C. 298.0 K

D. 293.7 K

Answer: B

9. If x and y are arbitrary intensive variables, then

- A. (P+Q) is extensive property
- B. P/Q is an intensive varibale
- C. PQ is an intensive variable
- D. $\frac{dP}{dQ}$ is an intensive property.

Answer: B::C::D

- 10. $\Delta E=0$ for which process
 - A. Cyclic process
 - B. Isothermal expansion
 - C. Isochoric process
 - D. Adiabatic process

Answer: A::B



11. What will be the entropy change when two moles of an ideal gas expand reversibly from initial volume of 1 litre to 10 litre at constant temperature of 300 K?

A. $19.15 JK^{-1} mol^{-1}$

B. $38.27 JK^{-1} mol^{-1}$

C. $11.48JK^{-1}mol^{-1}$

D. $5.74kJK^{-1}mol^{-1}$

Answer: B

12. The state of a mole of an ideal gas changed from state A at pressure 2P and volume V follows four different processes and finally returns to initial state A reversibly as shown below in the graph. By interpreting the graph, answer the following questions.



Which is the kind of process followed from state A to state, B?

A. isochoric expansion

B. Isobaric expansion

C. Isothermal reversible expansion

D. Isothermal irreversible compression

Answer: B

13. The state of a mole of an ideal gas changed from state A at pressure 2P and volume V follows four different processes and finally returns to initial state A reversibly as shown below in the graph. By interpreting the graph, answer the following questions.



In state D to state A, what kind of process is followed?

A. Isobaric expansion

B. Isobaric compression

C. Isochroic process

D. Isothermal compression

Answer: C



14. The state of a mole of an ideal gas changed from state A at pressure 2P and volume V follows four different processes and finally returns to initial state A reversibly as shown below in the graph. By interpreting the graph, answer the following questions.



what would the be total work done by the gas?

A. -PV

B. PV

C. 0

D. None of these

Answer: A

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15. The state of a mole of an ideal gas changed from state A at pressure 2P and volume V follows four different processes and finally returns to initial state A reversibly as shown below in the graph. By interpreting the graph, answer the following questions.



What would be the work done in state B
ightarrow C?

A. PV

B. PV

C. 2PV

D. Zero

Answer: D

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16. What would be the heat absorbed by the system in the cyclic process?

 $\mathrm{A.}-2PV$

B. zero

C. 2PV

D. PV

Answer: A

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17. A sample consisting of 1 mole of a mono-atomic perfect gas $\left(C_v=rac{3}{2}R
ight)$ is taken through the cycle as shown.



Temperature at points (1), (2) and (3), respectively is:

A. 273 K, 546 K, 273 K

B. 546 K, 273 K, 273 K

C. 273 K, 273 K, 273 K

D. 546 K, 546 K, 273 K

Answer: D

18. A sample consisting of 1mol of a mono-atomic perfect gas $\left(C_V=rac{3}{2}R
ight)$ is taken through the cycle as shown.



 ΔH for the overall cycle is

- A. $+5.67 imes10^3$ J
- $\mathrm{B.}-5.67\times10^3~\mathrm{J}$
- $\mathrm{C.}-11.34\times10^3~\mathrm{J}$

D. zero

Answer: D



 ΔU for the process(1
ightarrow 2) is

A. 0.00 J

 $\mathrm{B.+3.40\times10^{3}~J}$

 ${
m C.}-3.40~{
m J}$

 ${\sf D}.-3.40 imes10^3{\sf J}$

Answer: B





 ΔU for the process (2
ightarrow 3) is

A. 0.00 J

 $\mathrm{B.}+3.40~\mathrm{kJ}$

 $\mathrm{C.}-3.40~\mathrm{kJ}$

D. None of these

Answer: C



21. The enthalpy of vaporization of chloroform is $29.4kJmol^{-1}$ at its normal boiling point of 61.7° C. What is the entropy of condensation of chlorofom at this temperature?

 $\mathsf{A.}-57.3\mathsf{R}$

 $\mathrm{B.}-10.6~\mathrm{R}$

 $\mathrm{C.}-1.18~\mathrm{R}$

D. 10.6 R

Answer: B

22. Combustion of sucuose is used by aeroic organisms for providing energy for the life sustaining processes. If all the capturing of energy from the reaction is done through electrical process (non P-V word) then calculate maximum available energy which can be captured by combustion of 34.2 gm of sucrose

Given : $\Delta H_{\text{combustion}}(\text{sucrose}) = -6000 \text{kJ mol}^{-1}$

 $\Delta S_{
m combustion} = 180 {
m J/K} ext{-mol} ext{ and body temperature is } 300 {
m K}$

A. 600 kJ

B. 594.6 kJ

C. 5.4 kJ

D. 605.4 kJ

Answer: D

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23. The freezing of any liquid to a solid is expected to have:

A. a positive ΔH and a positive ΔS

B. a negative ΔH and a positive ΔS

C. a positive ΔH and a negative ΔS

D. a negative ΔH and a negative ΔS .

Answer: D

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24. Industrial acetylene gas (ethyne: C_2H_2) is made by the high temperature decomposition of ethane gas: C_2H_6 , at 300° C, according to the following equation: $C_2H_6(g) \rightarrow C_2H_5(g) + 2H_2(g)$

A.
$$\Delta_r G^\circ > \Delta_r H^\circ$$
 and $\Delta_r S^\circ > 0$

- B. $\Delta_r G^\circ\,<\,\Delta_r H^\circ\,$ and $\Delta_r S^\circ\,$ It 0
- C. $\Delta_r G^{\,\circ}\, < \Delta_r H^{\,\circ}$ and $\Delta_r S^{\,\circ}\, > 0$

D. $\Delta_r G^{\,\circ}\, > \Delta_r S^{\,\circ}\, < 0$

Answer: C



- 25. Which one of the following statements is true
 - A. For a given transfer of energy, the increase in entropy is directly

proportinal to the temperature.

B. $Br_q(g)$ has a lower entropy than Br_2 ?

C. The standard free energy of formation of Hg(l) is zero .

D. Endothermic reaction wit a neegative entropy change are always

non-spontaneous

Answer: C::D

26. Calculate the standard free energy change for the formation of methane at 300K:

$$C(ext{graphite}) + 2H_2(g) o CH_4(g)$$

The following data are given:

$$egin{aligned} &\Delta_f H^{\,\Theta} \left(k Jmol^{-1}
ight) : C H_4(g) = \ -74.81 \ &\Delta_f S^{\,\Theta} \left(J K^{-1} mol^{-1}
ight) : C(ext{graphite}) = 5.70, H_2(g) = 130.7 C H_4(g) = 186.3 \end{aligned}$$

A. $\Delta_r G^\circ$ is -50.8 kJ and the reactionis driven by enthalpy only

B. $\Delta_r G^\circ$ is -50.8 kJ and the reaction is driven by entropy only

C. $\Delta_r G^\circ$ is +5.0 kJ and the reaction is driven by enthalpy and

entropy

D. $\Delta_r G^\circ$ is -50.8 kJ and the reaction is driven by enthalpy and entropy

Answer: A

27. Given: $\Delta_f H^\circ(kJ/mol) = S_m^\circ(J/Kmol)$ $CCl_4(l) = -135 = 215.4$ $CCl_4(g) = -103.0 = 308.7$:

What is the boiling point of carbon tetrachloride?

A. $8.25\,^\circ\,$ C

 $\mathrm{B.}\,69.97^\circ\,\mathrm{C}$

 $\mathrm{C.}\,92.3^\circ\,\mathrm{C}$

D. $45.8^\circ\,$ C

Answer: B

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28. Calculate the change in molar Gibbs energy of carbon dioxide gas at

 $20^{\,\circ}$ C when it is isothermally compressed from 1.0 bar to 2.0 bar.

A. 2.4 kJ/mol

 $\mathrm{B.}-2.4~\mathrm{kJ/mol}$

C. 1.7 kJ/mol

 $\mathrm{D.}-1.7~\mathrm{kJ/mol}$

Answer: C

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29. Calculate $\Delta_r S_{
m sys}^\circ$ for the following reaction at 373 K:

 $CO(g)+H_2O(g)
ightarrow CO_2(g)+H_2(g)$

 $\Delta_r H^{\,\circ} \,=\, - \,4.1 imes 10^4 J, \Delta_r S^{\,\circ} \,({
m unv}) \,= \,56 J \,/\,K$

 $\mathrm{A.}-54~\mathrm{J/K}$

 $\mathrm{B.}-166~\mathrm{J/K}$

 ${\rm C.}+54~{\rm J/K}$

 $\mathrm{D.}+166~\mathrm{J/K}$

Answer: A

30. A certain process releases 64.0 kJ of heat, which is transferred to the surroundings at a constant pressure and a constant temperature of 300 K. For this process $\Delta S_{
m surr}$ is:

A. 64.0 kJ

 $\mathrm{B.}-64.0~\mathrm{kJ}$

 $\mathrm{C.}-213~\mathrm{J/K}$

D. None of these

Answer: D

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31. Which of the following is (are) correct?

A. Absolute value of heat content of the system can't be determined

using calorimetry

- B. Absolute value of entropy can't be known
- C. Absolute value of internal energy can't be known
- D. Absolute value of Gibbs energy can't be determined

Answer: A::C::D

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32. When ice melts at $1^{\circ}C$:

A. an increase in entropy

B. a decrease in entropy

C. a decreas in free entropy

D. process is spontaneous

Answer: A::C::D

33. The standard enthalpy of formation of gaseous H_2O at 298 K is -241.82 kJ/mol. Calculate ΔH° at 373 K given the following values of the molar heat capacities at constant pressure :

 $H_2O(g) = 33.58~~\mathrm{JK^{-1}}~~\mathrm{mol^{-1}}, \quad H_2(g) = 29.84~~\mathrm{JK^{-1}}~~\mathrm{mol^{-1}}, \quad O_2(g)$ Assume that the heat capacities are independent of temperature :

A.
$$-242.6k \frac{J}{\text{mol}}$$

$$B.+242.6kJ/mol$$

 $\mathrm{C.} + 24.26 \ \mathrm{kJ/mol}$

 $\mathrm{D.}-242.6\,\mathrm{J/mol}$

Answer: A

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34. Which statements in each of the following paris would you except to

have the higher standard molar entropy?

(I) $C_2H_2(g)$ or $C_2H_6(g)$, (II) $CO_2(g)$ or CO(g), (III) $I_2(s)$ or I_2 (g)

The correct choice is:

A. $C_2H_2(g), CO_2(g), I_2(g)$ B. $C_2H_6(g), CO(g), I_2(g)$ C. $C_2H_2(g), CO_2(g), I_2(g)$ D. $C_2H_6(g), CO_2(g), I_2(g)$

Answer: D

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35. ΔH for solid to liquid transitions for protein A and B are 2.73kcal/mol and 3.0kcal/mol. The two melting points are $0^{\circ}C$ and $30^{\circ}C$ respectively. The entropy changes ΔS_A and ΔS_B at two transition temperatures are related as

A.
$$\Delta S_A = \Delta S_B$$

B. $\Delta S_A < \Delta S_B$

D.
$$\Delta S_B = rac{303\Delta S_A}{273}$$

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 $C \wedge S = \wedge S_{-}$

Answer: A



D. None of these

Answer: A

37. For a particular reversible reaction at temperature T, ΔH and ΔS were found to be both +ve. If T_e is the temperature at equilibrium, the reaction would be spontaneous when :

A. $T_e > T$

 $\mathsf{B}.\,T>T_e$

- C. T_e is 5 times T
- $\mathsf{D}.\,T=T_e$

Answer: B

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38. Which of the following reactions defines ΔH_f° ?

A.
$$C(ext{diamond}) + O_2(g) o CO_2(g)$$

B.
$$rac{1}{2}H_2(g)+rac{1}{2}F_2(g)
ightarrow HF(g)$$

$$\mathsf{C}.\, H_4P_2O_7 + H_2O \rightarrow 2H_3PO_4$$

D.
$$SO_2(g)+rac{1}{2}O_2(g)
ightarrow SO_3(g)$$

Answer: B

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39. The direct conversion of A or B is difficult, hence it is carried out by

the following shown path

Given, $\Delta S_{A
ightarrow C} = 50 e u$, $\Delta S_{C
ightarrow D} = 30 e u$, $\Delta S_{B
ightarrow D} = 20 e u$



Where eu is entropy unit, then $\Delta S_{A
ightarrow B}$ is .

A. + 100 eu

 $\mathsf{B.}+60~\mathsf{eu}$

 ${\rm C.}-100~{\rm eu}$

 ${\sf D}.-60~{\sf eu}$

Answer: B

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40. A schematic plot of ln K_{eq} versus inverse of temperature for a reaction is shown below: The reaction must be:



A. Highly spontaneous at ordinary temperature

B. One with negligible enthalpy change

C. endothermic

D. exothermic

Answer: D

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41. An endotthermic reaction is non-spontaneous at freezing point of water and becomes feasible at its boiling point, then:

A. ΔH is $-ve, \Delta S$ is +ve

B. ΔH and ΔS both are +ve

C. ΔH and ΔS both are -ve

D. ΔH is +ve, ΔS is -ve

Answer: B

42. Select the correct statement(s) about entropy S

- A. $S_{
 m vapour} > S_{
 m solid} > S_{
 m liquid}$
- B. $S_{
 m vapour} > S_{
 m liquid} > S_{
 m solid}$
- C. $S_{
 m vapour} \, < \, S_{
 m liquid} \, < \, S_{
 m solid}$
- D. $S_{
 m vapour} = S_{
 m liquid} > S_{
 m solid}$

Answer: B

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43. A particular reaction at $27^{\circ}C$ for which $\Delta H > 0$ and $\Delta S > 0$ is found to be non-spontaneous. The reaction may proceed spontaneously if

A. The temperture is decreased



C. The temperature is increased

D. It is carried in open vessel at 27° C

Answer: C

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44. For a given reaction, $\Delta H = 35.5 k Jmol^{-1}$ and $\Delta S = 83.6 J K^{-1} mol^{-1}$. The reaction is spontaneous at (Assume that ΔH and ΔS do not vary with temperature)

A. 1118 K

B. 1008 K

C. 1200 K

D. 845 K

Answer: A



45. Standard entropies of X_2 , Y_2 and XY_3are60 , 40 and $50JK^{-1}mol^{-1}$ respectively. For the reaction $\frac{1}{2}X_2 + \frac{3}{2}Y_2 \Leftrightarrow XY_3\Delta H = -30KJ$ to be at equilibrium, the temperature should be:

A. 1000 K

B. 1250 K

C. 500 K

D. 750 K

Answer: D

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46. The incorrect expression among the following is

A.
$$rac{\Delta G_{
m system}}{\Delta S_{
m Total}} = \ - \ T$$

B. In isothermal process, $W_{ ext{reversible}} = -nRT \ln rac{V_t}{V_i}$

$$\mathsf{C.}\ln K = \frac{\Delta H^\circ - T\Delta S^\circ}{RT}$$

D.
$$K=e^{\,-\,\Delta\,G^\circ\,/\,RT}$$

Answer: C

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47. A reaction has $\Delta H=~-~33kJ~{
m and}~\Delta S=~-~58J/K.$ This reaction

would be:

- A. Spontaneous at all temperature
- B. non-spontaneous at all temperatures
- C. spontaneous above a certain temperature only
- D. spontaneous below a certain temperature only

Answer: D

48. Animals operate under conditons of constant pressure and most of the process tht maintain life are isothermal (in a broad sense) . How much energy is available for sustaining this type of muscular and nervous activity from the combustion of 1mol of glucose molecules under standard conditons at 37° C (blood temperature) ? The entropy change is $+182.4JK^{-1}$ for the reaction stated above

 $\Delta H_{
m combustion}$ [glucose]=-2808 KJ

 $\mathrm{A.}-2754.4~\mathrm{kJ}$

 $\mathrm{B.}-2864.5~\mathrm{kJ}$

 $\mathrm{C.}-56.5~\mathrm{kJ}$

 $\mathrm{D.}-2808~\mathrm{kJ}$

Answer: B
49. 10 g of argon is compressed isothermally and reversibly at a temperature of $27^{\circ}C$ from 10 L to 5L. Calculate , w, ΔE and ΔH for the process. $R = 2.0 cal K^{-1} mol^{-1}$, $\log 2 = 0.30$, At. Wt. of argon = 40.

