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Educational Services Private Limited

9th, 10th, NEET, JEE(Main/Advanced)

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CLASS : XI (PHYSICAL CHEMISTRY)

D P P

DAILY PRACTICE PROBLEM

DPP-37 to 59

Topic : Chemical Equilibrium
Type of Questions
M.M., Min.
Single choice Objective ('-1' negative marking) Q.1 to Q.8
(3 marks, 3 min.)
[24, 24]

- For the homogeneous gaseous reaction : $4\text{NH}_3 + 5\text{O}_2 \rightleftharpoons 4\text{NO} + 6\text{H}_2\text{O}$, the equilibrium constant K_c has the units of :
 (A) $(\text{Conc.})^{-10}$ (B) $(\text{Conc.})^1$ (C) $(\text{Conc.})^{-1}$ (D) It is dimensionless.
- Select the gaseous reaction for which the equilibrium constant is written as : $[\text{MX}_3]^2 = K[\text{MX}_2]^2 [\text{X}_2]$
 (A) $\text{MX}_3 \rightleftharpoons \text{MX}_2 + \frac{1}{2}\text{X}_2$ (B) $2\text{MX}_3 \rightleftharpoons 2\text{MX}_2 + \text{X}_2$
 (C) $2\text{MX}_2 + \text{X}_2 \rightleftharpoons 2\text{MX}_3$ (D) $\text{MX}_2 + \frac{1}{2}\text{X}_2 \rightleftharpoons \text{MX}_3$.
- In order to increase the rate of forward reaction : $2\text{A}(\text{g}) + 3\text{B}(\text{g}) \rightleftharpoons \text{Product}$, 32 times, it is necessary to :
 (A) Make the conc. of A and B three times (B) Make the conc. of A and B two times
 (C) Make the conc. of A and B half (D) Make the conc. of A and B four times
- For the reaction, $\text{A} + 2\text{B} \rightleftharpoons 2\text{C}$, the rate constants for the forward and the backward reactions are 1×10^{-4} and 2.5×10^{-2} respectively. The value of equilibrium constant, K for the reaction would be :
 (A) 1×10^{-4} (B) 2.5×10^{-2} (C) 4×10^{-3} (D) 2.5×10^2
- An equilibrium system for the reaction between hydrogen and iodine to give hydrogen iodide at 765 K in a 5 litre volume contains 0.4 mole of hydrogen, 0.4 mole of iodine and 2.4 moles of hydrogen iodide. The equilibrium constant for the reaction is : $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$
 (A) 36 (B) 15 (C) 0.067 (D) 0.28.
- For a gaseous reaction, $2\text{A} + \text{B} \rightleftharpoons 2\text{C}$, the partial pressures of A, B and C at equilibrium are 0.3 atm, 0.4 atm and 0.6 atm respectively. The value of K_p for the reaction would be :
 (A) 10 atm^{-1} (B) $1/10 \text{ atm}^{-1}$ (C) 0.2 atm^{-1} (D) 5 atm^{-1}
- The active mass of 64 g of HI in a two litre flask would be :
 (A) 2 (B) 1 (C) 5 (D) 0.25
- For the reaction , $\text{A} + \text{B} \rightleftharpoons 3\text{C}$, if 'a' moles/litre of each 'A' & 'B' are taken initially , then the incorrect relation about concentrations at equilibrium is :
 (A) $[\text{A}] - [\text{B}] = 0$ (B) $3[\text{B}] + [\text{C}] = 3a$ (C) $3[\text{A}] + [\text{C}] = 3a$ (D) $[\text{A}] + [\text{B}] = 3[\text{C}]$

Topic : Chemical Equilibrium
Type of Questions
Single choice Objective ('-1' negative marking) Q.1 to Q.5
(3 marks, 3 min.)
M.M., Min.
[15, 15]
Subjective Questions ('-1' negative marking) Q.6 to Q.9
(4 marks, 5 min.)
[16, 20]

- For the equilibrium $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$ in a closed vessel, K_p is found to be double of K_c . This is attained when :
 (A) $T = 2 \text{ K}$ (B) $T = 12.18 \text{ K}$ (C) $T = 24.36 \text{ K}$ (D) $T = 27.3 \text{ K}$
- K_p / K_c for the reaction $\text{CO}(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \rightleftharpoons \text{CO}_2(\text{g})$ will be :
 (A) 1 (B) \sqrt{RT} (C) $\frac{1}{\sqrt{RT}}$ (D) RT
- For the reaction : $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$ at 360 K, the value of $K_c = 0.4 \text{ mole lit}^{-1}$. The value of K_p for the reaction at the same temperature would be :
 (A) 12 atm (B) 1.2 atm (C) $1.2 \times 10^2 \text{ atm}$ (D) $1.2 \times 10^{-3} \text{ atm}$
- Starting with one mole of nitrogen and 3 moles of hydrogen, at equilibrium 50% of each had reacted according to the reaction : $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$
 If the equilibrium pressure is P, the partial pressure of hydrogen at equilibrium would be :
 (A) $P/2$ (B) $P/3$ (C) $P/4$ (D) $P/6$
- For which of the following equilibria, is $K_p = K_c$:
 (A) $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{H}_2\text{O}(\text{g})$ (B) $\text{CH}_4(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{CO}(\text{g}) + 3\text{H}_2(\text{g})$
 (C) $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{NO}(\text{g})$ (D) $\text{COCl}_2(\text{g}) \rightleftharpoons \text{CO}(\text{g}) + \text{Cl}_2(\text{g})$
- For the following chemical equation, write expression for equilibrium constants K_c and K_p
 $2\text{NO}_2(\text{g}) \rightleftharpoons \text{N}_2\text{O}_4(\text{g})$
 Also write their proper units.
- PCl_5 dissociates into PCl_3 and Cl_2 in a 2 L flask at about 600°C. At equilibrium, mixture is found to contain 1 mole PCl_5 and 2 moles each of PCl_3 and Cl_2 . Calculate :
 (i) equilibrium molar concentrations.
 (ii) equilibrium mole fractions.
 (iii) equilibrium constant K_c for the chemical equilibrium : $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$
- For an equilibrium $\text{A}(\text{g}) + 2\text{B}(\text{g}) \rightleftharpoons 2\text{C}(\text{g}) + \text{D}(\text{g})$, A and B are mixed in a reaction vessel at 300 K. The initial concentration of B was 1.5 times the initial concentration of A. After the equilibrium, the equilibrium concentrations of A and D are same. Calculate K_c for the given reaction .
- n mole of PCl_3 and n mole of Cl_2 are allowed to react at constant temperature T to have a total equilibrium pressure P, as : $\text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g}) \rightleftharpoons \text{PCl}_5(\text{g})$
 If y mole of PCl_5 are formed at equilibrium, find K_p for the given reaction.

Topic : Chemical Equilibrium
Type of Questions
Single choice Objective ('-1' negative marking) Q.1 to Q.7
(3 marks, 3 min.)
M.M., Min.
[21, 21]
Subjective Questions ('-1' negative marking) Q.8 to Q.9
(4 marks, 5 min.)
[8, 10]

- In a reaction $A(g) + 2B(g) \rightleftharpoons 2C(g)$, 2 moles of 'A', 3 moles of 'B' and 1 mole of 'C' are placed in a 2 L flask and the equilibrium concentration of 'C' is 1 mol/L. The equilibrium constant (K_c) for the reaction is :
 (A) 0.33 lit/mol (B) 1.33 lit/mol (C) 1.66 lit/mol (D) 0.66 lit/mol
- For the reaction : $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$, the equilibrium constant K_p changes with :
 (A) total pressure (B) addition of catalyst
 (C) the amounts of H_2 and I_2 taken initially (D) temperature
- In a reversible chemical reaction having two reactants in equilibrium with one product, if the initial concentration of both the reactants is doubled, then the equilibrium constant will :
 (A) also be doubled (B) be halved
 (C) become one fourth (D) remain the same.
- For the equilibrium $2H_2O(g) \rightleftharpoons 2H_2(g) + O_2(g)$, equilibrium constant is K_1 .
 For the equilibrium $2CO_2(g) \rightleftharpoons 2CO(g) + O_2(g)$, equilibrium constant is K_2 .
 Then, the equilibrium constant for $CO_2(g) + H_2(g) \rightleftharpoons CO(g) + H_2O(g)$ is :
 (A) $K_1 K_2$ (B) $\frac{K_1}{K_2}$ (C) $\sqrt{\frac{K_1}{K_2}}$ (D) $\sqrt{\frac{K_2}{K_1}}$
- For the reaction $A(g) + B(g) \rightleftharpoons C(g)$ at equilibrium, the partial pressure of the species are $P_A = 0.15$ atm, $P_C = P_B = 0.30$ atm. If the capacity of reaction vessel is reduced, the equilibrium is re-established. In the new situation, partial pressure A and B become twice. What is the partial pressure of C :
 (A) 0.3 atm (B) 0.6 atm (C) 1.2 atm (D) 1.8 atm
- The equilibrium constant for the reaction
 $A_2(g) + B_2(g) \rightleftharpoons 2AB(g)$ is 20 at 500 K.
 The equilibrium constant for the reaction,
 $2AB(g) \rightleftharpoons A_2(g) + B_2(g)$ at 500 K would be :
 (A) 20 (B) 0.5 (C) 0.05 (D) 10
- The value of K_p for the reaction, $A(g) + 2B(g) \rightleftharpoons C(g)$ is 25 atm^{-2} at a certain temperature. The value of K_p for the reaction, $\frac{1}{2} C(g) \rightleftharpoons \frac{1}{2} A(g) + B(g)$ at the same temperature would be :
 (A) 25 atm^{-1} (B) $\frac{1}{25} \text{ atm}^{-1}$ (C) $\frac{1}{5} \text{ atm}$ (D) 5 atm
- For the gaseous reaction of XO with O_2 to form XO_2 , the equilibrium constant at 398 K is 1×10^{-4} lit/mole. If 1 mole of XO and 2 mole of O_2 are placed in a 1 L vessel and allowed to come to equilibrium, what will be the equilibrium concentration of each of the species ?
- Prove that the pressure at equilibrium obtained upon 50% dissociation of PCl_5 as follows at 250°C is numerically three times of K_p . $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

PHYSICAL CHEMISTRY

DPP
 DAILY PRACTICE PROBLEMS

DPP No. 40

Total Marks : 26

Max. Time : 28 min.

Topic : Chemical Equilibrium

Type of Questions

Single choice Objective ('-1' negative marking) Q.1 to Q.6

(3 marks, 3 min.)

M.M., Min.

[18, 18]

Subjective Questions ('-1' negative marking) Q.7 to Q.8

(4 marks, 5 min.)

[8, 10]

- $\text{CH}_3\text{-CO-CH}_3(\text{g}) \rightleftharpoons \text{CH}_3\text{-CH}_3(\text{g}) + \text{CO}(\text{g})$
 Initial pressure of CH_3COCH_3 is 100 mm. When equilibrium is set up, mole fraction of $\text{CO}(\text{g})$ is $1/3$. Hence value of K_p for given reaction is :

(A) 100 mm (B) 50 mm (C) 25 mm (D) 0.6 mm
- The degree of dissociation of N_2O_4 (α) obeying the equilibrium,
 $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$, is approximately related to the pressure at equilibrium by :

(A) $\alpha \propto P$ (B) $\alpha \propto \frac{1}{\sqrt{P}}$ (C) $\alpha \propto \frac{1}{P^2}$ (D) $\alpha \propto \frac{1}{P^4}$
- Two moles of HI were heated in a sealed tube at 440°C till the given equilibrium was reached. HI was found to be 20% decomposed. The equilibrium constant for dissociation is :

$$2\text{HI}(\text{g}) \rightleftharpoons \text{H}_2(\text{g}) + \text{I}_2(\text{g})$$

(A) $\frac{1}{16}$ (B) $\frac{1}{32}$ (C) $\frac{1}{64}$ (D) $\frac{1}{128}$
- In the following reaction, $3\text{A}(\text{g}) + \text{B}(\text{g}) \rightleftharpoons 2\text{C}(\text{g}) + \text{D}(\text{g})$,
 Initial moles of B is double of A. At equilibrium, moles of A and C are equal. Hence % dissociation of B is :

(A) 10% (B) 20% (C) 40% (D) 5%
- For the equilibrium $\text{N}_2\text{O}_4 \rightleftharpoons 2\text{NO}_2$ in gaseous phase, NO_2 is 50% of the total volume when equilibrium is set up. Hence percent of dissociation of N_2O_4 is :

(A) 50% (B) 25% (C) 66.66% (D) 33.33%
- PCl_5 is 40% dissociated according to the following reaction, when equilibrium pressure is 2 atm. It will be 80% dissociated, when equilibrium pressure is approximately : $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$

(A) 0.2 atm (B) 0.5 atm (C) 0.3 atm (D) 0.6 atm
- The equilibrium constant for the following reaction, $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \rightleftharpoons 2\text{HBr}(\text{g})$ is 1.6×10^5 at 1024 K. Find the equilibrium pressure of all gases if 10 bar of HBr is introduced into a sealed container at 1024 K initially.
- At a certain temperature, the equilibrium constant (K_c) is $9/4$ for the reaction :

$$\text{CO}(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{CO}_2(\text{g}) + \text{H}_2(\text{g})$$

If we take 10 mole of each of the four gases in a one-litre container, what would be the equilibrium mole percent of $\text{H}_2(\text{g})$?

Topic : Chemical Equilibrium

Type of Questions

Single choice Objective ('-1' negative marking) Q.1, 2, Q.4 to Q.8	(3 marks, 3 min.)	M.M., Min.
Subjective Questions ('-1' negative marking) Q.3	(4 marks, 5 min.)	[21, 21]
Multiple choice objective ('-1' negative marking) Q.9	(4 marks, 4 min.)	[4, 5]
		[4, 4]

- For $A(g) \rightleftharpoons 2B(g)$, equilibrium constant at total equilibrium pressure p_1 is K_{p_1} & for $C(g) \rightleftharpoons D(g) + E(g)$, equilibrium constant at total equilibrium pressure p_2 is K_{p_2} . If degree of dissociation of A & C are same, then the ratio p_1/p_2 , if $K_{p_1} = 2 K_{p_2}$, is :
 (A) 1/2 (B) 1/3 (C) 1/4 (D) 2
- Match the following : (Take reactants to be in stoichiometric proportions in case of two reactants)

Reaction (Homogeneous gaseous phase)	Degree of dissociation of reactant in terms of equilibrium constant
1. $A + B \rightleftharpoons 2C$	(a) $(\sqrt{K})/(1 + \sqrt{K})$
2. $2A \rightleftharpoons B + C$	(b) $(\sqrt{K})/(2 + \sqrt{K})$
3. $A + B \rightleftharpoons C + D$	(c) $2K / (1 + 2K)$
4. $AB \rightleftharpoons \frac{1}{2}A_2 + \frac{1}{2}B_2$	(d) $\frac{2\sqrt{K}}{1 + 2\sqrt{K}}$

(A) 1-d, 2-c, 3-b, 4-a (B) 1-a, 2-c, 3-b, 4-d
 (C) 1-b, 2-d, 3-a, 4-c (D) 1-b, 2-a, 3-d, 4-c