A. $\Delta S \equiv 0.36 J K^{-1}$

 $\mathrm{B.}\,W=227.97\,\mathrm{J}$

C. q = -227.97 J

D. $\Delta H = 107.28$ J

Answer: A

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50.
$$4x^2 - 9 = (px + t)(px - t)$$

In the equation above, p and t are constants. Which of the following could be the value of p ?

A. Finely divided from of CuO kept in excess O_2 would be completely

converted to Cu_2O

B. Finely divided form Cu_2O of kept in excess O_2 would be completely

converted to CuO

C. Finely divided form of CuO kept in excess O_2 would be converted to

a mixture of CuO and Cu_2O (having more of CuO)

D. Finely divided form of CuO kept in excess O_2 would be converted to

a mixture of CuO and Cu_2O (having more of Cu_2O)

Answer: B

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LEVEL-2 (NUMERICAL VALUE TYPE)

1. One moles of an ideal gas which $C_V=3/2R$ is heated at a constant pressure of 1atm from $25^\circ C$ to $100^\circ C$. Calculate $\Delta U, \Delta H$ and the

entropy change during the process.



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3. A gas expands from $3dm^3$ to $5dm^3$ against a constant pressure of 3 atm. The work done during expansion is used to heat 10 mole of water at temperature 290 K. Calculate final temperature of water. Specific heat of water = 4.184J/g/K.

(given : 1 atm = 101.33 J)

4. An ideal monoatomic gas $C_v = 1.5R$ initially at 298 K and 1.013×10^6 Pa. pressure expands adiabatically unit it is a in equilibrium with a constant external pressure of 1.013×10^5 Pa. Calculate the final temperature of gas.

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5. Calculate the change in entropy for the fusion of 1 mole of ice (water). The melting point of water is 273 K and molar enthalpy of funsion for water $= 6.0 k Jmol^{-1}$

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6. A kettle containing 1kg of water is heated open to atmosphere until evaporation is complete. The work done during this process is

7.70 calories of heat is required to raise the temperature of 2 mole of an ideal gas at constant pressure from $30^{\circ}C$ to $35^{\circ}C$. The amount of heat required to raise the temperature of the same gas through the same range at constant volume is



8. One mole of an ideal gas at $27^{\circ}C$ expanded isothermally from an initial volume of 1 litre to 10 litre. The ΔU for this process is : $(R = 2calK^{-1}mol^{-1})$

9. Two moles of ideal gas at $27^{\,\circ}C$ temperature is expanded reversibly

from 2 litre to 20 liter. Find entropy change (R=2cal/molK) .



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

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11. one mole of an ideal gas at 300k in thermal contact with surroundings expands isothermally from 1.0 L to 2.0 L against a constant presses of 3.0 atm. In this process. The change in entropy of surroundings (ΔS) in J^{-1} is

(1 L atm = 101.3 J)

12. How many times a diatomic gas should be expanded adiabatically so

as to reduce the root mean square velocity to half. :



13. For the reaction:

 $X_2O_4(l)
ightarrow 2XO_2(g)$

 $\Delta U = 2.1 kcal, \Delta S = 20 ext{cal} K^{-1} ext{at} 300 K$

Hence ΔG is

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14. The enthalpy of a system increases by 50 kJ when its internal energy is increased by 113 kJ. What is the pressure in kNm^{-2} of the system if the volume of gas is reduced by 10^3m^3 at constant pressure?

15. A sample of argon gas at 1atm pressure and $27^{\circ}C$ expands reversibly and adiabatically from $1.25dm^3$ to $2.50dm^3$. Calculate the enthalpy change in this process. C_{vm} for orgon is $12.48JK^{-1}mol^{-1}$.



JEE (MAIN ARCHIVE)

1. For an endothermic reaction, ΔH represents the enthalpy of the reaction in kJ mol^{-1} . The mininum amount of activation energy will be

A. less than ΔH

B. zero

C. more than ΔH

D. equal to ΔH

Answer: C

2. Identify the intensive quantity from the following

A. enthalpy

B. temperature

C. volume

D. refractive index

Answer: B::D

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3. Which of the following is an endothermic reaction?

A. Combustion of methane

B. Decomposition of water

C. Dehydrogenation of ethane to ethylene

D. Conversion of graphite to diamond

Answer: B::C::D



4. A process is called reversible when

A. surroundings and system change inot each other

B. there is no boundary between system and surroundings.

C. the surroundings are always in equilibrium with the system

D. the system changes ito the surroundings spontaneously

Answer: C



5. Which one of the following statements is false?

A. Work is a state function

- B. Temperature is a state function
- C. Change in the state is completely defined when the initial and final

states are specified.

D. Work appears at the boundary of the systme

Answer: A

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6. Two moles of an ideal gas expanded isothermally and reversibly from 1L to 10L at 300K. What is the enthalpy change?

A. 11.4 kJ

 $\mathrm{B.}-11.4~\mathrm{kJ}$

C. 0 kJ

D. 4.9 kJ

Answer: C



7. Which of the following statements is/are false?

A. Work is state function

B. Temperature is a state function

C. Change in the state is completely defined when the initial and final

states are specified.

D. Work appears at the boundary of the system

Answer: A

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8. Among the following, the intensive property is (properties are):

A. molar conductivity

B. electromotive force

C. resistance

D. heat capacity

Answer: A::B

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9. A piston filled with 0.04 mol of an ideal gas expands reversibly from 50.0mL ot 375mL at a constant temperature of $37.0^{\circ}C$.As it does so, it absorbs 208 J of heat. The values of q and w for the process will be (R = 8.314J/molK) (In 7.5 = 2.01)

A.
$$q=\,+\,208J, W=\,-\,208J$$

B. q = -208J, W = -208J

C.
$$q = -208J, W = 208J$$

D.
$$q = -208J, W = +208J$$

Answer: A



10. The standard free energy of formation of NO(g) is 86.6 kJ/ mol at 298 K what is the standard free energy of formation of NO_2g at 298 k? $K_p=1.6 imes10^{12}$

$$\begin{array}{l} \mathsf{A.}\ R(298) \mathrm{ln} \big(1.6 \times 10^{12} \big) - 86600 \\\\ \mathsf{B.}\ 86000 + R(298) \mathrm{ln} \big(1.6 \times 10^{12} \big) \\\\ \mathsf{C.}\ 86600 - \frac{\mathrm{ln} \big(1.6 \times 10^{12} \big) }{R(298)} \\\\ \mathsf{D.}\ 0.5 \big[2 \times 86600 - R(298) \mathrm{ln} \big(1.6 \times 10^{12} \big) \big] \end{array}$$

Answer: D

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11. ΔU is equal to

A. Isothermal work

B. Isochoric work

C. Isobaric work

D. Adiabatic work

Answer: D

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12. The combination of plots which does not represent isothermal expansion of an ideal gas is :











Answer: A

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13. Consider the reversible isothermal expansion of an ideal gas in a closed ststem at two different temeratures T_1 and $T_2(T_1 < T_2)$. The correct graphical depiction of the dependence of work done (w) on the final volume (V) is :



A.



Β.





D.

Answer: D



14. The entropy change associated with the conversion of 1 kg of ice at

273 K to water vapours at 383 K is :

(Specific heat of water liquid and water vapour are $4.2kJK^{-1}kg^{-1}$ and $2.0kJK^{-1}kg^{-1}$, heat of liquid fusion and vapourisation of water are $334kJkg^{-1}$ and $2491kJkg^{-1}$, respectively). ($\log 273 = 2.436, \log 373 = 2.572, \log 383 = 2.583$) A. $9.26kJkg^{-1}K^{-1}$

B. $2.64kJkg^{-1}K^{-1}$

C. 7.90 $kJkg^{-1}K^{-1}$

D. $8.49kJkg^{-1}R^{-1}$

Answer: A



15. An ideal gas undergoes isothermal compression from $5m^3$ to $1m^3$ against a constant external pressure of $4Nm^{-2}$. Heat released in this process is used to increase the temperature of 1 mole of Al. If molar heat capacity of Al is 24 J $mol^{-1}K^{-1}$, the temperature of Al increases by

A. 32K

B. 2K

C. 1K

D.
$$\frac{2}{3}$$
 K

Answer: D



16. The process with negative entropy change is

A. Synthesis of ammonia from N_2 and H_2

B. Dissociation of $CaSO_4$ (s) to CaO(s) and SO_3 (g)

C. Subimation of dry ice

D. Dissolution of iodine in water

Answer: A

17. Two bolcks to the same metal having same mass and at temperature T_1 and T_2 respectively ,are brought in contact with each other and allowed to attain thermal equilibrium at constant pressure .The change in entropy , ΔS for this process is :

$$\begin{split} &\mathsf{A}. \, 2C_p \ln \left[\frac{T_1 + T_2}{2T_1 T_2} \right] \\ &\mathsf{B}. \, 2C_p \ln \left[\frac{T_1 + T_2}{4T_1 T_2} \right] \\ &\mathsf{C}. \, 2C_p \ln \left[\left(\frac{(T_1 + T_2)^{1/2}}{T_1 T_2} \right) \right] \\ &\mathsf{D}. \, C_p \ln \left[\left(\frac{(T_1 + T_2)^2}{4T_1 T_2} \right) \right] \end{split}$$

Answer: D



18. for a diatomic ideal gas in a closed system , which of the following plots does not correctly describe the relation between various thermodynamic quantities ?



Answer: C



19. A process has $\Delta H = 200 \text{ J} mol^{-1}$ and $\Delta S = 40 \text{ JK}^{-1} mol^{-1}$. Out of the values given below, choose the minimum temperature above which the process will be spontaneous :

A. 5K

B. 12 K

C. 4 K

D. 20 K

Answer: A

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20. The standard reaction Gibbs energy for a temperature T is given by

 $\Delta_r G^\circ \,=\, A - Bt$

Where A and B are non-zero constants.

Which of the following is TRUE about this reaction ?

A. Exothermic if B < 0

B. Exothermic if A>0 and B<0

C. Endothermic if A < 0 and B > 0

D. Endothermic if A > 0

Answer: D



21. The reaction,

MgO(s) + C(s) o Mg(s) + CO(g), for which $\Delta_r H^\circ = + 491.1$ kJ mol^{-1} and $\Delta_r S^\circ = 198.0 J K^{-1} mol^{-1}$, is not feasible at 289 K. Temperature above which reaction will be feasible is :

A. 2480.3 K

B. 1890.0 K

C. 2380.5 K

D. 2040.5 K

Answer: A

22. In which case, process will be spontaneous at all temperature?

A. $\Delta H < 0$ and $\Delta S > 0$

B. $\Delta H > 0$ and $\Delta S < 0$

C. $\Delta H < 0$ and $\Delta S < 0$

D. $\Delta H > 0$ and $\Delta S < 0$

Answer: A

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23. Among the following, the set of parameters that represents path

functions is

(A) q + w (B) q (C) w (D) H - TS

A. II, III AND IV

B. I,II AND III

C. II AND III

D. I AND IV

Answer: C



24. Maltose on treatment with dilute HCl gives:

A. D-galactose

B. D-Fructose

C. D-glucose and D-Fructose

D. D-glucose

Answer: D



25. For silver, $C_P(JK^{-1}\text{mol}^{-1}) = 23 + 0.01T$. If the temperature (T) of 3 moles of silver is raised from 300K to 1000K at 1 atm pressure, the value of ΔH will be close to :

A. 21 kJ

B. 13 kJ

C. 16 kJ

D. 62 kJ

Answer: D

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26. Which of the following is not correct for an ideal gas as per first low of

thermodynamics

A. Cyclic process : q=-w

B. Adiabacit process: $\Delta U=~-w$

C. Isochoric process: $\Delta U = q$

D. Isothermal process: $q=\ -w$

Answer: B

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27. During compression of a spring the work done is 10 kJ and 2 kJ escaped to the surroundings as heat. The change in internal energy ΔU (in kj) is

A. 8

 $\mathsf{B.}-12$

C. 12

D.-8

Answer: A

28. 5 moles of an ideal gas at 100 K are allowed to undergo reversible compression till its temperature becomes 200 K. If ΔU is 14 kJ, what is Delta PV f or this process (R = 8.0J K ^(-1) mol^(-1)) `

A.
$$\Delta U = 14kJ, \Delta(pV) = 4kJ$$

B.
$$\Delta U = 14J, \Delta(pV) = 0.8J$$

C.
$$\Delta U = 14kJ, \Delta(pV) = 18kJ$$

D.
$$\Delta U = 28 k J, \Delta (pv) = 0.8 k J$$

Answer: A

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29. At constant volume 4 mol of an ideal gas when heated form 300k to 500k changes its internal energy by 500 J . The molar heat capacity at constant volume is _____.

30. The true statement amongst the following is :

- A.S is a function of temperature but ΔS is not a function of temperature
- B.S is not a function of temperature but ΔS is a function of

temperature

C. Both S and ΔS are not functions of temperature

D. Both ΔS and S are functions of temperature

Answer: d

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31. The magnitude of work done by a gas that undergoes a reversible expansion alog the path ABC shown in the figure is _____.





32. $A_{(\mathrm{l})}
ightarrow 2B_{(\mathrm{g})}$

 $\Delta U=2.~1~{
m kcal}$, $\Delta S=20~{
m Cal/k}$, T = 300 K.

Find ΔG (in kcal)

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JEE ADVANCED (ARCHIVE)

1. First law of thermodynamics is not adequare in predicting the direction

of the process.



5. A system is.....if it cannot exchange matter and energy with the

surroundings.





9. The heat absorbed during the isothermal expansion of an ideal gas against vacuum is zero.

The volume occupied by the molecules of an ideal gas is zero.