- 0.96 g of HI were heated to attain equilibrium $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$. The equilibrium mixture, on reaction requires 15 mL of M/10 Hypo ($Na_2S_2O_3$) solution. Calculate the degree of dissociation of HI.
 $I_2 + Na_2S_2O_3 \longrightarrow Na_2S_4O_6 + NaI$ (unbalanced)
- In an evacuated closed isolated chamber at $227^\circ C$, 0.02 mole PCl_5 and 0.01 mole Cl_2 are mixed and $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ equilibrium is attained. At equilibrium, density of mixture was 2.4 g/L and pressure was 1 atm. The number of total moles at equilibrium will be approximately :
 (A) 0.012 (B) 0.022 (C) 0.032 (D) 0.0488
- For $NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$ reaction started only with $NH_4HS(s)$, the observed pressure for reaction mixture in equilibrium is 1.12 atm at $106^\circ C$. What is the value of K_p for the reaction ?
- For the reaction : $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$, $K_p = 1$ atm at $727^\circ C$. If 20 g of $CaCO_3$ were kept in a 10 litre vessel at $727^\circ C$, then the percentage of $CaCO_3$ remaining at equilibrium is :
 (A) 40% (B) 60% (C) 46% (D) 66%
- 200 g of $CaCO_3(s)$ are taken in a 4 L container at a certain temperature. K_c for the dissociation of $CaCO_3$ at this temperature is found to be $1/4$ mole L^{-1} . Then, the concentration of CaO in mole/litre is : [Given $\rho_{CaO} = 1.12$ g cm^{-3}]
 (A) 1/2 (B) 1/4 (C) 0.02 (D) 20
- The exothermic formation of NH_3 is represented by the equation : $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
 Which of the following will increase the quantity of NH_3 in an equilibrium mixture of N_2 , H_2 and NH_3 :
 (A) Increasing the temperature (B) Increasing the volume of container
 (C) Removing N_2 (D) Adding H_2
- * When $AgNO_3$ is heated mildly in a closed vessel, oxygen is liberated and $AgNO_2$ is left behind. At equilibrium according to reaction $AgNO_3(s) \rightleftharpoons AgNO_2(s) + \frac{1}{2}O_2(g)$:
 (A) addition of $AgNO_2$ favours reverse reaction (B) addition of $AgNO_3$ favours forward reaction
 (C) increasing temperature favours forward reaction (D) increasing pressure favours reverse reaction

Topic : Chemical Equilibrium
Type of Questions
M.M., Min.

Single choice Objective ('-1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Multiple choice objective ('-1' negative marking) Q.4 to Q.5	(4 marks, 4 min.)	[8, 8]
Comprehension ('-1' negative marking) Q.6 to Q.8	(3 marks, 3 min.)	[9, 9]

- $\text{CaCO}_3(\text{s}) \rightleftharpoons \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$,
 At equilibrium in the above case, 'a' moles of CaCO_3 , 'b' moles of CaO and 'c' moles of CO_2 are found. Then, identify the wrong statement :
 (A) Moles of CaCO_3 will decrease with the addition of inert gas at constant pressure.
 (B) Moles of CaCO_3 will remain constant with the increase in volume.
 (C) If volume of the vessel is halved, then moles of CaCO_3 will increase.
 (D) Moles of CaO will decrease with the increase in pressure.
- For the equilibrium $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}(\text{s}) \rightleftharpoons \text{CuSO}_4 \cdot \text{H}_2\text{O}(\text{s}) + 4\text{H}_2\text{O}(\text{g})$, the equilibrium constant $K_p = 2.56 \times 10^{-10} \text{ atm}^4$ at 27°C . Now, if an air sample 40% saturated with water vapour is exposed to the above reaction at equilibrium, which of the following statements is/are correct :
 Given : Saturated vapour pressure of water at 27°C is 12.5 torr.
 (A) Mass of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ will increase. (B) Mass of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ will decrease.
 (C) Mass of $\text{CuSO}_4 \cdot \text{H}_2\text{O}$ will increase. (D) Mass of $\text{CuSO}_4 \cdot \text{H}_2\text{O}$ will decrease.
- $2\text{Pb}(\text{NO}_3)_2(\text{s}) \rightleftharpoons 2\text{PbO}(\text{s}) + 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g}), \Delta H > 0$
 Above equilibrium is established by taking some amount of $\text{Pb}(\text{NO}_3)_2(\text{s})$ in a closed container at 1600 K. Then which of the following is the INCORRECT option :
 (A) moles of $\text{PbO}(\text{s})$ will increase with the increase in temperature
 (B) If the volume of the container is doubled at equilibrium, then partial pressure of $\text{NO}_2(\text{g})$ will change at new equilibrium.
 (C) If the volume of the container is halved, partial pressure of $\text{O}_2(\text{g})$ at new equilibrium will remain same
 (D) If two moles of He gas is added at constant pressure, then the moles of $\text{PbO}(\text{s})$ will increase.
- *
 1 mole each of $\text{N}_2(\text{g})$ and $\text{O}_2(\text{g})$ are introduced in a 1L evacuated vessel at 523K and equilibrium $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{NO}(\text{g})$ is established. The concentration of $\text{NO}(\text{g})$ at equilibrium :
 (A) Changes on changing pressure. (B) Changes on changing temperature.
 (C) Changes on changing volume of the vessel.
 (D) Remains same even when a platinum gauze is introduced to catalyse the reaction.

- 5.* For the reaction, $\frac{1}{2} \text{H}_2(\text{g}) + \frac{1}{2} \text{I}_2(\text{g}) \rightleftharpoons \text{HI}(\text{g})$
 If pressure is increased by reducing the volume of the container, then :
- (A) Total pressure at equilibrium will change.
 (B) Concentration of all the components at equilibrium will change.
 (C) Concentration of all the components at equilibrium will remain same.
 (D) Equilibrium will shift in the forward direction.

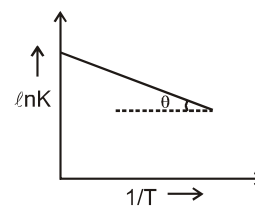
Comprehension # (Q. 6 to Q. 8)

Variation of equilibrium constant K with temperature T is given by Vant Hoff's equation as :

$$K = Ae^{-\frac{\Delta H^\circ}{RT}} \quad (\text{A} - \text{Pre exponential factor})$$

For a certain reaction, a graph between $\ln K$ and $1/T$ was observed to be straight line as shown in the figure below :

- Given :
- (1) As $T \rightarrow \infty$, $\ln K = 46.06$
 (2) $\theta = 30^\circ$
 (3) Use $\ln K = 2.303 \log_{10} K$



6. The value of ΔH° (standard enthalpy change) for the given reaction is :
- (A) $-\frac{R}{\sqrt{3}}$ (B) $-R\sqrt{3}$ (C) $R\sqrt{3}$ (D) $\frac{R}{\sqrt{3}}$
7. The value of pre-exponential factor A for the given reaction is :
- (A) 10^2 (B) 10^{20} (C) 10^{-2} (D) 10^{-20}
8. Which of the following statements is INCORRECT regarding the given reaction :
- (A) The given reaction is an endothermic reaction.
 (B) For the given reaction, standard entropy change (ΔS°) is positive.
 (C) The value of equilibrium constant K decreases with increase in temperature.
 (D) The value of equilibrium constant K is unaffected by pressure changes.

Topic : Chemical Equilibrium

Type of Questions

Subjective Questions ('-1' negative marking) Q.1 to Q.4

(4 marks, 5 min.)

M.M., Min.

[16, 20]

Multiple choice objective ('-1' negative marking) Q.5

(4 marks, 4 min.)

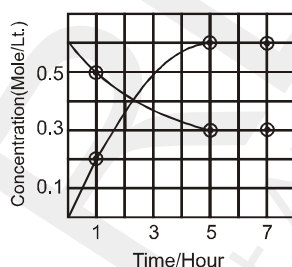
[4, 4]

Comprehension ('-1' negative marking) Q.6 to Q.8

(3 marks, 3 min.)

[9, 9]

- The equilibrium constant of the reaction $A_2(g) + B_2(g) \rightleftharpoons 2AB(g)$ at $100^\circ C$ is 50. If a one litre flask containing one mole of A_2 is connected to a two litre flask containing two moles of B_2 , how many moles of AB will be formed at 373 K ?
- The progress of reaction : $A(g) \rightleftharpoons nB(g)$ with time, is presented in fig. given below. Determine :



- the value of n
 - the equilibrium constant, K_c and
- One mole of $Cl_2(g)$ and 3 moles of $PCl_5(g)$ are placed in a 100 litre vessel heated to $227^\circ C$. The equilibrium pressure is 2.05 atm. Assuming ideal behaviour, calculate the degree of dissociation of $PCl_5(g)$ and K_p for the reaction, $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$.
 - When equal volumes of 0.2 M $AgNO_3$ and 1 M KCN solutions were mixed then at equilibrium, concentration of Ag^+ was found to be 10^{-6} M. While when equal volumes of 0.2 M $Zn(NO_3)_2$ solution and of 1 M KCN solution were mixed then at equilibrium, concentration of Zn^{2+} ion was found to be 10^{-12} M. Then find the equilibrium constant K_c of following reaction : $2[Ag(CN)_2]^- (aq.) + Zn^{2+} (aq.) \rightleftharpoons [Zn(CN)_4]^{2-} (aq.) + 2Ag^+ (aq.)$.
 - * Consider two equilibrium $2Cl_2(g) + 2H_2O(g) \rightleftharpoons 4HCl(g) + O_2(g)$ and $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ simultaneously established in a closed vessel. When some amount of HCl is added at equilibrium, which of the following statements is correct :
 (A) amount of N_2 gas will decrease. (B) amount of N_2 gas will increase.
 (C) amount of O_2 gas will decrease. (D) nothing can be said with certainty.

Comperhension # (Q.6 to Q.8)

Solid NH_4I rapidly decompose as follows : $NH_4I(s) \rightleftharpoons NH_3(g) + HI(g)$

At equilibrium, total pressure = 0.5 atm.

Now, HI starts decomposing as follows : $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$

At final equilibrium, partial pressure of $H_2 = \frac{3}{16}$ atm.

Now answer the following questions :

- Calculate new total pressure :
 (A) 0.9 atm (B) 1 atm (C) 0.6 atm (D) 0.5 atm
- Calculate K_p for the reaction $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$:
 (A) $\frac{9}{4}$ (B) $\frac{9}{8}$ (C) $\frac{9}{16}$ (D) None of these
- Partial pressure of HI at equilibrium is :
 (A) 0.05 atm (B) 0.1 atm (C) 0.15 atm (D) 0.125 atm

PHYSICAL CHEMISTRY

DPP
 DAILY PRACTICE PROBLEMS

DPP No. 44

Total Marks : 28

Max. Time : 32 min.

Topic : Thermodynamics & Thermochemistry

Type of Questions

Single choice Objective ('-1' negative marking) Q.1 to Q.4

(3 marks, 3 min.)

M.M., Min.

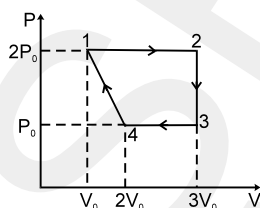
[12, 12]

Subjective Questions ('-1' negative marking) Q.5 to Q.8

(4 marks, 5 min.)

[16, 20]

- In thermodynamics, a process is called reversible when :
 (A) surrounding and system change into each other.
 (B) there is no real boundary between system and surrounding.
 (C) the surrounding is always in equilibrium with the system.
 (D) the system changes into the surrounding spontaneously.
- Choose the incorrect statement :
 (A) System and surrounding are always separated by a real or imaginary boundary.
 (B) Perfectly isolated system can never be created.
 (C) In reversible process, energy change in each step can be reversed.
 (D) Irreversible process is also called quasi-equilibrium process.
- For the process on an ideal gas, which of the following statements is true :

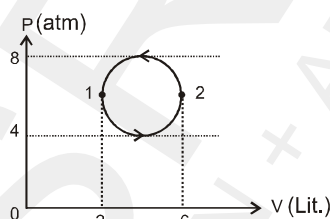


- (A) v_{mps} at 1 > v_{mps} at 2 > v_{mps} at 3 > v_{mps} at 4. (B) v_{mps} at 1 = v_{mps} at 4 < v_{mps} at 2 < v_{mps} at 3.
 (C) v_{mps} at 1 = v_{mps} at 4 < v_{mps} at 3 < v_{mps} at 2. (D) v_{mps} at 2 > v_{mps} at 3 > v_{mps} at 4 = v_{mps} at 1.
- Two flask A and B have equal volumes. Flask A contains hydrogen at 600 K while flask B has same mass of CH_4 at 300 K. Then choose the correct options :
 (A) In flask A, the molecules move faster than in B, on an average.
 (B) In flask B, the molecules move faster than in A, on an average.
 (C) Flask A contains greater number of molecules than B.
 (D) Flask B contains greater number of molecules than A.
 - Categorise the following into state and path functions :
 (a) Internal energy (b) Pressure (c) Volume (d) Temperature (e) Heat
 (f) Work (g) Free energy (h) Entropy (i) Molar heat Capacity (j) Height of a hill
 (k) Distance travelled in climbing the hill
 - Categorise these properties into extensive and intensive property :
 (a) Pressure of gas (b) Volume (c) Density (d) Temperature
 (e) Heat capacity (f) Specific heat capacity (g) Molar heat capacity (h) Molarity
 (i) Dielectric constant (j) Internal energy (k) Specific internal energy (l) Mass
 - Classify the following among closed, open and isolated system :
 (a) Pressure cooker (b) Boiler (c) Liquid cooling system of an automobile (d) Thermos flask
 (e) Universe (f) Living things (g) Human body (h) Electrochemical cells
 (i) A cup of tea (j) A closely packed room in which a split air-conditioner is working.
 - 7.5 KJ heat is added to a closed system and its internal energy decreases by 12 KJ. So, how much energy is transferred as work? For a new process, if the work is zero, then how much heat is transferred for the same changes in state of system?

Topic : Thermodynamics & Thermochemistry

Type of Questions		M.M., Min.
Single choice Objective ('-1' negative marking) Q.1 to Q.2	(3 marks, 3 min.)	[6, 6]
Multiple choice objective ('-1' negative marking) Q.3 to Q.4	(4 marks, 4 min.)	[8, 8]
Subjective Questions ('-1' negative marking) Q.5 to Q.7	(4 marks, 5 min.)	[12, 15]
Comprehension ('-1' negative marking) Q.8 to Q.10	(3 marks, 3 min.)	[9, 9]

1. For a reversible process, calculate magnitude of work done from the following PV diagram :



- (A) 4π (B) 6π (C) 2π (D) 0

2. 2 mole of an ideal gas expands isothermally and reversibly from 1 L to 10 L at 300 K. What is the internal energy change :

- (A) 4.98 kJ (B) 11.47 kJ (C) -11.47 kJ (D) 0 kJ

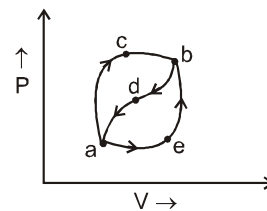
3.* For isothermal expansion of an ideal gas sample, the correct relation(s) is/are : (Consider all quantities with sign according to IUPAC convention and the reversible and irreversible processes are carried out between same initial and final states.)

- (A) $W_{rev} > W_{irrev}$ (B) $W_{irrev} > W_{rev}$ (C) $q_{rev} < q_{irrev}$ (D) $\Delta E_{rev} = \Delta E_{irrev}$

4.* 1 mole of argon gas is expanded isothermally and reversibly from 10L to 100L. Which of the following options is/are incorrect for the process :

- (A) $\Delta E = 0$ (B) $W = 0$
 (C) heat supplied (q) = 0 (D) $\Delta T = 0$

5. When a system is taken from state 'a' to state 'b' in fig. along path 'acb', 100 J of heat flows into the system and the system does 40 J of work. How much heat flows into the system along path 'aeb' if work done by the system is 20 J? The system returns from 'b' to 'a' along path 'bda'. If the work done on the system is 30 J, does the system absorb or liberate heat? How much?