A. Statement-I is True, Statement-II is True and Statement-II is a correct

explanation for Statement-I

B. Statement-I is True, Statement-II is True and Statement-II is NOT a

correct explanation for Statement-I

C. Statement-I is True, Statement-II is False

D. Statement-I is False, Statement-II is True

Answer: b

10. Show that the reaction $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$ at 300 K is spontaneous and exothermic, when the standard entropy change is $-0.094kJmol^{-1}K^{-1}$. The standard Gibbs energies of formation for CO_2 and CO are -394.4 and $-137.2kJmol^{-1}$, respectively.

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11. When 1-pentyne (A) is treated with 4N alcoholic KOH at $175^{\circ}C$, it is converted slowely into an equilibrium mixture of 1.3% 1-pentyne (A), 95.2% 2-pentyne (B),and 3.5% of 1, 2-pentadiene (C). The equilibrium is maintained at $175^{\circ}C$. Calculate ΔG^{Θ} for the following equilibria.

 $B \Leftrightarrow A, \Delta G_1^{\Theta} = ?$

 $B \Leftrightarrow C, \Delta G_2^{\Theta} = ?$

From the calculated values of ΔG_1^{Θ} and ΔG_2^{Θ} , indicate the order of stability of A, B, and C.

12. One mole of a non-ideal gas undergoes a change of state $(2.0atm, 3.0L, 95K) \rightarrow (4.0atm, 5.0L, 245K)$ with a change in internal energy, $\Delta E = 30.0L - atm$. The change in enthalpy (ΔH) of the process in L - atm is

A. 40

B. 42.3

C. 44

D. not defined, because pressure is not constant

Answer: c

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13. Two moles of a perfect gas undergo the following processes:

a. A reversible isobaric expansion from (1.0atm, 20.0L) to (1.0atm, 40.0L).

b. A reversible isochroic change of state from $\left(1.0atm, 40.0L
ight)$ to
(0.5 atm, 40.0L)

c. A reversible isothermal expansion from (0.5atm, 40.0L)
ightarrow (1.0atm, 20.0L).

i. Sketch with lables each of the processes on the same P-V diagram.

ii. Calculate the total work (w) and the total heat change (q) involved in the above process.

iii. What will be the values of ΔH for the overall process?

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14. The molar heat capacity , C_v of helium gas is 3/2R 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 5/2R at high temperatures. Give a reason for the temperature dependence of C_v in case of hydrogen, in not more than two or three sentences.



15. The enthalpy of vaporisation of a liquid is $30kJmol^{-1}$ and entropy of vaporisation is $75Jmol^{-1}K^{-1}$. The boiling point of the liquid at 1atm is

A. 250 K

:

B. 400 K

C. 450 K

D. 600 K

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16. An insulated vessel contains 1mole of a liquid, molar volume 100mL at

1bar. When liquid is steeply passed to 100 bar, volume decreases to 99 mL.

Find ΔH and ΔU for the process.



17. When 1mol of a monoatomic ideal gas at TK undergoes adiabatic change under a constant external pressure of 1atm, changes volume from $1L \rightarrow 2L$. The final temperature (in K) would be

A.
$$rac{T}{2^{2/3}}$$

B. $T+rac{2}{3 imes 0.0821}$
C. T
D. $-rac{2}{3 imes 0.0821}$

Answer: d

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18. A monatomic ideal gas undergoes a process in which the ratio of P to V at any instant is constant and equals 1. What is the molar heat capacity of the gas?

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

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

C. $\frac{5R}{2}$
D. 0

Answer: a

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19. The direct conversion of A to B is difficult hence it is carried out by

the following shown path $\underset{A}{C} \rightarrow \overset{}{\underset{B}{D\downarrow}}_{B}$

Given,

 $\Delta S_{(A
ightarrow C)} = 50 eu$

 $\Delta S_{(\,C
ightarrow D\,)}\,=30 eu$

 $\Delta S_{(B
ightarrow D)} = 20 eu$

where eu is the entropy unit, then $\Delta S_{(A o B)}$ is

A. +60e. u.

 $\mathsf{B.}+100e.\;u.$

C. - 60e. u.

D. -100e. u.

Answer: a

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20. $N_2 + 3H_2 \Leftrightarrow 2NH_3$

Which of the following statements is correct if N_2 added at equilibrium condition?

A. The equilibrium will shift to forward direction because according to

lind law of the thermodynamcis the entropy must increase in the

direction of spontaneous reaction.

B. The condition for equilibrium is $G_{N_2}+3G_{NH_3}=2G_{NH_3}$, where G

is Gibbs free energy per mole of the gaseous species measured at that partial pressure. The condition of equilibrium is unaffected by the ue of catalyst, which increases the rate of both the forward and

backward reactions to the same extant.

C. The catalyst will increase the rate of forward reaction by lpha and that

of backward reaction by β .

D. Catalyst will not alter the rate of either of the reaction.

Answer: b



21. The value of
$$\log_{10} K$$
 for a reaction $A \Leftrightarrow B$ is (Given:
 $\Delta_f H_{298K}^{\Theta} = -54.07 k J mol^{-1}$,
 $\Delta_r S_{298K}^{\Theta} = 10 J K^{=1} mol^{-1}$, and $R = 8.314 J K^{-1} mol^{-1}$
A. 5
B. 10
C. 95

D. 100

Answer: b



22. For the process $H_2O(l)(1\text{bar}, 373K) \to H_2O(g)(1\text{bar}, 373K)$ the correct set of thermodynamic parameters is

A. $\Delta G=0,$ $\Delta S=+ve$

B. $\Delta G=0, \Delta S=-ve$

C.
$$\Delta G=~+~ve,\,\Delta S=0$$
,

D.
$$\Delta G = -ve, \Delta S = +ve$$

Answer: a



23. Assertion (A): For every chemical reaction at equilibrium, standard

Gibbs enegry of the reaction is zero.

Reason (R) : At constant temperature and pressure chemical reactions are spontaneous in the direction of the decreasing Gibbs energy.

A. Statement-I is true, Statement-II is True and Statement-II is a correct

explanation for statement -I

B. Statement -I is true, Statement-II is true and Statement-II is NOT a

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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24. Assertion (A) : There is a natural asymmetry between converting work to heat and converting heat of work.

Reason (R) : No process is possible in which the sole result is the

absorption of heat from a reservoir and its complete conversion into work.

A. Statement-I is True, Statement-II is True and Statement-II is a correct

explanation for Statement-I

B. Statement-I is True, Statement-II is True and Statement-II is NOT a

correct explanation for Statement-I.

C. Statement-I is True, Statement-II is False

D. Statement-I is False, Statement-II is True

Answer: b

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

A. internal energy

B. irreversible expansion work

C. reversible expansion work

D. molar enthalpy

Answer: AD

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26. One mole of an ideal gas is taken from a to b along two paths denoted by the solid and the dashed lines as shown in the graph below. If the work done along the solid line path is W_s and that along the the dotted line path is w_d , then the integer closest to the ratio w_d/w_s is



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27. To an evacuated vessel with movable piston under external pressure of 1 atm and 0.1mole of He and 1 mole of an unknown compound (vapour pressure 0.68 atm at 0° C) are introduced. Considering the ideal behaviour, the volume (in litre) of the gases at 0° C is close to:

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28. Match the transformation in Column I with appropriate option in

Column II.

	Column I		Column II
(A)	$\operatorname{CO}_2(\mathfrak{g}) \to \operatorname{CO}_2(\mathfrak{g})$	(p)	Phase transition
(B)	$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$	(q)	Allotropic change
(C)	$2 \text{H} \rightarrow \text{H}_2$ (g)	(r)	$\Delta {\rm H}_{-}$ is positive
(D)	$P_{\text{(rhite, solid)}} \rightarrow P_{\text{(red, solid)}}$	(s)	∆∋ is positíve
		(t)	∆s is negative



29. Match the thermodynamic processes given under column I with the

expressions given under column II.

Column I		Column II	
А.	Freezing of water at 273 K and 1 atm	p.	q = 0
В.	Expansion of 1 mole of an ideal gas into a vacuum under isolated conditions	q.	W = 0
C.	Mixing of equal volumes of two ideal gases at constant temperature and pressure in an isolated container	r.	$\Delta S_{\rm sys} < 0$
D.	Reversible heating of $H_2(g)$ at 1 atm from 300 K to 600 K, followed by reversible cooling to 300 K at 1 atm	S.	$\Delta U = 0$
		+	$\Delta G = 0$

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30. For an ideal gas, consider only P-V work in going from an initial state X to the final state Z. The final state Z can be reached by either of the two paths shown in the figure. Which of the following choice(s) is(are)

correct? [Take ΔS as change in entropy and w as work done]



A.
$$\Delta S_{X o Z} = \Delta S_{X o Y} + \Delta S_{Y o Z}$$

B. $W_{X o Y} = W_{X o Y} + W_{Y o Z}$

$$\mathsf{C}.\, W_{X\, \rightarrow \, Y\, \rightarrow \, Z} = W_{X\, \rightarrow \, Y}$$

D.
$$\Delta S_{X o Y o Z} = \Delta S_{X o Y}$$

Answer: ac

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31. The reversible expansion of an ideal gas under adiabatic and isothermal conditions is shown in the figure. Which of the following statement(s) is (are) correct?



A. $T_1 = T_2$

- B. $T_3 > T_1$
- C. $W_{
 m isothermal} > W_{
 m adiabatic}$
- D. $\Delta U_{
 m isothermal} > \Delta U_{
 m adiabatic}$

Answer: acd



32. A fixed mass 'm' of a gas is subjected to transformation of states from K to L to M to N and back to K as shown in the figure.



The succeeding operations that enable this transformation of states are:

A. heating, cooling, heating, cooling

B. cooling, heating, cooling, heating

C. heating, cooling, cooling, heating

D. cooling, heating, heating, cooling

Answer: c



33. The pair of isochoric among the transformation of state is :



A. K to L and L to M

B. L to M and N to K

C. L to M and M to N

D. M to N and N to K

Answer: b

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34. An ideal gas in a thermally insulated vessel at internal pressure $= P_1$, 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. $P_2V_2^Y=P_1V_1^Y$

Answer: abc

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35. For the process,
$$H_2O(l)
ightarrow H_2O(g)$$

A.
$$\Delta S_{
m system} > 0$$
 and $\Delta S_{
m surrouding} > 0$

- B. $\Delta S_{
 m system} > 0$ and $\Delta S_{
 m surrounding} < 0$
- C. $\Delta S_{
 m system} < 0$ and $\Delta S_{
 m surrounding} > 0$
- D. $\Delta S_{
 m system} < 0$ and $\Delta S_{
 m surrounding} > 0$

Answer: b

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36. Thermal decomposition of gaseous X_2 to gaseous X at 298K takes place according to the following equation:

 $X(g) \Leftrightarrow 2X(g)$

The standard reaction Gibbs energy $\Delta_r G^{\circ}$, of this reaction is positive. At the start of the reaction, there is one mole of X_2 and no X. As the reaction proceeds, the number of moles of X formed is given by β . Thus $\beta_{\text{equilibrium}}$ is the number of moles of X formed at equilibrium. The reaction is carried out at a constant total pressure of 2 bar. Consider the gases to behave ideally.

[Given, R = 0.083L bar $K^{-1}mol^{-1}$)

The equilibrium constant K_p for this reaction at 298K, in terms of $\beta_{\rm equilibrium}$ is

A.
$$\frac{8(\beta^2)_{\text{equilibrium}}}{2 - \beta_{\text{equilibrium}}}$$
B.
$$\frac{8(\beta^2)_{\text{equilibrium}}}{4 - \beta_{\text{equilibrium}}^2}$$
C.
$$\frac{4(\beta^2)_{equilibrium}}{2 - \beta_{\text{equilibrium}}}$$

D.
$$rac{4(eta^2)_{
m equilibrium}}{4-eta^2_{-}}$$
 (equilibrium)

Answer: b



37. Thermal decomposition of gaseous X_2 to gaseous X at 298 K takes place according to the following equations.

 $X_2(g) + 2X(g)$

The standard reaction Gibbs energy, $\Delta_r G^\circ$, of this reaction is positive. At the start of the reaction, there is one mole of X_2 and no X. As the reaction procees, the number of moles of X formed is given by β . Thus, $\beta_{\text{equlibrium}}$ is the number of moles of X formed at equilibrium. The reaction is carried out at a constant total pressure of 2 bar. Consider the gases to behave ideally. (Given: R=0.083 L bar $K^{-1}mol^{-1}$).

The equilibrium constant K_p for this reaction at 298 K, in terms of $eta_{
m equilibrium}$, is

A. Decrease in the total pressure will result in formation of more

moles of gaseous X

B. At the start of the reaction, dissociation of gaseous X_2 takes place

spontaneously

C. $\beta_{\text{equilibrium}} = 0.7$

D. $K_c = 1$

Answer: a

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38. The standard state Gibbs free energies of formation of) C(graphite and C(diamond) at T = 298 K are $\Delta_f G^{\circ} [\text{C}(\text{graphite})] = 0 k J mol^{-1}$ $\Delta_f G^{\circ} [\text{C}(\text{diamond})] = 2.9 k J mol^{-1}$ The standard state means that the pressure should be 1 bar, and

substance should be pure at a given temperature. The conversion of graphite [) C(graphite] to diamond [C(diamond)] reduces its volume by

 $2 \times 10^{-6} m^3 mol^{-1}$. If) C(graphite is converted to C(diamond) isothermally at T = 298 K, the pressure at which) C(graphite is in equilibrium with C(diamond), is

 $ig[ext{Useful information:} 1J = 1kgm^2s^{-2}, 1Pa = 1kgm^{-1}s^{-2}, 1 ext{bar} = 10^5Pa ig]$

A. 14501 bar

B. 29001 bar

C. 1450 bar

D. 58001 bar

Answer: a

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39. For a reaction taking place in a container in equilibrium with its surroundings, the effect of temperature on its equilibrium constant Kin terms of change in entropy is described by

- A. With increase in temperature, the value of K for exothermic reaction decreases because the entropy change of the system is positive
- B. With increase in temperature, the value of K for endothermic reaction increases because unfavourable change in entropy of the surroundings decreases
- C. With increase in temperature, the value of K for endothermic reaction increases because the entropy change of the system is negative
- D. With increase in temperature, the value of K for exothermic reaction decreases because favourable change in entropy of the surroundings decreases

Answer: bd

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- **40.** A thermo-dynamical system is changed from state (P_1, V_1) to (P_2, V_2) by two different process. The quantity which will remain same will be
 - A. The work done on the gas is maximum when it is compressed irreversibly from (p_2, V_2) to (p_1, V_1) against constant pressure p_1 . B. The change in internal energy of the gas is (i) zero, if it explained reversibly with $T_1 = T_2$, and (ii) positive, if it is expanded reversibly under adiabatic conditions with $T_1 \neq T_2$.
 - C. If the expansion is carried out freely, it is simultaneously both isothermal as well as adiabatic
 - D. The work done by the gas is less when it is expanded reversibly from V_1 to V_2 under adiabatic conditions as compared to that when expanded reversibly from V_1 to V_2 under isothermal conditions.