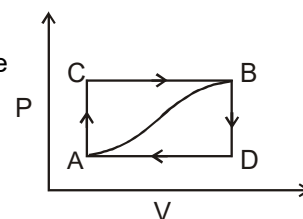


6. Calculate the energy needed to raise the temperature of 20 g iron from 25°C to 500°C, if specific heat capacity of iron is 0.45 J°C⁻¹g⁻¹.
7. The energy required to vapourise one mole of benzene at its boiling point is 31.2 kJ mol⁻¹. For how long a 100 W electric heater has to be operated in order to vaporize a 100 g sample of benzene at its boiling temperature?

Comprehension # (Q.8 to Q.10)

When a system is taken from state A to state B along path ACB as shown in figure below, 80 J of heat flows into the system and the system does 30 J of work.

Now answer the following questions :



8. How much heat flows into the system along path ADB if the work done by the system is 10 J :
 (A) 40 J (B) 60 J (C) 80 J (D) 100 J
9. When the system is returned from state B to A along the curved path, the work done on the system is 20 J. Does the system absorb or liberate heat and how much :
 (A) 70 J ; heat is liberated. (B) 60 J ; heat is liberated.
 (C) 70 J ; heat is absorbed. (D) 60 J ; heat is absorbed.
10. If $E_D - E_A = -40\text{J}$, then the heat corresponding to the processes AD and DB is respectively :
 (A) $q_{AD} = 30\text{ J}$ and $q_{DB} = -90\text{ J}$ (B) $q_{AD} = -60\text{ J}$ and $q_{DB} = 30\text{ J}$
 (C) $q_{AD} = 30\text{ J}$ and $q_{DB} = 90\text{ J}$ (D) $q_{AD} = -30\text{ J}$ and $q_{DB} = 90\text{ J}$

PHYSICAL CHEMISTRY

DPP
 DAILY PRACTICE PROBLEMS

DPP No. 46

Total Marks : 28

Max. Time : 30 min.

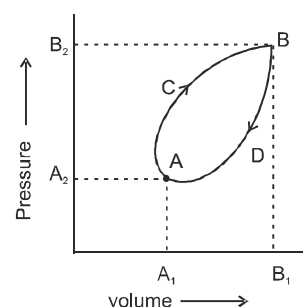
Topic : Thermodynamics & Thermochemistry

Type of Questions

Type of Questions	M.M., Min.
Single choice Objective ('-1' negative marking) Q.1 to Q.5	(3 marks, 3 min.) [15, 15]
Subjective Questions ('-1' negative marking) Q.6 to Q.8	(4 marks, 5 min.) [12, 15]
True or False (no negative marking) Q.9	(2 marks, 2 min.) [2, 2]

- In a system, a piston caused an expansion against an external pressure of 1.2 atm giving a change in volume of 32 L for which $\Delta E = -51$ kJ. What was the value of heat involved : (Take 1 L atm = 100 J)
 (A) -36 kJ (B) -13 kJ (C) -47 kJ (D) 24 kJ
- The q value and work done in isothermal reversible expansion of one mole of an ideal gas from initial pressure of 1 bar to final pressure of 0.1 bar at constant temperature 273 K are :
 (A) 5.22 kJ, -5.22 kJ (B) -5.22 kJ, 5.22 kJ (C) 5.22 kJ, 5.22 kJ (D) -5.22 kJ, -5.22 kJ
- What is the difference between change in enthalpy and change in internal energy at constant volume :
 (A) 0 (B) VdP (C) $-VdP$ (D) $+PdV$
- Calculate work done when 1 mole of an ideal gas is expanded from 10 L to 20 L against a constant 1 atm pressure at constant temperature of 300 K :
 (A) 7.78 kJ (B) -1.013 kJ (C) 11.73 kJ (D) -4.78 kJ

- A thermodynamic system goes in cyclic reversible process as represented in the following P-V diagram :
 The net work done during the complete cycle is given by the area :
 (A) cycle ACBDA (B) AA_1B_1BDA
 (C) AA_2B_2B (D) AA_1B_1BCA



- The valve on a cylinder containing initially 10 liters of an ideal gas at 25 atm and 25°C is opened to the atmosphere, where the pressure is 760 torr and the temperature is 25°C. Assuming that the process is isothermal, how much work in L atm is done on the atmosphere by the action of expanding gas ?
- 20 g Ar gas is allowed to expand reversibly and isothermally at 300 K from 5 L to 10 L. Calculate the approximate value of work done. (Take $R = 8.3$ J/K/mole, at.wt of Ar = 40)
- A horizontal piston-cylinder arrangement is placed in a constant temperature bath. The piston slides in the cylinder with negligible friction, and an external force holds it in place against an initial gas pressure of 14 bar. The initial gas volume is 0.03 m³.
 (a) The external force on the piston is reduced gradually, allowing the gas to expand until its volume doubles. Calculate the work done by the gas in moving the external force.
 (b) How much work would be done if the same expansion is carried out by removing a part of the external force suddenly. Also calculate efficiency of this process as compared with the reversible process.
- Which of the following statements are correct (T/F) :
 (a) 1st law of thermodynamics can be applied on the individual particle enclosed in vessel.
 (b) Many thermodynamic properties cannot be measured absolutely, so change in thermodynamic property is required for calculation.
 (c) Feasibility of any chemical reaction cannot be explained by thermodynamics.
 (d) When surroundings are always in equilibrium with the system, the process is called reversible.
 (e) Between same initial and final states, work done by gas in isothermal irreversible expansion is less than the work in isothermal reversible expansion.

Topic : Thermodynamics & Thermochemistry

Type of Questions

Single choice Objective ('-1' negative marking) Q.1 to Q.7

(3 marks, 3 min.)

M.M., Min.

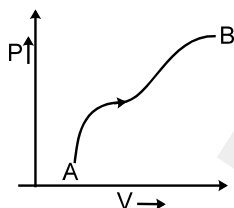
[21, 21]

Comprehension ('-1' negative marking) Q.8 to Q.10

(3 marks, 3 min.)

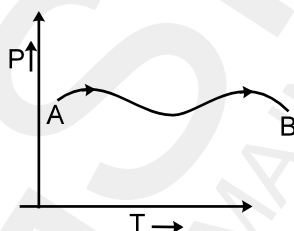
[9, 9]

1. The graph given below shows the P-V plot for a process on an ideal gas. Select the correct statement :



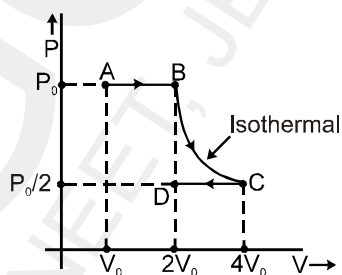
- (A) Enthalpy content of the gas is constantly increasing and the process is carried out slowly.
- (B) Enthalpy content of the gas first increases, then decreases and the process is carried out quasistatically.
- (C) Enthalpy content of the gas is constant and the process takes infinite time for completion.
- (D) Enthalpy content first decreases, then increases and the process is reversible.