Answer: acd

41. Which of the following lines correctly show the temperature dependence of equilibrium constant, K, for an exothermic reaction ?



A. C and D

B. A and D

C. A and B

D. B and C

Answer: c

42. An ideal gas undergoes a cyclic process as shown in figure .



A. $-5kJmol^{-1}$

- B. $5kJmol^{-1}$
- C. $18kJmol^{-1}$
- $\mathsf{D.}-18 kJmol^{-1}$

Answer: b

43. A reversible cyclic process for an ideal gas is shown below. Here, P, V, and T are pressure, volume and temperature, respectively. The thermodynamic parameters q, w, H and U are heat, work, enthalpy and internal energy, respectively.



The correct option (s) is (are)

A. $q_{AC}=\Delta U_{BC}$

B.
$$W_{BC}=P_2(V_2-V_1)$$
 and $q_{BC}=\Delta H_{AC}$

C. $\Delta H_{CA} < \Delta U_{CA}$ and $q_{AC} = \Delta U_{BC}$

D.
$$q_{BC} = \Delta U_{AC}$$
 and $\Delta H_{CA} > \Delta U_{CA}$

Answer: bc



44. For a reaction $A \rightarrow P$, the plots of [A] and [P] with time at temperatures T_1 and T_2 are given below.



If $T_1 > T_2$, the correct statements is (are):

(Assume ΔH^{Θ} and ΔS^{Θ} are independent of temperature and ratio of ln K at T_1 to ln K at T_2 is greater than $\frac{T_2}{T_1}$. Here H,S,G and K are enthalpy, entropy, Gibbs energy and equilibrium constant, respectively).

$$egin{aligned} \mathsf{A}.\,\Delta H^{\,\Theta} &< 0,\,\Delta S^{\,\Theta} &< 0 \end{aligned} \ egin{aligned} \mathsf{B}.\,\Delta G^{\,\Theta} &< 0,\,\Delta H^{\,\Theta} &> 0 \end{aligned} \ egin{aligned} \mathsf{C}.\,\Delta G^{\,\Theta} &< 0,\,\Delta S^{\,\Theta} &< 0 \end{aligned} \ egin{aligned} \mathsf{D}.\,\Delta G^{\,\Theta} &< 0,\,\Delta S^{\,\Theta} &> 0 \end{aligned}$$

Answer: ac

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Fundamental

- 1. Temperature and heat are not :-
 - A. Extensive properties
 - **B.** Intensive properties
 - C. Intensive and extensive properties respectively
 - D. Extensive and intensive properties respectively

Answer: D Watch Video Solution 2. Both q & w are _____ function & q + w is a _____ function :-A. State, Path B. State, State C. Path, State D. Path, Path Answer: C **Watch Video Solution**

3. q= -w is not true for :-

A. Isothermal process

B. Adiabatic process

C. Cyclic process

D. Options (1) and (3)

Answer: B

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4. Two moles of an ideal gas expand spontaneouly into vacuum. The work

done is :-

A. Zero

B. 2J

C. 4J

D. 8J

Answer: A

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5. For the reversible isothermal expansion of one mole of an ideal gas at 300 K, from a volume of $10 dm^3$ to $20 dm^3$, ΔH is -

A. 1.73kJ

 $\mathrm{B.}-1.73kJ$

C. 3.46kJ

D. Zero

Answer: D

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6. An adiabatic reversible process is one in which?

A. Temperature of the system is not change

B. The system is not closed to heat transfer

C. There is no change in entropy

D. There is no net work done

Answer: C



7. A well stoppered thermoflask contains some ice cubes. This is an example of a-

A. Closed system

B. Open system

C. Non-thermodynamic system

D. Isolated system

Answer: C

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8. The work done by a system is 8 Joule, when 40 joule heat is supplied to

it .What is the increase in internal energy of the system?

A. 32 J

B. 40 J

C. 48 J

D. - 32J

Answer: A

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9. For a gaseous reaction, $A(g) + 3B(g) \rightarrow 3C(g) + 3D(g), \Delta U$ is 17 kcal at $27^{\circ}C$. Assuming $R = 2cal \quad K^{-1}mol^{-1}$, the value of ΔH for the above reaction is:

A. 15.8kcal

B. 18.2 kcal

C. 20.0 kcal

D. 16.4 kcal

Answer: B

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10. Difference between the heats of reaction at constant pressure and a

constant volume for the reaction $2C_6H_6(l)+15O_2(g) o 12CO_2(g)+6H_2O(l)$ at $25^\circ C$ in kJ is

A. + 7.43

B. + 3.72

C. - 7.43

D. - 3.72

Answer: C

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11. The enthalpy of vaporisation of water at $100^{\circ}C$ is $40.63KJmol^{-1}$. The value ΔE for the process would be :-

```
A. 37.53 kJ mol<sup>-1</sup>
B. 39.08 kJ mol<sup>-1</sup>
C. 42.19 kJ mol<sup>-1</sup>
```

```
D. 43.73 kJ mol ^{-1}
```

Answer: A

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12. For $CaCO_3(s)
ightarrow CaO(s) + CO_2(g)$ at $977^\circ C, \Delta H = 174$ KJ/mol ,

then ΔE is :-

A. 163 kJ

B. 163.6 Kj
C. 186.4 kJ

D. 180 kJ

Answer: B

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

- A. riangle H = riangle E
- $\mathsf{B.}\ \bigtriangleup\ H > \ \bigtriangleup\ E$
- $\mathsf{C.}\ \bigtriangleup\ H=\ \bigtriangleup\ E=0$
- D. riangle H < riangle E

Answer: D

14. Which statement is true for reversible processes?

A. It takes place in a single step

B. Driving force is much greater than opposing force

C. Work obtained is maximum

D. There is no work done in such processes

Answer: C

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

A. Zero

B. Infinity

C. $40.50 k J K^{-1} \text{ mol}^{-1}$

D. 75.48 JK^{-1} mol⁻¹

Answer: B



16. Change in entropy is negative for

A. Br(l) o Br(g)

B. $C(s)+H_2O(g)
ightarrow CO(g)+H_2(g)$

 $\mathsf{C}.\, N_2(g,10atm) \rightarrow N_2, (g,1atm)$

 $\mathsf{D}.\,Fe(~~\mathrm{at}~400~\mathrm{K})\rightarrow Fe(~~\mathrm{at}~300~\mathrm{K})$

Answer: D



17. When the egg is hard boiled, there is

A. Increase in disorder

- B. Decrease in disorder
- C. No change in disorder
- D. riangle G is negative

Answer: A

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18. 5 mol of an ideal gas expand reversibly from a volume of $8dm^3$ to $80dm^3$ at an temperature of $27^{\circ}C$. Calculate the change in entropy.

A. $-95.73 JK^{-1}$

B. $95.93 JK^{-1}$

 $C. - 41.57 JK^{-1}$

D. $41.57 JK^{-1}$

Answer: C

19. For the reaction $Ag_2O(s) \rightarrow 2Ag(s) + 1/2O_2(g)$ the value of $\Delta H = 30.56 K J mol^{-1}$ and $\Delta S = 66 J K^{-1} mol^{-1}$. The temperature at which the free energy change for the reaction will be zero is :-

A. 373k

B. 413k

C. 463k

D. 493k

Answer: C

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20. If $\Delta G^\circ > 0$ for a reaction then :

A. $K_p > 1$

B. $K_p < 1$

C. Products dominate in the equilibrium mixture

D. $K_p=2$

Answer: B

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21. For a reaction at $25\,^\circ C$ enthalpy change (ΔH) and entropy change

 (ΔS) are $-11.7 K J mol^{-1}$ and $-105 J mol^{-1} K^{-1}$, respectively. Find out

whether this reaction is spontaneous or not?

A. Spontaneous

B. Non spontaneous

C. At equilibrium

D. Unpredictable

Answer: B

22. Calculate the enthalpy of vaporisation per mole for ethanol. Given, $\Delta S = 109.8 J K^{-1} mol^{-1}$ and boiling point of ethanol is $78.5^{\circ}C$.

- A. $riangle H_{vap} = (riangle S_{vap})(T)$
- B. $38.594 k Jmol^{-1}$
- C. $3.85 k Jmol^{-1}$
- D. Insufficient data

Answer: B

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23. The equilibrium constant for a reaction is 10. What will be the value of

 ΔG° ? $R = 8.314 J K^{-1} mol^{-1}, T = 300 K.$

 $A. + 5.527 \text{ kJ mol}^{-1}$

B. -5.527 kJ mol⁻¹

 $C. + 55.27 \text{ kJ mol}^{-1}$

 $D. - 55.27 \text{ kJ mol}^{-1}$

Answer: B

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24. If S° for H_2, Cl_2 and HCl are 0.13, 0.22 and 0.19 KJ $K^{-1}mol^{-1}$ respectively. The total change in standard entropy for the reaction $H_2 + Cl_2 \rightarrow 2HCl$ is :-

A. $30JK^{-1}mol^{-1}$

B. $40JK^{-1}mol^{-1}$

C. $60JK^{-1}mol^{-1}$

D. $20JK^{-1}mol^{-1}$

Answer: A

25. For the process $CO_{2(s)} \rightarrow CO_{2(g)}$

A. Both riangle H and riangle S are positive

B. riangle H is negative and riangle S is positive

C. riangle H is +ve and riangle S is negative

D. Both riangle H and riangle S are negative

Answer: A

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26. Evaporation of water is

A. A process in which neither heat is evolved nor ab sorbed

B. A process accompained by chemical reaction

C. An exothermic change

D. An endothermic change

Answer: D



- **27.** The formation of water from $H_2(g)$ and $O_2(g)$ is an exothermic process because :
 - A. The chemical energy of $H_2(g)$ and $O_2(g)$ is mere than that of water
 - B. The chemical ener gy of $H_2(g)$ and $O_2(g)$ is less than that of water
 - C. The temperature of $H_2(g)$ and $O_2(g)$ is higher than that of water
 - D. The temperature of $H_2(g)$ and $O_2(g)$ is lower than that of water

Answer: A

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28. In which of the following cases entropy decreases?

A. Solid changing to liquid

B. Expansion of a gas

C. polymerisation

D. All of these

Answer: C

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29. If $C_6H_{12}O_6(s) + 9O_2(g) \rightarrow 6CO_2(g) + 6H_2O(g), \Delta H = -680$ Kcal The weight of $CO_2(g)$ produced when 170 Kcal of heat is evolved in the combustion of glucose is :-

A. 265 gm

B. 66 gm

C. 11 gm

D. 64 gm

Answer: B

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30. Heat of combustion of CH_4 , C_2H_6 , C_2H_4 and C_2H_2 gases are -212.8, -212.8, -373.0, -337.0 and -310.5 Kcal respectively at the same temperature. The best fuel among these gases is :

A. CH_4

 $\mathsf{B.}\, C_2 H_6$

 $\mathsf{C.}\, C_2 H_4$

D. C_2H_2

Answer: A

31. Which of the following values of heat of formation does indicate that

the product is least stable ?

- 94 kcal

- 231.5 kcal

+64.8 kcal.

+21.4 kcal

A. -94 Kcal

B.-231.5 Kcal

C. + 21.4 Kcal

D. + 64.8 Kcal

Answer: D

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32. The standard molar heat of formation of ethane, CO_2 and water are

respectively -21.1, -94.1 and -68.3kcal. The standard molar heat of

combustion of ethane will be:

A. 372 Kcal

B.162 Kcal

C. - 240 Kcal

D. 183.5 Kcal

Answer: A

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33. Given that standard heat enthalpy of CH_4, C_2H_4 and C_3H_8 are -17.9,

12.5, -24.8 Kcal/mol. The ΔH for $CH_4+C_2H
ightarrow C_3H_8$ is :

A. - 55.2 Kcal

B. - 30.2 Kcal

C. 55.2 Kcal

D. - 19.4 Kcal

Answer: D

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34. If enthalpies of formation of $C_2H_4(g)$, $CO_2(g)$ and $H_2O(l)$ at $25^\circ C$ and 1 atm pressure are 52, -394 and -286 KJ/mol , the enthalpy of combustion of ethane is equal to

A. $+1412 \text{ kJ mole}^{-1}$

 $B. - 1412 kJ mole^{-1}$

 $C. + 142.2 \text{ kJ mole}^{-1}$

 $D. - 141.2 \text{ kJ mole}^{-1}$

Answer: B

35. In the reaction : $S+3/2O_2 o SO_3+2 {
m x}$ kcal and $SO_2+1/2O_2 o SO_3+y$ kcal, heat of formation of SO_2 is

A. (2x+y)

 $\mathsf{B.}-(2x-y)$

C. x+y

D. 2x/y

Answer: B

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36. Given that:

$$2C(s) + O_2(g) o 2CO_2(g)$$
 $(\Delta H = -787kJ) \dots$ (i)
 $H_2(g) + 1/2O_2(g) o H_2O(l)$ $(\Delta H = -286kJ) \dots$ (ii)
 $C_2H_2 + 2\frac{1}{2}O_2(g) o 2CO_2(g) + H_2O(l)$ $(\Delta H = -1310kJ) \dots$ (iii)
The heat of formation of acetylene is:

A. + 1802kJ

 $\mathrm{B.}-1802 kJ$

C. - 800 kJ

 $\mathsf{D.}+237kJ$

Answer: D

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37. Form the thermochemical reactions.

 ${\sf C}({\sf graphite}) + 1/2O_2(g) \to CO(g), \ \bigtriangleup \ H = \ - \ 110.5 kJ$

 $CO(g)+1/2O_2(g)
ightarrow CO_2(g),\ riangle H=\ -\ 283.2kJ$

The enthalpy ofreaction of C(graphite) $+O_2(g) o CO_2~~{
m is}$

A. 393.3kJ

 $\mathrm{B.}-393.7kJ$

 ${\rm C.}-172.7kJ$

D. + 172.7kJ

Answer: B



38. Find the heat change in the reaction:

$$NH_3(g) + HCI(g) o NH_4CI(s)$$

from the following data

 $egin{aligned} NH_3(g)+aq &
ightarrow NH_3(aq) igtarrow H=\ -8.4 KCal \ HCl(g)+aq &
ightarrow HCl(aq) igtarrow H=\ -17.3 KCal \ NH_3(aq)+HCl(aq) &
ightarrow NH_4Cl(aq) igtarrow H=\ -12.5 KCal \ NH_4Cl(s)+aq &
ightarrow NH_4Cl(aq) igtarrow H=\ +3.9 Kcal \end{aligned}$

A. - 42.1

 $\mathsf{B.}-34.3$

 $\mathsf{C.}+34.3$

D.42.1

Answer: A



39. The heat of combustion of ethanol determinal in a bomb calorimeter

is -670.48 K. Cals ${
m mole}^{-1}$ at $25\,^\circ C$. What is ΔH at $25\,^\circ C$ for the reaction :-

A. - 335.24 Kcal

B.-671.08 Kcal

C. - 670.48 Kcal

D. +670.48 Kcal

Answer: B

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40. Heat of formation of CO_2 is -94.0 K. cal. What would be the quantity

of heat liberated, when 3 g of graphite is burnt in excess of oxygen :-

A. 23.5Kcal

B. 2.35 Kcal

C.94.0 Kcal

D. 31.3 Kcal

Answer: A

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41. On complete combustion of 2 gm methane 26575 cals heat is generated. The heat of formation of methane will be (given heat of formation of CO_2 and H_2O are - 97000 and - 68000 cais respectively) :

 $\mathsf{A.}+20400 cal$

 $\mathsf{B.}+20600 cal$

 ${\rm C.}-20400 cal$

 $\mathsf{D.}-2000 cal$

Answer: C



42. The heat of solution of anhydrous $CuSO_4$ and $CuSO_4.5H_2O$ are -15.89 and 2.80 Kcal mol^{-1} respectively. What will be the heat of hydration of anhydrous $CuSO_4$?