2. The P-T graph, as given below, was observed for a process on an ideal gas. Which of the following statement is true :



- (A) $W = +ve, \Delta H = +ve$
- (B) $W = -ve, \Delta H = -ve$
- (C) $W = -ve, \Delta H = +ve$
- (D) $W = +ve, \Delta H = -ve$

3. $q, W, \Delta E$ and ΔH for the following process ABCD on a monoatomic gas are :



- (A) $W = -2 P_0 V_0 \ln 2, q = 2 P_0 V_0 \ln 2, \Delta E = 0, \Delta H = 0$
- (B) $W = -2 P_0 V_0 \ln 2, q = 2 P_0 V_0 \ln 2, \Delta E = 0, \Delta H = 2 P_0 V_0 \ln 2$
- (C) $W = -P_0 V_0 (1 + \ln 2), q = P_0 V_0 (1 + \ln 2), \Delta E = 0, \Delta H = 0$
- (D) $W = -P_0 V_0 \ln 2, q = P_0 V_0 \ln 2, \Delta E = 0, \Delta H = 0$

4. A system containing a real gas changes its state from state-1 to state-2.

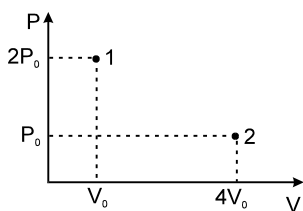
State-1 (3 atm, 2L, 300 K)

State-2 (5 atm, 4L, 500 K)

If change in internal energy = 30 L atm, then calculate change in enthalpy :

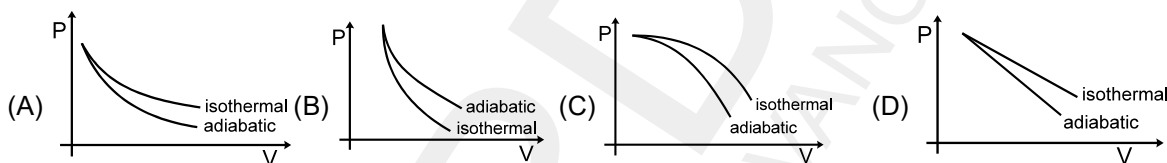
- (A) 44 L atm
- (B) 35 L atm
- (C) 40 L atm
- (D) None of these

5. A liquid which is confined inside an adiabatic piston is suddenly taken from state-1 to state-2 by a single stage irreversible process. If the piston comes to rest at point 2 as shown, then the enthalpy change for the process will be :

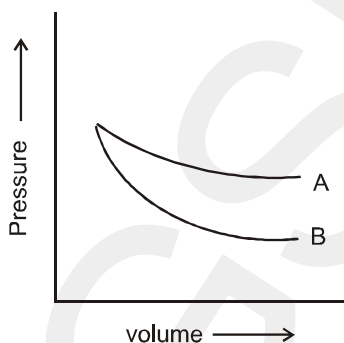


- (A) $\Delta H = \frac{2\gamma P_0 V_0}{\gamma - 1}$ (B) $\Delta H = \frac{3\gamma P_0 V_0}{\gamma - 1}$ (C) $\Delta H = -P_0 V_0$ (D) None of these

6. The correct figure representing isothermal and adiabatic expansions of an ideal gas from a particular initial state is :



7. P-V plots for two gases during an adiabatic process are given in the figure :

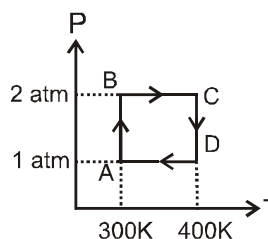


Plot A and plot B should correspond to :

- (A) He and O₂ (B) He and Ar (C) O₂ and He (D) O₂ and F₂

Comprehension # (Q. Nos. 8 to 10)

One mole of Helium gas undergoes a reversible cyclic process ABCDA as shown in the figure. Assuming gas to be ideal, answer the following questions:



8. What is the value of ΔH for the overall cyclic process :
 (A) $-100 R \ln 2$ (B) $+100 R \ln 2$ (C) $+200 R \ln 2$ (D) Zero
9. What is the value of 'q' for the overall cyclic process :
 (A) $-100 R \ln 2$ (B) $+100 R \ln 2$ (C) $+200 R \ln 2$ (D) $-200 R \ln 2$
10. What is the net work involved in the cyclic process :
 (A) $-100 R \ln 2$ (B) $+100 R \ln 2$ (C) $+200 R \ln 2$ (D) $-200 R \ln 2$

Topic : Thermodynamics & Thermochemistry

Type of Questions		M.M., Min.
Single choice Objective ('-1' negative marking) Q.1 to Q.7	(3 marks, 3 min.)	[21, 21]
Subjective Questions ('-1' negative marking) Q.8 to Q.10	(4 marks, 5 min.)	[12, 15]

- A monoatomic ideal gas ($C_v = \frac{3}{2} R$) is allowed to expand adiabatically and reversibly from initial volume of 8L at 300 K to a volume of V_2 at 250 K. V_2 is : (Given $(4.8)^{1/2} = 2.2$)

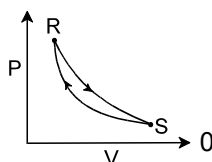
(A) 10.5 L (B) 23 L (C) 8.5 L (D) 50.5 L
- A gas is expanded from volume V_0 to $4V_0$ by following two ways : (from same initial state)

(a) 1st using reversible isothermal expansion from V_0 to $2V_0$, then using reversible adiabatic expansion from $2V_0$ to $4V_0$.

(b) 1st using reversible adiabatic expansion from V_0 to $2V_0$, then from $2V_0$ to $4V_0$ using reversible isothermal expansion.

Then which of the following options is correct :

(A) Work done in (a) process > work done in (b) process
 (B) Work done in (b) process > work done in (a) process
 (C) Work done in (b) process = work done in (a) process
 (D) cannot be predicted
- Consider the cyclic process $R \rightarrow S \rightarrow R$ as shown in the Fig. You told that one of the path is adiabatic and the other one isothermal. Which one of the following is(are) true :



- | | |
|---|--|
| (A) Process $R \rightarrow S$ is isothermal | (B) Process $S \rightarrow R$ is adiabatic |
| (C) Process $R \rightarrow S$ is adiabatic | (D) Such a graph is not possible |

4. A sample of gas is compressed from an initial volume of $2v_0$ to v_0 using three different processes.
First : Using reversible isothermal
Second : Using reversible adiabatic
Third : Using irreversible adiabatic under a constant external pressure
 Then :
 (A) Final temperature of gas will be highest in third process.
 (B) Final temperature of gas will be highest in second process.
 (C) Enthalpy change of sample will be highest in isothermal process. (magnitude wise)
 (D) Final pressure of gas will be highest in second process.
5. The magnitude of enthalpy changes for irreversible adiabatic expansion of a gas from 1L to 2L is ΔH_1 and for reversible adiabatic expansion for the same expansion, it is ΔH_2 . Then :
 (A) $\Delta H_1 > \Delta H_2$
 (B) $\Delta H_1 < \Delta H_2$
 (C) $\Delta H_1 = \Delta H_2$, enthalpy being a state function
 (D) $\Delta H_1 = \Delta E_1$ & $\Delta H_2 = \Delta E_2$
6. In which process, net work done by gas is zero :
 (A) Cyclic (B) Isobaric (C) Free expansion (D) Adiabatic
7. The ratio of slopes of P–V plots for reversible adiabatic process and reversible isothermal process of an ideal gas is equal to :
 (A) γ (B) $1 - \gamma$ (C) $(\gamma - 1)$ (D) $1/\gamma$
8. 2 moles of an ideal gas A ($\gamma = 4/3$) and 4 moles of an ideal gas B ($\gamma = 5/3$) are taken together in a container and expanded reversibly and adiabatically from 2 L to 8 L starting from initial temperature of 320 K. Calculate the work done by the gas (in calories) in the above process. ($R = 2$ calories/K/mol)
9. 1 mole of an ideal gas, initially at 400 K and 10 atm is first expanded at constant pressure till the volume is doubled. Then the gas is made to undergo an isochoric process, in which its temperature is found to decrease. In the last final step, gas was compressed reversibly and adiabatically to initial state. Determine the net work involved in this cyclic process (in terms of R). Given, C_V for gas = $1.5 R$, $(4)^{-1/3} = 0.63$.
10. Polytropic process for ideal gas is given as $PV^n = \text{constant}$. Show that for polytropic process for an ideal gas, the expression for work obtained is :

$$W = \frac{P_1 V_1 \left[\left(\frac{V_2}{V_1} \right)^{1-n} - 1 \right]}{(n-1)}$$

PHYSICAL CHEMISTRY

DPP
 DAILY PRACTICE PROBLEMS

DPP No. 49

Total Marks : 29

Max. Time : 31 min.