A. -18.69 Kcal

B.18.69 Kcal

C. - 28.96 Kcal

D. 28.96 Kcal

Answer: A

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43. Xg of ethanal was subjected to combustion in a bomb calorimeter and the heat produced is YJ. Then A. $\triangle E_{(ext{combustion})} = -XJ$

B.
$$\triangle E_{(\text{combustion})} = -YJ$$

C.
$$\triangle E_{(\text{combustion})} = \frac{44Y}{X} \text{J mol}^{-1}$$

D.
$$riangle E_{(ext{ combustion})} = rac{44Y}{X} ext{J} ext{ mol}^{-1}$$

Answer: D



44. The heats of combustion of yellow P and red P are -9.91kJ and -8.78kJ respectively. The heat of transition of yellow to red phosphorus is

 $\mathsf{A.}-18.69 kJ$

 $\mathsf{B.}+1.313kJ$

 ${\rm C.}+18.69 kJ$

 $\mathsf{D}.-1.13kJ$

Answer: D



45. The heats of combustion of C_2H_4 , C_2H_6 and H_2 gases are -1409.5 KJ, -1558.3 KJ and -285.6 KJ respectively. The heat of hydrogenation of ethene is

 $\mathsf{A.}-136.8kJ$

 $\mathsf{B.}-13.67kJ$

 $\mathsf{C.}\,273.6kJ$

 $D.\,1.368kJ$

Answer: A

46. Equal volumes of 1MHCI and $1MH_2SO_4$ are neutralised by 1MNaOH solution and x and ykJ/ equivalent of heat are liberated, respectively. Which of the following relations is correct?

A. x=y

B. x=0.5y

C. x=0.4y

D. x=2.5y

Answer: B

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47. The enthalpy changes at 298K in successive breaking of O-H bonds

of water are

 $H_2O(g)
ightarrow H(g) + OH(g), \Delta H = 498 kJ \;\; \mathrm{mol}^{-1}$

 $OH(g)
ightarrow H(g) + O(g), \Delta H = 428 kJ \;\; \mathrm{mol}^{-1}$

The bond enthalpy of O - H bond is:

A. 498 kJ mol $^{-1}$

B. 428 kJ mol $^{-1}$

C. 70 kJ mol $^{-1}$

D. 463 kJ mol $^{-1}$

Answer: D

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48. The standard heat of formation of carbon disulphide (I) given that standard heat of combustion of carbon (s), sulphur (s) and carbon disulphide (I) are -393.3, -293.72 and $-1108.76 K Jmol^{-1}$ respectively is

A. -128.02 kJ mol⁻¹

 $B. + 12.802 \text{ kJ mol}^{-1}$

 $C. + 128.02 \text{ kJ mol}^{-1}$

 $D. - 12.802 \text{ kJ mol}^{-1}$

Answer: C



49. If water is formed from H^+ ions and OH^- the heat of formation of water is :

A. 13.7Kcal

B. 13.7 Kcal

 $\mathsf{C.}-63.4 K cal$

D. More data required

Answer: A



50. The bond energies of F_2, Cl_2, Br_2 and I_2 are 155.4, 243.6, 193.2 and

 $151.2 K jmol^{-1}$ respectively. The strongest bond is :

A. F-F

B. Cl-Cl

C. Br-Br

D. I-I

Answer: B

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Enable

1. Consider the following reactions :

(a)
$$H_{(aq)}^{+} + OH_{(aq)}^{-} = H_2O_{(l)}, \Delta H = -X_1 \text{kJ mol}^{-1}$$

(b) $H_{2(g)} + \frac{1}{2}O_{2(g)} = H_2O_{(l)}, \Delta H = -X_2 \text{kJ mol}^{-1}$
(c) $CO_{2(g)} + H_{2(g)} = CO_{(g)} + H_2O_{(l)} - X_3 \text{kJ mol}^{-1}$
(d) $C_2H_{2(g)} + \frac{5}{2}O_{2(g)} = 2CO_{2(g)} + H_2O_{(l)} + X_4 \text{kJ mol}^{-1}$
Enthalpy of formation of $H_2O_{(l)}$ is :

A. $+X_3kJmol^{-1}$

- $B. X_{-4}kJmol^{-1}$
- $C. + X_1 k Jmol^{-1}$
- D. $-X_2kJmol^{-1}$

Answer: D

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2. Given that bond energies of H–H and Cl–Cl are 430 kJ mol^{-1} and 240 kJ mol^{-1} respectively and $\Delta_f H$ for HCl is -90 kJ mol^{-1} . Bond enthalpy of HCl is :

A. 380 kJ mol^{-1}

B. 425 kJ mol^{-1}

C. 245 kJ mol $^{-1}$

D. 290 kJ mol $^{-1}$

Answer: B



3. Identify the correct statement for change of Gibbs free energy for a system $(\Delta G_{
m system})$ at constant temperature and pressure.

A. If $ig(riangleq G_{
m system}ig) < 0$, the process is not spontaneous

B. If $ig(riangleq G_{
m system}ig) > 0$, the process is spontaneous

C. If $ig(riangle G_{
m system}ig) = 0$, the system has attained equillibrium

D. If $(riangle G_{
m system}) = 0$ the system is still moving in a particular

direction

Answer: C

4. The enthalpy and entropy change for the reaction,

 $Br_2(l)+Cl_2(g)
ightarrow 2BrCl(g)$

are $30KJmol^{-1}$ and $105JK^{-1}mol^{-1}$ respectively. The temperature at which the reaction will be in equilibrium is:

A. 300K

B. 285.7K

C. 273K

D. 450K

Answer: B

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5. Which of the following pairs of a chemical reaction is certain to result

in a spontaneous reaction ?

A. exothermic and increasing disorder

B. exothermic and decreasing disorder

C. endothermic and increasing disorder

D. endothermic and decreasing disorder

Answer: A

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6. A reaction occurs spontaneouly if

$${\sf A}. \, T \, \bigtriangleup \, S \, < \, \bigtriangleup \, H \ \, {\rm are \ both} \ \ \bigtriangleup \, H \ \, {\rm and} \ \ \bigtriangleup \, S \ \, {\rm are \ +ve}$$

 $\mathsf{B}.\,T\,\bigtriangleup\,S>\,\bigtriangleup\,H\ \, \text{is +Ve and }\ \, \bigtriangleup\,S\text{ is -ve}$

 $\mathsf{C}.\,T\,\bigtriangleup\,S\,>\,\bigtriangleup\,H\,\text{ and }\,\perp\,h\,\bigtriangleup\,H\,\text{ and }\,\bigtriangleup\,S\,\text{are +ve}$

 $\mathsf{D}.\,T\,\bigtriangleup\,S=\ \bigtriangleup\,H\,\text{ and }\quad\text{both }\ \bigtriangleup\,H\,\text{ and }\ \bigtriangleup\,S\,\text{are +ve}$

Answer: C

7. Standard enthalpy and standard entropy changes for the oxidation of ammonia at 298 K are $-582.64kJmol^{-1}$ and $-150.6Jmol^{-1}k^{-1}$, respectively. Standard Gibb's energy change for the same reaction at 298 K is

```
A. -221.1kJ mol^{-1}
```

 $B. - 339.3 kJ mol^{-1}$

 $C. - 439.3 kJ mol^{-1}$

D. -523.2kJ mol⁻¹

Answer: B

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8. Considering entropy (S) as a thermodynamic parameter, the criterion

for the spontaneity of any process is

A. $S_{
m system}+\ igtriangleq S_{
m surroundings}>0$

B. $S_{
m system} - \ igtriangleq S_{
m surroundings} > 0$

- C. $S_{
 m system} > 0$ only
- D. $S_{
 m surroundings} > 0$ only

Answer: A

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9. For which one of the following equations ΔH_r° equal to ΔH_f° for the product ?

$$egin{aligned} &\mathsf{A}.\, N_2(g) + O_3(g) o N_2 O_3(g) \ &\mathsf{B}.\, CH_4(g) + 2Cl_2(g) o CH_2 Cl_2(l) + 2HCl(g) \ &\mathsf{C}.\, Xe(g) + 2F_2(g) o XeF_4(g) \ &\mathsf{D}.\, 2CO_g + O_2(g) o 2CO_2(g) \end{aligned}$$

Answer: C

10. In an irreversible process taking place at constant T and P and in which only pressure-volume work is being done, the change in Gibbs free energy (dG) and the change in entropy (dS) satisfy the criteria

$$egin{aligned} \mathsf{A}.\,(\ \bigtriangleup\ S)_{VE} &= 0,\,(\ \bigtriangleup\ G)_{T,P} = 0 \ && \mathsf{B}.\,(\ \bigtriangleup\ S)_{V,E} = 0,\,(\ \bigtriangleup\ G)_{T,P} > 0 \ && \mathsf{C}.\,(\ \bigtriangleup\ S)_{V,E} < 0,\,(\ \bigtriangleup\ G)_{T,P} < 0 \ && \mathsf{D}.\,(\ \bigtriangleup\ S)_{V,E} > 0,\,(\ \bigtriangleup\ G)_{T,P} < 0 \end{aligned}$$

Answer: D

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11. The internal energy change when a system goes fromk state A to B is $40kJmol^{-1}$. If the system goes from A to B by a reversible path and returns to state A by an irreversible path, what would be the net change in internal energy?

A. <40kJ

B. Zero

 $\mathsf{C.}\,40kJ$

D. > 40 kJ

Answer: B

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12. If a 298K the bond energies of C - H, C - C, C = C and H - Hbonds are respectivly 414, 347, $615KJmol^{-1}$, the value of enthalpy change for the reaction

$$H_2C=CH_2(g)+H_2(g)+H_2(g)
ightarrow H_3C-CH_3(g)$$
 at $298K$ will be

 $\mathsf{A.}+124kJ$

 $\mathrm{B.}-125kJ$

 ${\rm C.}+250kJ$

 $\mathsf{D}.-250kJ$

Answer: B



13. In a closed insulated container a liquid is stirred with a paddle to increase the temperature , which of the following is true ?

A.
$$riangle E = W
eq 0, q = 0$$

B.
$$riangle E = W = 0, q \neq 0$$

C.
$$riangle E=0, W=q
eq 0$$

D.
$$W=0, \ riangle E=q
eq 0$$

Answer: A



14. When 1 mole gas is heated at constant volume, temperature is raised

from 298 to 308 K. Heat supplied to the gas in 500 J. Then, which
statement is correct ?

A.
$$q = w = 500J, \ \bigtriangleup U = 0$$

B. $q = \ \bigtriangleup U = 500J, \ w = 0$
C. $q = w = 500J, \ \bigtriangleup U = 0$
D. $\bigtriangleup U = 0, \ q = w = 500J$

Answer: B

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15. A gas occupies 2 litre at STP. It is provided 300 joule heat so that its volume becomes 2.5 litre at 1atm. Calculate change in its internal energy.

A. 211.11J

B. 249.35J

C. 217.21J

D. 217.41J

Answer: B

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16. In order to decompose 9 grams of water 142.5 KJ heat is required. Hence the enthalpy of formation of water is

 $\mathsf{A.}+285kJ$

 $\mathrm{B.}-285 kJ$

 $\mathsf{C.}+142.5kJ$

 $\mathsf{D.}-142.5kJ$

Answer: B

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17.
$$2Zn+O_2
ightarrow 2ZnO~\Delta G^\circ = -616J$$

 $2Zn+S_2
ightarrow 2ZnS\,\Delta G^\circ = -293J$

 $S_2+2O_2
ightarrow 2SO_2 \, \Delta G^\circ \, = 0408 J$

 ΔG° for the following reaction is:

 $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$

 $\mathrm{A.}-731J$

 $\mathrm{B.}-1317J$

 ${\rm C.}-501J$

 $\mathrm{D.}+731J$

Answer: A

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18. Entropy change involve in conversation of 1mole of liquid water at 373Kto vapour at the same temperature (latent heat of vaporisation of water= $2.257kJg^{-1}$)

A. $105.9 J K^{-1}$

B. $107.9JK^{-1}$

C. $108.9 J K^{-1}$

D. $109.9 J K^{-1}$

Answer: C

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19. Heat of neutralization of strong acid against strong base is constant

and is equal to

A. 13.7 kcal

B. 57 kJ

C. $5.7 imes10^4 J$

D. All of the above

Answer: D

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20. The free energy change for a reversible reaction at equilibrium is:

zero

small positive

small negative

large positive.

A. Large positive

B. Small negative

C. Small positive

D. Zero

Answer: D

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21. When enthalpy and entropy change for a chemical reaction are $-2.5 imes10^3$ cals and 7.4 cals K^{-1} respectively. Predict that reaction at 298 K is

A. Spontaneous

B. Reversible

C. Irreversible

D. Non-spontaneotus

Answer: A

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22. What is the free energy change, $\Delta G'$ When 1.0 mole of water at $100^{\circ}C$ and 1 atm pressure is converted into steam at $100^{\circ}C$ and 1 atm pressure

A. 549 cal

 ${\rm B.}-9800 cal$

C. 9800 cal

D. 0 cal

Answer: D



23. The combustion enthalpies of carbon, hydrogen and methane are -395.5kJ mol^{-1} , -285.8kJ mol^{-1} and -890.4kJ mol^{-1} respectively at 25. The value of standard formation enthalpy of methane at that temperature is _____.

A. 890.4 kJ mol $^{-1}$

 $B. - 298.8 \text{ kJ mol}^{-1}$

 $C. - 76.7 \text{ kJ mol}^{-1}$

 $D. - 107.7 \text{ kJ mol}^{-1}$

Answer: C

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24. Identify the correct statement regarding entropy

A. At $0^{\circ}C$, the entropy of a perfectly crystalline substance is taken to be zero.

B. At absolute zero of temperature, the entropy of a perfectly crystal

line substance is + ve.

C. At absolute zero of temperature, the antropy of all crystalline

substances is taken to be zero.

D. At absolute zero of temperature, the entropy of a perfectly crystal

line substance is taken to be zero.

Answer: D



25. Equal volumes of methanoic acid and sodium hydroxide are mixed. If x

is the heat of formation of water from its ions then heat evolved on

neutralisation is

A. More than x

B. Equal to x

C. Twice of x

D. Less than x

Answer: D

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26. The neutralization of a strong acid by a strong base liberates an amount of energy per mole of H^+ that

A. Depends upon which acid and base are involved.

B. Depends upon the temperature at which the reaction takes place.

C. Depends upon which catalyst is used.

D. Is always the same.

Answer: D



27. The equilibrium constant of a reaction at 298 K is $5 imes 10^{-3}$ and at 1000 K is $2 imes 10^{-5}$ What is the sign of riangle H for the reaction.

- A. riangle H = 0
- B. riangle H is negative
- C. \triangle *H* is positive
- D. None of these

Answer: B



28. In an isochoric process the increase in internal energy is

- A. Equal to the heat absorbed
- B. Equal to the heat evolved
- C. Equal to the work done
- D. Equal to the sum of the heat absorbed and work done

Answer: A

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29. In the complete oombustion of butanol $C_4H_9OH(I)$, if $\triangle H$ is enthalpy of combustion and AE is the heat of combustion at constant volume, then

- A. riangle H < riangle E
- B. $\triangle H = \triangle E$
- $\mathsf{C}. \ \bigtriangleup \ H > \ \bigtriangleup \ E$

D. riangle H, riangle relation cannot be predicted

Answer: A

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30. The enthalpy change of a reaction does not depend upon

A. The state of reactants and products

B. Nature of reactants and products

C. Different intermediate reaction

D. Initial and final enthalpy change of a reaction

Answer: C

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31. Which of the following expression represents, the first law of thermodynamics ?

A.
$$riangle E = -q + W$$

- B. $\triangle E = -q W$
- $\mathsf{C.}\ \bigtriangleup \ E = q + W$
- D. $\triangle E = -q W$

Answer: C



32. The dependence of Gibbs free energy on pressure for an isothermal process of an ideal gas is given by

$$\begin{array}{l} \mathsf{A.}\ \bigtriangleup \ G_r = nRT \frac{\ln P_2}{P_1} \\ \mathsf{B.}\ \bigtriangleup \ G_T = nRT \frac{\ln V_2{\,}'}{V_1} \\ \mathsf{C.}\ \bigtriangleup \ G_T = nRT \frac{\ln P_1}{P_2} \\ \mathsf{D.}\ \bigtriangleup \ G_T = nRT \frac{\log V_1}{V_2} \end{array}$$

Answer: A

33. For a reaction to occur spontaneously

- A. (riangle H T riangle S) must be negative
- B. (riangle H + T riangle S) must be negative
- C. riangle H must be negative
- D. riangle S must be negative

Answer: A



34. If enthalpies of formation of $C_2H_4(g)$, $CO_2(g)$ and $H_2O(l)$ at $25^\circ C$ and 1 atm pressure are 52, -394 and -286 KJ/mol , the enthalpy of combustion of ethane is equal to 35. For an ideal diatomic gas:

A.
$$C_P=rac{7}{2}R$$

B. $C_P=rac{3}{2}R$
C. $C_P=rac{5}{2}R$
D. $C_v=rac{3}{2}R$

Answer: A

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36. When a solid changes into liquid, the entropy

A. Becomes zero

B. Remains the same

C. Increases

D. Decreases

Answer: D



Answer: A



38. For an exothermic reaction

A. H_p of the products is less than H_r of the reactants

B. H_p of the products is more than H_r of the reactants

C. H_p of the products is equal to H_r of the reactants

D. \triangle *H* is always positive

Answer: A

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39. The enthalpy change for the transition of liquid water to steam, Δ_{vap} H=37.3 kJ mol^{-1} at 373 K. The entropy change for the process is

A. $119.9 Jmol^{-1}K^{-1}$

B. $37.3 Jmol^{-1}K^{-1}$

C. $100 Jmol^{-1}K^{-1}$

D. 74.6 $Jmol^{-1}K^{-1}$

Answer: C



40. In the combustion of 2.0 g of methane 25 kcal heat is liberated, heat

of combustion of methane would be _____.

A. 100 Kcal

B. 200 Kcal

C. 300 Kcal

D. 4000 Kcal

Answer: B

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41. The combustion reaction occuring in an automobile is $2C_8H_{18} + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(g)$ This reaction is accompanied with signs of change in enthalpy, entropy and gibbs free energy A. +, -, +B. -, +, -C. -, +, +D. +, +, -

Answer: B

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42. At constant T and P, Which of the following statements is correct for the reaction,

$$CO(G)+rac{1}{2}O_2(g) o CO_2(g)$$
,

A. riangle H is independent of the physical state of the reactants of that

compound

- $\mathsf{B.}\ \bigtriangleup\ H > \ \bigtriangleup\ E$
- C. riangle H < riangle E

D. $\triangle H = \triangle E$

Answer: C



43. The heat of formations of $CO_{(g)}$ and $CO_{2(g)}$ are -26.4 kcal and -94.0 kcal respectively. The heat of combustion of carbon monoxide will be _____.

A. + 26.4 Kcal

B.-67.6 Kcal

C. - 120.6 Kcal

D. + 52.8 Kcal

Answer: B

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44. The value of heat generated when 36.5 gm of HCI and 40 gm of NaOH

reacts during neutralization

A. 76.5 Kcal

B. 13.7 Kcal

C. More than 13.7 Kcal

D. 108 Kcal

Answer: B

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45. In the reaction,

$$CO_2(g)+H_2(g)
ightarrow CO(g)+H_2O(g), \qquad \Delta H=2.8kJ$$

 ΔH represents :

A. Heat of formation

B. Heat of combustion

C. Heat of neutralization

D. Heat of reaction

Answer: D

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46. The heat of formation is the change in enthalpy accompanying the formation of a substance from its elements at 298 K and 1 atm pressure. Since the anthalpies of elements are taken to be zero, the heat of formation (\triangle *H*) of compounds

A. always negative

B. Is always positive

C. May be negative or positive

D.

Answer: C



47. An isolated system is that system in which

A. There is no exchange of energy with the is zero

B. There is exchange of mass and energy with the surroundings

C. There is no exchange of mass or energy with the surroundings

D. There is exchange of mass with the surroundings

Answer: C

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48. Which of the following statement is true regarding the entropy of the

universe?

A. Increases and tends towards m aximum value

B. Decreases and tends to be zero

C. Remains constant

D. Decreases and increases with a periodic rate

Answer: A

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49. In a reversible isothermal process, the change in internal energy is :

A. Zero

B. Positive

C. Negative

D. Unpredictable

Answer: A

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Efficient

1. Which of the following expressions is true for an ideal gas ?

A.
$$\left(\frac{\delta V}{\delta T}\right)_P = 0$$

B. $\left(\frac{\delta P}{\delta T}\right)_V = 0$
C. $\left(\frac{\delta E}{\delta T}\right)_T = 0$
D. $\left(\frac{\delta E}{\delta T}\right)_V = 0$

Answer: C



2. The expression $\left[\left. \delta U \right/ \delta T
ight]_V$ represents

A. Heat capacity at constant volume

- B. Heat capacity at constant pressure
- C. Enthalpy change
- D. Entropy change

Answer: A



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4. The work done by the system in a cyclic process involving one mole of an ideal monoatomic gas is -50 kJ/cycle. The heat absorbed by system per

cycle is

A. Zero

B. 50 kJ

 ${\rm C.}-50kJ$

 $\mathsf{D.}\,250kJ$

Answer: B

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5. The enthalpy of reaction,

 $H_2(g)+rac{1}{2}O_2(g) o H_2O(g){
m is}\Delta H_1$ and that of $H_2(g)+rac{1}{2}O_2(g) o H_2O(l){
m is}\Delta H_2.$ Then

- A. $riangle H_1 > riangle H_2$
- $\mathsf{B.}\ \bigtriangleup\ H_1=\ \bigtriangleup\ H_2$
- C. $riangle H_1 < riangle H_2$
- D. $riangle H_1 + riangle H_2 = 0$

Answer: C

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6. "The resultant heat change in a reaction is the same whether it takes

place in one or several stages." This statement is called

A. Lavoisier and Laplace law

B. Hess's law

C. Le-chatelier principle

D. Joule's law

Answer: B



7.
$$NH_3(g)+3Cl_2(g)
ightarrow NCl_3(g)+3HCl(g), \qquad \Delta H_1$$
 $N_2(g)+3H_2(g)
ightarrow 2NH_3(g), \qquad \Delta H_2$

 $H_2(g)+Cl_2(g)
ightarrow 2HCl(g), \qquad \Delta H_3$

The heat of formation of NCl3(g) in the terms of $\Delta H_1, \Delta H_2$ and ΔH_3 is

$$\begin{array}{l} \mathsf{A.} \ \bigtriangleup H_f = \ - \ \bigtriangleup H_1 + \frac{\bigtriangleup H_2}{2} - \frac{3}{2} \bigtriangleup H_3 \\ \mathsf{B.} \ \bigtriangleup H_f = \ \bigtriangleup H_1 + \frac{\bigtriangleup H_2}{2} - \frac{3}{2} \bigtriangleup H_3 \\ \mathsf{C.} \ \bigtriangleup H_f = \ \bigtriangleup H_1 - \frac{\bigtriangleup H_2}{2} - \frac{3}{2} \bigtriangleup H_3 \\ \mathsf{D.} \ \bigtriangleup H_f = \ \bigtriangleup H_1 + \frac{\bigtriangleup H_2}{2} - \frac{3}{2} \bigtriangleup H_3 \end{array}$$

Answer: A

:

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8. Which of the following molecules does not have zero entropy even at zero kelvin? $CO, CO_2, NaCl, NO$

A. CO, CO_2

B.CO, NO

 $C.CO_2, NaCl$

D. NaCl

Answer: B

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9. If $riangle H_f(C_2H_5 - S - C_2H_5) = -147$ kJ/mole and $riangle H_f(C_2H_5 - S - S - C_2H_5) = -202$ Kj/mole and `triangle H (f) (S) (g)=+ 223 kJ/mole then the S-S bond energy will be

A. 168 kJ

B. 126 kJ

C. 278 kJ

D. 572 kJ

Answer: C

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10. How much energy must be supplied to change 36 g of ice at $0^{\circ}C$ to

water	at	room	temperature	$25^{\circ}C$?
	Data for water			
$\Delta H_{ m fusion}^{\circ}$		6.01 kJ/mol		
C_{P} liquid		$4.18 JK^{-1}g^{-1}$	1	
A. 12 kJ				
B. 16 kJ				
C. 19 kJ				
D. 22 kJ				
Answer: B				

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11. Consider the values of $\Delta H(\text{in}kJmol^-)$ and for $\Delta S(\text{in}mol^-K^{-1})$ given for four different reactions. For which reaction will ΔG increases the most (becoming more positive) when the temperature is increased form $0^{\circ}C$ to $25^{\circ}C$? A. $riangle H^\circ = 50, \ riangle S^\circ = 50$

- B. $riangle H^\circ = 90, \ riangle S^\circ = 20$
- C. $riangle H^\circ = -20, \ riangle S^\circ = -50$
- D. $riangle H^\circ = -90, \ riangle S^\circ = -20$

Answer: C



12. The enthalpy of neutralisation of a strong acid by a string base is $-57.32kJmol^{-1}$. The enthalpy of formation of water is $-285.84kJmol^{-1}$. The enthalpy of formation of hydroxyl ion is

A. + 228.52 kJ/mole

B. -114.26 kJ/mole

C. - 228.52 kJ/mole

D. +114.26 kJ/mole

Answer: C



13. Consider the following two reactions :

(i) Propene $+H_2
ightarrow$ Propane, ΔH_1

(ii) Cyclopropane $+H_2 \rightarrow$ Propane, ΔH_2

Then, $\Delta H_2 - \Delta H_1$ will be

A. Zero

- B. $2BE_{C-C} BE_{C-C}$
- C. $BE_{C=C}$
- D. $2BE_{C=C} BE_{C-C}$

Answer: B

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14. Match the thermodynamic property given in column I with its correct

cxpression given in column II

Column I		Column II		
(A)	ΔG	(i)	- RT lnK	
(B)	ΔS [°]	(ii)	- nFE	
(C)	ΔH°	(iii)	$RT^2 \left(\frac{d\ln K}{dT}\right)_{p}$	
(D)	ΔG°	(iv)	$-\left(\frac{d\Delta G}{dT}\right)_{P}$	

Select the correct answer:

٨	A	B	C	D
А.	I	ii	iii	iv
р	A	B	C	D
ь.	ii	iv	iii	i
c	A	B	C	D
C.	iv	ii	iii	i
D	A	B	C	D
υ.	I	ii	iv	iii

Answer: B

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Work done in the cyclic process is

A. $12P_1V_1$

B. $6P_1V_1$

C. $3P_1V_1$

D. Zero

Answer: C



17. A gas expands adiabatically at constant pressure such that:

$$T\propto \frac{1}{\sqrt{V}}$$

The value of γ i.e., $\left(C_{P} \, / \, C_{V}
ight)$ of the gas will be:
B. 1.5

C. 1.7

D. 2

Answer: B

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18. In the Haber 's process of ammonia manufacture:

 $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g), \ \bigtriangleup H_{298K}^\circ = -92.2kJ$ If $N_2(g), H_2(g)$ and $NH_3(g)$ have $C_p(JK^{-1}mol^{-1})$ values 29.1, 28.8 and 35.1 respectively then if C_p is independent of temperature, the reaction at $100^\circ C$ as compared to that of $25^\circ C$ will be

A. More endothermic

B. Less endothermic

- C. Less exothermic
- D. More exothermic

Answer: D



19. In C_2H_4 energies of formation of (C = C) and (C - C) are -145 kJ/mol and -80kJ/mol respectively. What is the enthalpy change w hen ethylene polymerises to form polythene?

A. +650 kJ/mole

B.1.5 kJ/mole

C.-650 kJ/mole

D.-65 kJ/mole

Answer: B

20. If 150 kJ of energy is needed for muscular work to walk a distance of one km, then how much of glucose one has to consume to walk a distance of 5 km. Provided only 30 % energy is available for muscular work. The enthalpy of combustion of glucose is $3000kJmol^{-1}$

A. 75g

B. 30 g

C. 180g

D. 150g

Answer: D

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21. A mol of $Al_3C_4(s)$ reacts with water in a closed vessel at $27^\circ C$ against atmospheric pressure, work is doens

 $\mathsf{A.}-1800 cal$

 $\mathsf{B.}-600 cal$

 $\mathsf{C.} + 1800 cal$

D. zero

Answer: D

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22. $\triangle G^{\circ}$ and $\triangle H^{\circ}$ for a reaction at 300K are -66.9 kJ/mole and 41.8 kJ/mole respectively. $\triangle G^{\circ}$ for the same reaction at 330K is

 $\mathsf{A.}-25.1kJ$

 $\mathrm{B.}+25.1kJ$

 $\mathsf{C.}\,118.7kJ$

 $\mathrm{D.}-69.4kJ$

Answer: D

23. A gaseous reaction was carried out first keeping the volume constant and then keeping the pressure constant. In the second experiment, there was an increase in volume. The heats of reaction were different because

A. In the first case energy was spent to keep the volume constant

B. In the second case energy was spent to expand the gases

C. Specific heats of compressed gases is more

D. Specific heats of rarefied gases is more

Answer: B

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24. The standard entropies of $CO_{2(g)}$, $C_{(s)}$, and $O_{2(g)}$ are 213.5, 5.740 and 205 JK^{-1} respectively. The standard entropy of formation of CO_2 is A. $1.86 JK^{-1}$

B. 1.96*JK*⁻¹

C. $2.81 J K^{-1}$

D. $2.86 J K^{-1}$

Answer: C

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25. Calcualte ΔH_f° for chloride ion from the following data: $rac{1}{2}H_2(g) + rac{1}{2}Cl_2(g)
ightarrow HCl(g), \Delta H_f^{\circ} = -92.4 ext{ kJ}$ $HCl(g) + nH_2O
ightarrow H^+(aq) + Cl^-(aq), \Delta H_f^{\circ}$ of H^+ (aq) = 0.0 kJ

 $\mathsf{A.}-40.0 K cal$

 $\mathsf{B.}+40.0 K cal$

 $\mathsf{C.}+17.9 K cal$

 $\mathsf{D.}+22.1 K cal$

Answer: A



26.