Topic : Thermodynamics & Thermochemistry

Type of Questions

Single choice Objective ('-1' negative marking) Q.1 to Q.7

(3 marks, 3 min.)

M.M., Min.

[21, 21]

Subjective Questions ('-1' negative marking) Q.8 to Q.9

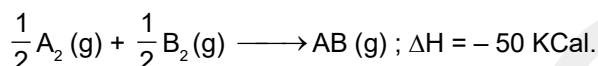
(4 marks, 5 min.)

[8, 10]

1. The species which by definition has zero standard molar enthalpy of formation at 298 K is :
 (A) CO₂ (g) (B) H₂O (l) (C) O₂ (g) (D) P₄ (red)
2. Consider the following processes
 (i) 1/2 H₂ (g) + aq. → H⁺ (aq.) (ii) 2O(g) → O₂(g)
 (iii) NH₄⁺ (g) + Cl⁻ (g) → NH₄Cl(s) (iv) P₄ (black) + 5O₂(g) → P₄O₁₀(s)
 Which of the above does not represent ΔH_{formation} of the product :
 (A) I,IV (B) II, IV (C) I, II, III (D) II, III, IV
3. The difference between heat of reaction at constant pressure and constant volume for the reaction given below at 27°C in kJ is : (Take R = 8.3 J/K/mole) 2 C₆H₆ (l) + 15 O₂ (g) → 12 CO₂ (g) + 6H₂O (l)
 (A) -7.47 (B) + 3.72 (C) - 3.72 (D) + 7.47
4. For the two reactions given below :
 H₂(g) + 1/2O₂(g) → H₂O (l) + x₁ kJ mol⁻¹
 H₂(g) + 1/2O₂(g) → H₂O (g) + x₂ kJ mol⁻¹
 Compare the magnitude of x₁ and x₂ : (x₁ and x₂ are the heat released in above two process.)
 (A) x₁ > x₂ (B) x₁ < x₂ (C) x₁ = x₂ (D) x₂ = 2x₁
5. The combustion of 0.2 mol of liquid carbon disulphide CS₂ to give CO₂(g) and SO₂(g) releases 215 kJ of heat. What is ΔH_f^o for CS_{2(l)} in kJ mol⁻¹ :
- | ΔH _f ^o | kJ mol ⁻¹ |
|------------------------------|----------------------|
| CO _{2(g)} | -393.5 |
| SO _{2(g)} | -296.8 |
- (A) 772.1 (B) 87.9 (C) -385 (D) - 475
6. Consider the following changes
 Na⁺(g) → Na⁺(aq) ΔH₁ (1) Na(s) → Na(g) ΔH₂ (2)
 Cl⁻(g) → Cl⁻(aq) ΔH₃ (3) Cl₂(g) → 2Cl(g) ΔH₄ (4)
 Na⁺(g) + Cl(g) → NaCl (s) + e⁻ ΔH₅ (5) NaCl(s) → Na⁺(aq) + Cl⁻(aq) ΔH₆ (6)
 Hydration enthalpy of NaCl can be defined by sum of the following :
 (A) ΔH₁ + ΔH₄ (B) ΔH₁ + ΔH₅ (C) ΔH₁ + ΔH₃ (D) ΔH₆ only
7. Given that S_(s) + 3/2 O_{2(g)} → SO_{3(g)} + 2x Kcal ; SO_{2(g)} + 1/2 O_{2(g)} → SO_{3(g)} + y Kcal
 What would be the enthalpy of formation of SO₂ :
 (A) - 2x + y (B) 2x + y (C) x + y (D) 2x/y
8. From the following data :
 (i) C_(graphite) + O₂ (g) → CO₂ (g) ; ΔH₁ = - 94.1 KCal
 (ii) C_(diamond) → C_(graphite) ; ΔH₂ = - 0.5 KCal
 Calculate ΔH for burning of diamond to CO₂.
9. The standard enthalpies of formation at 298 K for CCl₄ (g), H₂O (g), CO₂ (g) and HCl (g) are - 25.5, - 57.8, - 94.1 & - 22.1 KCal/mole respectively. Calculate ΔH₂₉₈^o for the reaction :
 CCl₄ (g) + 2 H₂O (g) → CO₂ (g) + 4 HCl (g).

PHYSICAL CHEMISTRY
DPP
DAILY PRACTICE PROBLEMS
DPP No. 50
Total Marks : 31
Max. Time : 35 min.
Topic : Thermodynamics & Thermochemistry
Type of Questions
Single choice Objective ('-1' negative marking) Q.1 to Q.5
(3 marks, 3 min.)
M.M., Min.
[15, 15]
Subjective Questions ('-1' negative marking) Q.6 to Q.9
(4 marks, 5 min.)
[16, 20]

1. For the reaction,



If the bond energies of A_2 , B_2 and 'AB' are respectively x , $\frac{x}{2}$ and x KCal, the value of x is :

- (A) 50 (B) 100 (C) 200 (D) 400

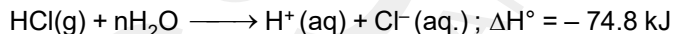
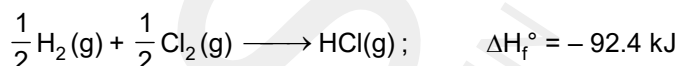
2. The enthalpy of neutralization of 40 g of NaOH by 60 g of CH_3COOH will be :

- (A) 57.1 kJ equiv⁻¹ (B) less than 57.1 kJ equiv⁻¹
 (C) more than 57.1 kJ equiv⁻¹ (D) 13.7 kJ equiv⁻¹

3. The heat evolved in neutralizing a solution containing 1mole of HCN with a strong alkali is 3 KCal. The enthalpy of dissociation of HCN is :

- (A) 10.2 KCal (B) 13.7 KCal (C) 10.7 KCal (D) 16.7 KCal

4. ΔH_f° for the chloride ion (aq) from the following data will be :



- (A) 167.2 kJ (B) -167.2 kJ (C) 334.4 kJ (D) -334.4 kJ

5. The polymerisation of ethylene to linear polyethylene is represented by the reaction :

$n CH_2 = CH_2 \longrightarrow (CH_2 - CH_2)_n$ where n has a large integral value. Given that the average enthalpies of bond dissociation for $C = C$ & $C - C$ at 298 K are +590 & +331 KJ mol⁻¹ respectively. Then the enthalpy of polymerisation per mole of ethylene at 298 K will be :

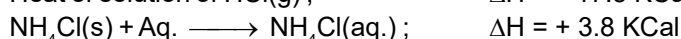
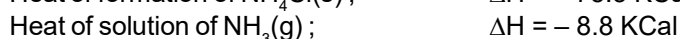
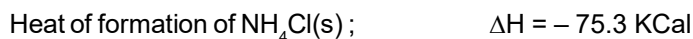
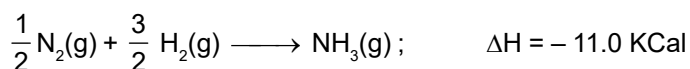
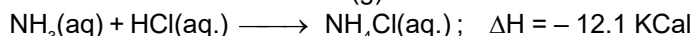
- (A) 72 kJ/mol (B) -72 kJ/mol (C) 36 kJ/mol (D) -36 kJ/mol

6. Assuming that 50% of the heat is useful, how many kg of water at 15°C can be heated to 95°C by burning 280 litre of methane at STP ? The heat of combustion of methane is 240 KCal/mol.