 $egin{aligned} Mg(s)+2HCl(aq) &
ightarrow MgCl_2(aq)+H_2(g), \Delta_r H^{\,\circ}=\ -467kJ/mol\ MgO(s)+2HCl(aq) &
ightarrow MgCl_2(aq)+H_2O(l), \Delta_r H^{\,\circ}=\ -151kJ/molW \end{aligned}$

According to the information, and given the fact that for water, $\Delta_f H^\circ = - 286 kJ/mol$ what is the $\Delta_f H^\circ$ for MgO(s)?

- A. -904 kJ//mole
- B.-602kJ//mole
- C. 334 kJ/mole
- D. 30 kJ//mole

Answer: B

27. Given the experimental information below:

 $2Sr(s) + O_2(g) \rightarrow 2SrO(s),$ $\Delta_r H^\circ = -1180kJ/mol$ $SrCO_3(s) \rightarrow CO_2(g) + SrO(s)\Delta_r H^\circ = 234kJ/mol$ $2O_2(g) + 2C(s) \rightarrow 2CO_2(g),$ $\Delta_r H^\circ = -788kJ/mol$ Calculate the enthalpy change $\Delta_r H^\circ$ for the formation of 1.0 mol of strontium carbonate, the material that gives red color in fireworks, from its elements.

$$Sr(s)+rac{3}{2}O_2(g)+C(ext{graphite}) o SrCO_3(s).$$

A. -740 Kj/mol

B. + 714 Kj/mol

C. - 1218 Kj/mol

D. - 2436 Kj/mol

Answer: C

28. What is the heat of reaction for the following reaction?

$$CH_4(g) + NH_3(g)
ightarrow 3H_2(g) + HCN(g)$$

Use the following thermodynamic data in kJ/mole

$$egin{aligned} N_2(G) + 3H_2(g) &
ightarrow 2NH_3(g), \ riangle_r \ H^\circ = \ -91.8 \ C(s) + 2H_2(g) &
ightarrow CH_3(g), \ riangle_r \ H^\circ = \ +74.9 \ H_2(g) + 2C(s) + N_2(g) &
ightarrow 2HCN(g), \ riangle_r \ H^\circ = \ +261 \end{aligned}$$

A. 299.3kJ

B. 256kJ

 ${\rm C.}-149.5 kJ$

 $\mathsf{D}.\,101.5kJ$

Answer: D



29. 25.0 mL of 1.0M HCl is combined with 35.0 mL of 0.5 M NaOH. The initial temperatures of the solutions is $25^{\circ}C$, the density of the solution is 1.0 g/mL, the specific heat capacity of the solution is 4.184J/g.^o C, the

reaction is completed in insulated beaker, and the standard enthalpy of reaction for $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$ is -56kJ/mol. What is the final temperature of the solution?

A. $27^{\,\circ}\,C$

 $\mathrm{B.}\,25.223^{\,\circ}\,C$

C. $30.1^{\circ}C$

D. $32.8^{\circ}C$

Answer: B

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30. The reaction $3O_2(g) \rightarrow 2O_3(g), \Delta_r H > 0$. What can be concluded about average energy per bond in O_2 and O_3 ?

A. The average energy per bond in O_2 is greater than the average

bond energy per bond in O_3

B. The average energy per bond in O_2 is less than the average bond

energy per bond in O_3

C. The average energy per bond in O_2 is same as the average bond

average per bond in O_3

D. No conclusion can be drawn about the average bond energies from

this information alone.

Answer: A

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31. When 5.0 mL of a 1.0 M HCl solution is mixed with 5.0 mL of a 0.1 M NaOH solution, temperature of solution is increased by $2^{\circ}C$ predicted accurately from this observation?

A. If 10 ml of same HCI is mixed with 10 ml of same NAOH, temperature

rise will be $4^\circ C$

B. If 10 ml of 0.05 M HCI is mixed with 10 ml of 0.05 M NaCl the

temperature rise will be $2^\circ C$

C. If 5 ml of 0.1 MHCI is mixed with 5 ml of 0.1 M NH_3 solution, the

temeprature rise will be less than $2^\circ C$

D. If 5 ml of 0.1 MCH_3COOH is mixed with 5 ml 0.1 M NaOH the

temperature rise will be more than $2^\circ C$

Answer: C

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32. Which of the following reactions doesn't represent the standard state

enthalpy of formation reaction?

$$egin{aligned} & ext{A.} \ rac{1}{2} H_2(g) + rac{1}{2} Cl_2(g) o HCl(g) \ & ext{B.} \ Xe(g) + 2F_2(g) o XeF_4(g) \ & ext{Cl} \ & ex$$

D.
$$Kr(g)+F_2(g)
ightarrow KrF_2(s)$$

Answer: B



33. What can be accurately predicted for the isomerization reaction between gaseous penta-1,4-diene and gaseous penta-1.3-diene?

A. The process is exothermic

B. Enthalpy change of the reaction is same as resonance energy of the

product

C. Magnitude of enthalpy of combustion of product is more than that

of the reactant

D. Combustion of the reactant will be exothermic while the same for

the products will be endothermic.

Answer: A

34. At 5×10^5 bar pressure density of diamond and graphite are 3g/ccand 2g/cc respectively, at certain temperature 'T'. Find the value of $\Delta U - \Delta H$ for the conversion of 1 mole of graphite to 1 mole of diamond at temperature 'T' :

A. 100 kJ/mole

B. 50 kJ/mole

C. -100 kJ/mole

D. 300 kJ/mole

Answer: A



35. The enthalpies of neutralization of a weak base AOH and a strong

base BOH by HCl are -12250 cal/mol and -13000 cal/mol respectively. When

one mole of HCl is added to a solution containing 1 mole of AOH and 1 mole of BOH, the enthalpy change was -12500 cal/mol. In what ratio is the acid distribution between AOH and BOH?

A. 2:1

B. 2:3

C. 1: 2

D. 4:5

Answer: A

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36. What is the bond enthalpy of Xe - F bond ?

 $XeF_4(g)
ightarrow Xe^+(g) + F^-(g) + F_2(g) + F(g), \hspace{1em} \Delta_r H = 292 ext{kcal/mol}$

Given : Ionization energy of $Xe=279\mathrm{kcal/mol}$

B. E. (F - F) = 38kcal/mol, Electron affinity of F = 85 kcal/mol

A. 24 Kcal/mole

B. 34 Kcal/mole

C. 8.5 Kcal/mole

D. 16.3 Kcal/mole

Answer: B

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37. Combustion of sucuose is used by aeroic organisms for providing energy for the life sustaining processes. If all the capturing of energy from the reaction is done through electrical process (non P-V word) then calculate maximum available energy which can be captured by combustion of 34.2 gm of sucrose

Given : $\Delta H_{
m combustion}(
m sucrose) = -6000
m kJ \ mol^{-1}$

 $\Delta S_{
m combustion} = 180 {
m J/K} ext{-mol} ext{ and body temperature is } 300 {
m K}$

A. 600 kJ

B. 594.6kJ

C. 5.4 kJ

D. 605.4 kJ

Answer: D

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38. The freezing of any liquid to a solid is expected to have:

A. a positive riangle H and a positive riangle S

B. a negative riangle H and a positive riangle S

C. a positive riangle H and a negative riangle S

D. a negative riangle H and a negative riangle S

Answer: D

39. The enthalpy of neutralization is about 57.3 kJ for the pair

A. HCl and NH_4OH

B. NH_4OH and HNO_3

 $\mathsf{C}.HCl$ and NaOH

D. CH_3COOH and NaOH

Answer: C

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40. Consider the reaction below at 298K,

 $C(ext{graphite}) + 2H_2(g) o CH_4(G)$

$$riangle_f \, H^{\,\circ}(\mathrm{Kj/mol}) - 74.9$$

 $S_m^{\,\circ}({
m J/mol-K}) + 5.6 + 130.7 + 186.3$

Which statement below is correct?

A. $riangle_r ~G^\circ$ is -50.8 kJ and the reaction is driven by enthalpy only

- B. $riangle_r G^\circ$ is -50.8 kJ and the reaction is driven by entropy only
- C. $riangle_r G^\circ$ is +50.8 kJ and the reaction is driven by both enthalpy and entropy
- D. $riangle_r G^\circ$ is -50,8 kJ and the reaction is driven by both enthalpy and

entropy

Answer: A

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41. Given $riangle_r H^\circ(\mathrm{kJ/mol})S^\circ_m(\mathrm{J/mol-K})$

 $CCl_4(l) - 135.4$ 214.4

 $CCl_4(g) - 103.0$ 308.7

The boiling point of carbon tetrachloride is

A. $8.25^{\,\circ}\,C$

B. $70.5\,^{\circ}\,C$

 $\mathrm{C.}\,92.3^{\,\circ}\,C$

D. $45.8^{\circ}C$

Answer: B



42. Calculate the change in molar Gibbs energy of carbon dioxide gas at

 $20^{\,\circ}$ C when it is isothermally compressed from 1.0 bar to 2.0 bar.

A. 2.4 kJ/mole

B.-2.4kJ/mole

C. 1.7 kJ/mole

D. - 1.7 kJ/mole

Answer: C

43. What will be the value of $riangle_r S_{sys}^\circ$ for the following reaction at 373 K: $CO(g) + H_2O(g) o CO_2(g) + H_2(g) riangle_r H^\circ = -4.5 imes 10^4 J, \ riangle_r S_{
m univ}^\circ$

A.
$$+178 \frac{J}{K}$$

B. $-166 \frac{J}{K}$
C. $-178 \frac{J}{K}$
D. $+166 \frac{J}{K}$

Answer: A



44. A certain process releases 64.0 kJ of heat, which is transferred to the surroundings at a constant pressure and a constant temperature of 300 K. For this process $\Delta S_{
m surr}$ is:

A. 64 kJ

B.-64kJ

 $\mathsf{C.}-213J\,/\,K$

D. 213 J/K

Answer: D

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45. A certain homogenous gas-phase reaction is exothermic and proceeds with an increase in the number of moles of gas. Which of the following statements concerning this reaction is true?

- A. This reaction is spontancous at lower temperatures but nonspontancous at higher temperatures.
- B. This reaction is is non-spontaneous over all possible temperatures
- C. This reaction is is spontancous over all possible temperatures
- D. There is a temperature at which this reaction can be at equilibrium

where all species are present at standard concentrations.

Answer: C

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46. Which of the following proceeds with decrea se in entropy?

A. Boiling of an egg

B. Combustion of benzene at $27^{\,\circ}\,C$

C. Dissolution of sugar in water

D. Calcination of solid $CaCO_3$

Answer: B

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47. The standard enthalpy of formation of gaseous H_2O at 298 K is -241.82 kJ/mol. Calculate ΔH° at 373 K given the following values of the molar heat capacities at constant pressure :

 $H_2O(g)=33.58~~{
m JK}^{-1}~~{
m mol}^{-1},~~H_2(g)=29.84~~{
m JK}^{-1}~~{
m mol}^{-1},~~O_2(g)=1000~{
m M}^{-1}$

Assume that the heat capacities are independent of temperature :

A. -242.6kJ/mole

B. + 242.6 kJ/mole

C. + 24.26 kJ/mole

D. - 242.6 J/mole

Answer: A

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48. $\Delta_r H^{\circ}$ for solid-to-liquid transitions for proteins A and B are 2.73 Kcal mol^{-1} and 3.03 kcal mol^{-1} . The two melting points are 0° C and 30° C respectively. The entropy changes ΔS_A and ΔS_B at two transition temperatures are related as:

A.
$$riangle S_A = riangle S_B$$

 $\mathsf{B.}\ \bigtriangleup\ S_A > \ \bigtriangleup\ S_B$

C.

$$\mathsf{D.}\ riangle \ S_B = rac{303 riangle \ S_A}{273}$$

Answer: A

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Impeccable

1. Calculate the work done when 1 mol of an ideal gas is compressed reversibly from 1 bar to 4 bar at a constant temperature of 300 K

A. 4.01 kJ

 $\mathrm{B.}-8.02kJ$

C. 18.02kJ

D. 3.45kJ

Answer: D



2. Consider the following reactions:

$$egin{aligned} & \mathsf{I}.\, C(s) + rac{1}{2}O_2(g) o CO(g), & \Delta H_1 = x_1 \ & \mathsf{II}.\, CO(g) + rac{1}{2}O_2(g) o CO_2(g), & \Delta H_2 = x_2 \ & \mathsf{III}.\, C(s) + CO_2(g) o 2CO(g), & \Delta H_3 = x_3 \end{aligned}$$

Select the correct statements:

A. Heat of formation of CO_2 is (a + b)

B. Heat of combustion of C is (a + b)

$$\mathsf{C}.\ \bigtriangleup\ H_3=\ \bigtriangleup\ H_1=\ \bigtriangleup_2$$

D. All the above are correct statements

Answer: D

3. An endothermic reaction has a positive internal energy change $\triangle U$. In such a case, what is the minimum value that activation energy can have

A.
$$\triangle U$$

B. $\triangle = \triangle H + \triangle nRT$
C. $\triangle U = \triangle H - \triangle nRT$
D. $\triangle U = \triangle E_a + RT$

Answer: A

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4. The heat of atomisation of $PH_3(g)$ and $P_2H_4(g)$ are $953kJmol^{-1}$ and $1485kJmol^{-1}$ respectively. The P – P bond energy in $kJmol^{-1}$ is: B. 426

C. 318

D. 1272

Answer: A

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5. Given that $\Delta h_f(H)=218kJ/\mathit{mol}.$ Express the H-H bond energy in

 $K cal \, / \, mol$

A. 52.15

B. 911

C. 104

D. 52153

Answer: C

6. The heat change for the following reaction at 298K and constant pressure is +7.3kcal $A_{\circ}B(s) \rightarrow 2A(s) + \frac{1}{2}B_2(g)$, $\Delta H = +7.3kcal$ The heat change at constant volume would be

A. + 7.3 Kcal

B. more than 7.3 Kcal

C. less than 7.3Kcal

D. zero

Answer: C

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7. Entropy changesh for the process, $H_2O(l)
ightarrow H_2O$ at normal pressure

and 274K are given below

 $riangle \, S_{
m system} = \, - \, 22.13, \ riangle \, S_{
m surr} = \, + \, 22.05,$ the process is non

spontaneous because

A.
$$riangle S_{
m system}$$
 is $-ve$

- B. $riangle S_{
 m surr}$ is +ve
- C. $riangle S_{
 m u}$ is -ve
- D. $riangle S_{
 m system}
 eq riangle S_{
 m surr}$

Answer: C

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8. A process is called reversible when

A. surrounding and system change into each other

B. there is no boundry between system and surrounding

C. the surrounding are always in equlibrium with the systeme

D. the sytem changes into surroundings spontaneously

Answer: C



9. The incorrect statemetns amgong the following is

A. The entropy of the universe remains constant

B. Heat cannot be completely converted into work

C. The absoltute entropy of a perferctly cystaline solid at absolute

zero temperature is zero

D. The total energy of an isolates system remains contant

Answer: A



10. Under which of the following sets of conditions, riangle G is always

negative ?

A. riangle H = -ve and riangle S = +ve

 $\mathsf{B.}\ \bigtriangleup\ H=\ -\ ve\ \text{and}\ \ \bigtriangleup\ S=\ -\ ve$

 $\mathsf{C}. \ \bigtriangleup \ H = \ + ve \ \text{and} \ \ \bigtriangleup \ S = \ + ve$

D. riangle H = +ve and riangle S = -ve

Answer: A



11. The second law of thermodynamic states that in a cyclic process,

A. work cannot be converted into heat

B. heat cannot be converted into work

C. work cannot be completely converted into heat

D. heat cannot be completely converted into work

Answer: D

12. When 400 mL of 0.2 N solution of a weak acid is neutralized by a dilute aqueous solution of sodium hydroxide un der standard conditions, 4.4 kJ amount of heat is liberated. Therefore, the standard enthalpy of neutralization of this weak acid in kJ equiv⁻¹ is

A. - 11

 $\mathsf{B.}-44$

C.-55

D. - 22

Answer: C



13. Equal volumes of molar hydrochloric acid and sulphuric acid are neutralised by dilute NaOH solution and x kcal and v kcal of heat are liberated respectively. Which of the following is true ?

A. x=y

B.
$$x=rac{y}{2}$$

C. x=2y

D. x=3y

Answer: B



14. for an endothermic reaction , energy of activation is E_{α} and Enthalpy of raction is ΔH (both of these in kj / mol) . Minimum value of E_{α} will be

A. equal to zero

B. less than $\ riangle H$

C. equal to $\ riangle H$

D. more than $\ riangle H$

Answer: D

15. Which equation is correct for adiabatic process ?

A. Q=+W

B. Q=0

- $\mathsf{C}.\ \bigtriangleup \ E = Q$
- $\mathsf{D}.\,P+\ \bigtriangleup \,V=0$

Answer: B

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16. For a given reaction, $\Delta H = 35.5 k Jmol^{-1}$ and $\Delta S = 83.6 J K^{-1} mol^{-1}$. The reaction is spontaneous at (Assume that ΔH and ΔS do not vary with temperature)

A. T < 425 K

 $\mathrm{B.}\,T>425K$

C. all temperature

 $\mathrm{D.}\,T>298K$

Answer: B

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17. If W is the amount of work done by the system and q is the amount of

heat supplied to the system, identify the type of the system

A. isolated system

B. closed system

C. Open system

D. system with thermally conducting walls

Answer: B
18. Thermodynamically the most stable form of carbon is

- (a) diamond , (b) graphite
- (c) fullerenes , (d) coal

A. diamond

B. graphite

C. fullerenes

D. coal

Answer: A

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19. If 1 mole of an ideal gas expands isothermally at $37^{\circ}C$ from 15 litres to

25 litres, the maximum work obtained is :

A. 12.87 L-atm

B. 6.43 L-atm

C. 8.57 L-atm

D. 2.92 L-atm

Answer: A

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20. The pressure of a gas is 100 k Pa. if it is compressed from 1 m^3 to $10 dm^3$, find the work done .

A. 990 J

B. 9990 J

C. 9900 J

D. 99000 J

Answer: D

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21. The heat liberated when 1.89 g of benzoic acid is burnt in a bomb calorimeter at $25^{\circ}C$ and it increases the temperature of 18.94 kg of water by $0.632^{\circ}C$. If the specific heat of water at $25^{\circ}C$ is 0.998 cal/g-deg, the value of the heat of combustion of benzoic acid is

A. 881.1 kcal

B. 771.4 kcal

C. 921. 1 kcal

D. 871.2 kcal

Answer: B



22. The heat of combustion of liquid ethanol is -327.0 kcal calculate the heat of formation of ethanol. Given that the heats of formation of $CO_2(g)$ and $H_2O(l)$ are -94.0 kcal and -68.4 kcal respectively.

 $\mathsf{A.}-212.4kcal$

 $\mathsf{B.}+212.4kcal$

C. - 249.2kcal

 $\mathsf{D.}+249.2kcal$

Answer: A

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23. The amount of heat evolved when $500cm^30.1MHCl$ is mixed with $200cm^3$ of 0.2MNaOH is

A. 2.292kJ

B. 1.292kJ

C. 0.292kJ

D. 3.392kJ

Answer: A

24. The heats of neutralisation of four acids a, b, c and d when neutralised against a common base are 13.7, 9.4, 11.2 and 12.4 kcal respectively. The weakest among these acids is

A. A B. B C. C D. D

Answer: B



25. According to the second law of thermodynamics, a process (reaction)

is spontaneous, if during the process

- A. $riangle S_{ ext{universe}} > 0$
- B. $riangle S_{ ext{universe}} = 0$
- C. \triangle $H_{\mathrm{system}} > 0$
- D. $riangle S_{ ext{universe}} = riangle S_{ ext{system}}$

Answer: A

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26. Calculate the free energy change for the following reaction at 300 K. $2CuO_{(s)} \rightarrow Cu_2O_{(s)} + rac{1}{2}O_{2(g)}$ Given $\Delta H = 145.6kJmol^{-1}$ and $\Delta S = 116. \ JK^{-1}mol^{-1}$

A. 110.8kJ mol⁻¹

B. 221.5kJ mol⁻¹

C. 55.4kJ mol $^{-1}$

D. 145.6kJ mol⁻¹

Answer: A



27. Which one of the following is correct?

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

B. $\bigtriangleup H = \bigtriangleup H - T \bigtriangleup S$
C. $\bigtriangleup S = \frac{1}{T} [\bigtriangleup G - \bigtriangleup H]$

D.
$$riangle S = rac{1}{T} [riangle H - riangle G]$$

Answer: D



28. Which of the following is correct option for free expansion of an ideal

gas under adiabatic condition?

A.
$$q=0, \ riangle T < 0, w
eq 0$$

B.
$$q=0, \ riangle T
eq 0, w=0$$

$$\mathsf{C}.\,q
eq 0,\,\, riangle \,T=0,\,w=0$$

D.
$$q=0, \ riangle T=0, w=0$$

Answer: D



29. Enthalpy change for the reaction,

 $4H(g)
ightarrow 2H_2(g)$ is -869.6 kJ

The dissociation energy of H - H bond is

A. + 217.4 kJ

 ${\rm B.}-434.8 {\rm kJ}$

C. - 869.6 kJ

 $\mathsf{D.}+434.8 kJ$

Answer: D



30. If the enthalpy change for the transition of liquid water to steam is 300kJ mol^{-1} at $27^{\circ}C$, the entropy change for the proces would be

- A. $1000 J K^{-1} mol^{-1}$
- B. $10JK^{-1}mol^{-1}$
- C. $1.0JK^{-1}mol^{-1}$
- D. $0.1 J K^{-1} mol^{-1}$

Answer: A



31. Based on the first law of thermodynamics, which one of the following

is correct?

A. For an isothermal process q =+w

B. For an isochoric process, $\ riangle U = \ - \ q$

C. For an adiabatic process, $\ riangle U = \ -w$

D. For a cyclic process, q=-w

Answer: D

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32. The enthalpy of solution of sodium chloride is 4 kJ mol^{-1} and its enthalpy of hydration of ions is -784 kJ mol^{-1} . What will be the lattice enthalpy of sodium chloride?

A. + 788

 $\mathsf{B.}+4$

 $\mathsf{C.}+98$

 $\mathsf{D.}+780$

Answer: A



33. Which reaction, with the following values of ΔH , ΔS , at 400 K is spontaneous and endothermic?

A.
$$riangle H = -48kJ, \ riangle S = +135J/K$$

B.
$$riangle \, H = \, - \, 48 k J, \, \, riangle \, S = \, - \, 135 J \, / \, K$$

C.
$$riangle H = \ + \ 48 kJ, \ riangle S = \ + \ 135 J/K$$

D.
$$riangle \, H = \, - \, 48 k J, \, \, riangle \, S = \, - \, 135 J \, / \, K$$

Answer: C



34. Enthalpy of vapourization of benzene is $+35.3kJmol^{-1}$ at its boiling

point of $80^{\circ}C$. The entropy change in the transition of the vapour to

liquid at its boiling points [in $K^{-1}mol^{-1}$] is

A. - 100

B. + 100

 $\mathsf{C.}+342$

 $\mathsf{D.}-342$

Answer: A

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35. For the reversible reaction.

 $A(s)+B(g) \Leftrightarrow C(g)+D(g), \ riangle \ G^\circ = \ -\ 350 kJ$

Which one of the following statement is true?

A. The reaction is thermodynamically non-feasible

B. the entropy change is negative

C. Equilibrium constant is greater than one

D. The reaction should be instantaneous

Answer: C



36. A reaction is spontaneous at low temperature but non- spontaneous at high temperature. Which of the following is true for the reaction?

- A. $riangle H > 0, \ riangle S > 0$
- $\mathsf{B.}\ \bigtriangleup\ H < 0,\ \bigtriangleup\ S > 0$
- $\mathsf{C}.\ \bigtriangleup\ H>0,\ \bigtriangleup\ S=0$
- D. $riangle H < 0, \ riangle S < 0$

Answer: D

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37. A reaction having equal energies of activation for forward and reverse

reactions has

- A. riangle H = riangle G = riangle S = 0
- B. $\triangle S = 0$
- C. $\triangle G = 0$
- D. riangle H = 0

Answer: D

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38. Which of the following statements is correct for the spontaneous adsorption of a gas ?

- A. riangle S is positive and, therefore, riangle H should be negative.
- B. riangle S is positive and, therefore, riangle H should also be highly

positive.

C. riangle S is negative and, therefore, riangle H should be highly positive.

D. riangle S is negative and therefore, riangle H should be highly negative.

Answer: D



39. For the reaction:

 $X_2O_4(l)
ightarrow 2XO_2(g)$

 $\Delta U = 2.1 kcal, \Delta S = 20 ext{cal} K^{-1} ext{at} 300 K$

Hence ΔG is

A. 9.3 kcal

 ${\rm B.}-9.3 kcal$

C. 2.7kcal

 $\mathsf{D.}-2.7 k cal$

Answer: D



40. Which of the following statements is correct for a reversible process

in a state of equilibrium ?

- A. $riangle G = 2.30 RT \log K$
- B. $riangle G^\circ = - 2.30 RT \log K$
- C. $riangle G^\circ = 2.30 RT \log K$
- D. $riangle G = -2.30 RT \log K$

Answer: D

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41. The heat of combustion of carbon to CO_2 is-395.5kJ/mol. The heat released upon the formation of 35.2g of CO_2 from carbon and oxygen gas .

is

A. -630kJ

 $\mathsf{B.}-3.15kJ$

 ${\rm C.}-315kJ$

D. + 315kJ

Answer: C

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42. The correct thermodynamic conditions for the spontaneous reaction

at all temperature is

- A. riangle H < 0 and riangle S < 0
- $\mathsf{B.}\ \bigtriangleup\ H< \ \text{ and }\ \bigtriangleup\ S=0$
- $\mathsf{C}. \ \bigtriangleup \ H > 0 \ \text{and} \ \ \bigtriangleup \ S < 0$
- $\mathsf{D.}\ \bigtriangleup\ H < 0 \ \text{and} \ \bigtriangleup\ S > 0$

Answer: D

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43. Consider the following liquid-vapour equilibrium

$\mathsf{Liquid} \ \Leftrightarrow \ \mathsf{Vapour}$

Which of the following relations is correct ?

A.
$$rac{d\ln P}{dT} = rac{igtriangleq H_v}{RT^2}$$

B. $rac{d\ln P}{dT^2} = rac{igtriangleq H_v}{RT^2}$
C. $rac{d\ln P}{dT} = rac{-igtriangleq H_v}{RT}$
D. $rac{d\ln P}{dT} = rac{-igtriangleq H_v}{T^2}$

Answer: A

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44. What is the amount of work done when 0.5 mole of methane, $CH_4(g)$

is subjected to combustion at 300 K? (given, $R=8.314 J k^{-1} mol^{-1})$

A.
$$-2494J$$

 $\mathrm{B.}-4988J$

 $\mathsf{C.}+4988J$

 $\mathsf{D.}+2494J$

Answer: D

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45. Which one of the following is incorrect for ideal solution ?

- A. $riangle H_{
 m mix}=0$
- B. $riangle U_{
 m mix} = 0$
- C. $riangle P = riangle_{
 m observed} P_{
 m calculated} = 0$
- D. $riangle G_{
 m mix}=0$

Answer: B

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46. For a sample of perfect gas when its pressure is changed isothermally

from p_i to p_f , the entropy change is given by

$$\begin{array}{l} \mathsf{A.}\ \bigtriangleup S = nR\ln\!\left(\frac{p_f}{p_i}\right)\\ \mathsf{B.}\ \bigtriangleup S = nR\ln\!\left(\frac{p_i}{p_f}\right)\\ \mathsf{C.}\ \bigtriangleup S = nRT\ln\!\left(\frac{p_f}{p_i}\right)\\ \mathsf{D.}\ \bigtriangleup S = RT\ln\!\left(\frac{p_f}{p_i}\right)\end{array}$$

Answer: B

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47. If the E_{cell}° for a given reaction has a negative value, which of the following gives the correct relationships for the values of ΔG° and K_{eq} ?

A.
$$riangle G^\circ > 0, K_{eq} < 1$$

 $\mathsf{B.}\ \bigtriangleup\ G^{\,\circ}\ >0, K_{eq}>1$

C. $riangle G^\circ < 0, K_{eq} > 1$

D. $riangle \, G^\circ \, < 0, \, K_{eq} < 1$

Answer: C

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48. A gas is allowed to expand in a well insulated container against a constant external pressure of 2.5 atm from an initial volume of 2.50 L to a final volume of 4.50 L. The change in internal energy ΔU of the gas in joules will be

A. 1136.25J

 $\mathrm{B.}-500J$

 ${\rm C.}-505J$

 $\mathsf{D.}+505J$

Answer: B