7. One litre sample of a mixture of CH_4 and O_2 measured at 27°C and 760 torr, was allowed to react at constant pressure in a calorimeter. The complete combustion of CH_4 to CO_2 and water caused a temperature rise in calorimeter of 0.667 K. Calculate mole % of CH_4 in original mixture. ($R = 1/12L \text{ atm/K/mole}$)

8. The specific heats of iodine vapour and solid are 0.031 Calg⁻¹°C⁻¹ and 0.055 Calg⁻¹°C⁻¹ respectively. If heat of sublimation of iodine is 24 Cal/g at 200°C, what is its value at 250°C ?

9. Calculate the heat of formation of HCl (g) from :



PHYSICAL CHEMISTRY
DPP
 DAILY PRACTICE PROBLEMS

DPP No. 51

Total Marks : 41

Max. Time : 49 min.

Topic : Thermodynamics & Thermochemistry
Type of Questions
Single choice Objective ('-1' negative marking) Q.8, 10, 11
(3 marks, 3 min.)
M.M., Min.
[9, 9]
Subjective Questions ('-1' negative marking) Q.1 to Q.7, 9
(4 marks, 5 min.)
[32, 40]

- The standard molar enthalpies of formation of ethane, CO_2 & liquid water are -21.1 , -94.1 and -68.3 kCal respectively. Calculate the standard molar enthalpy of combustion of ethane.
- The enthalpies of combustion of $\text{C}_2\text{H}_4(\text{g})$, $\text{C}_2\text{H}_6(\text{g})$ & $\text{H}_2(\text{g})$ are -1409.5 kJ, -1558.3 kJ and -285.6 kJ respectively. Calculate the enthalpy of hydrogenation of ethylene.
- The standard enthalpy of combustion at 25°C of hydrogen (H_2), cyclohexene (C_6H_{10}) and cyclohexane (C_6H_{12}) are -241 , -3800 and -3920 kJ/mole respectively. Calculate the enthalpy of hydrogenation of cyclohexene.
- Calculate the enthalpy of combustion of carbon monoxide at constant volume, given the following enthalpy of reactions at constant pressure at 17°C :
 (i) $\text{C}(\text{s}) + \text{O}_2(\text{g}) \longrightarrow \text{CO}_2(\text{g}) ; \Delta H_1 = -97000 \text{ Cal}$
 (ii) $\text{CO}_2(\text{g}) + \text{C}(\text{s}) \longrightarrow 2 \text{CO}(\text{g}) ; \Delta H_2 = 39000 \text{ Cal}$
- The bond dissociation energies of gaseous H_2 , Cl_2 & HCl are 104 , 58 & 103 kCal/mole respectively. Calculate the enthalpy of formation of HCl gas.
- Determine the enthalpy of hydrogenation of ethylene from the following data .

Bond	Bond energy	Bond	Bond energy
H – H	104 kCal/mol	C – C	80 kCal/mol
C – H	99 kCal/mol	C = C	145 kCal/mol
- Calculate the bond energy of $\text{C} = \text{C}$ from the following data. All ΔH units are in kCal.

$2 \text{C}(\text{s}) + 2 \text{H}_2(\text{g}) \longrightarrow \text{C}_2\text{H}_4(\text{g})$	$\Delta H = 12.5$
$\text{C}(\text{s}) \longrightarrow \text{C}(\text{g})$	$\Delta H = 170.9$
$\text{H}_2(\text{g}) \longrightarrow 2 \text{H}(\text{g})$	$\Delta H = 104.2$

 Bond energy of $\text{C} - \text{H}$ bond is 99 kCal/mol.
- Enthalpy of atomisation of NH_3 and N_2H_4 are x kcal mol^{-1} and y kcal mol^{-1} respectively. Calculate average bond energy of $\text{N}-\text{N}$ bond :
 (A) $\frac{4y - 3x}{3}$ kCal mol^{-1} (B) $\frac{2y - 3x}{3}$ kCal mol^{-1} (C) $\frac{4y - 3x}{4}$ kCal mol^{-1} (D) $\frac{3y - 4x}{3}$ kCal mol^{-1}
- From the following bond energy and standard ΔH° values for the formation of elements in gaseous state, calculate the standard enthalpy of formation of acetone(g) :

Standard ΔH°	Bond energies
H (g) = 52 kCal/mol	C – H = 99 kCal/mol
O (g) = 59 kCal/mol	C – C = 80 kCal/mol
C (g) = 171 kCal/mol	C = O = 81 kCal/mol
- The enthalpy of neutralization of a strong base and strong acid is 57.0 kJ eq^{-1} . The heat evolved when 0.5 moles of HNO_3 are added to 1 L of 0.2 M NaOH solution is :
 (A) 57.0 kJ (B) 28.5 kJ (C) 11.4 kJ (D) 34.9 kJ
- For strong acid and strong base neutralization, net chemical change is :
 $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \longrightarrow \text{H}_2\text{O}(\ell) ; \Delta_r H^\circ = -57.1 \text{ kJ/mol}$
 If enthalpy of neutralization of CH_3COOH by HCl is -50 kJ/mol, then enthalpy of ionisation of CH_3COOH is :
 (A) 7.1 kJ/mol (B) -7.1 kJ/mol (C) 107.1 kJ/mol (D) -107.1 kJ/mol

PHYSICAL CHEMISTRY

DPP
 DAILY PRACTICE PROBLEMS

DPP No. 52

Total Marks : 35

Max. Time : 40 min.

Topic : Thermodynamics & Thermochemistry

Type of Questions

Single choice Objective ('-1' negative marking) Q.1 to Q.5

(3 marks, 3 min.)

M.M., Min.

[15, 15]

Subjective Questions ('-1' negative marking) Q.6 to Q.10

(4 marks, 5 min.)

[20, 25]

- Given the following standard enthalpies of reaction :
 (i) Enthalpy of formation of water = - 68.3 kCal/mol
 (ii) Enthalpy of combustion of acetylene = - 310.6 kCal/mol
 (iii) Enthalpy of combustion of ethylene = - 337.2 kCal/mol
 Calculate the heat of reaction for the hydrogenation of acetylene at constant volume and 25°C.
- The internal energy change of the combustion of C₆H₆ (g) and C₂H₂ (g) at 300 K are - 800 Kcal/mole and - 300 Kcal/mole respectively. What is the enthalpy of polymerisation of C₂H₂ (g) to C₆H₆ (g) per mole of C₆H₆ (g) produced ? C₆H₆ (g), C₂H₂ (g) and C₂H₆ (g) behave ideally. R = 2 cal K⁻¹ mol⁻¹.
 (A) - 100 K Cal/mol (B) - 101.2 K Cal/mol (C) -98.8 K Cal/mol (D) - 103.6 K Cal/mol
- The dissociation energy of CH₄ is 360 kCal/mol and of ethane is 620 kCal/mol. Calculate C - C bond energy.
- Estimate Δ_rH for 2 C₄H₁₀ (g) → C₈H₁₈ (g) + H₂ (g). Given bond energy of C - C and C - H are 347 and 441 kJmol⁻¹. The enthalpy of formation of H (g) atom is 217.5 kJmol⁻¹.
- The average energy required to break a P - P bond in P₄ (s) into gaseous atoms is 53.3 kcal mol⁻¹. The bond dissociation energy of H₂(g) is 104.3 kcalmol⁻¹ ; Δ_fH⁰ of PH₃(g) from P₄(s) is 5.4 kcalmol⁻¹. The P-H bond energy in kcal mol⁻¹ is : [Neglect presence of Vanderwaal forces in P₄(s)]
 (A) 85.2 (B) 57.6 (C) 77 (D) 63.3
- Using the data (all values are in kilocalories per mole at 25°C) given below, calculate the bond energy of C - H and C - C bonds.
 Δ_{combustion (ethane) g} H⁰ = - 372 ; Δ_{combustion (propene) g} H⁰ = - 530
 Δ_fH⁰ for C (graphite) → C (g) = 172 ; Bond energy of H - H bond = 104
 Δ_fH⁰ of H₂O (l) = - 68 ; Δ_fH⁰ of CO₂ (g) = - 94
- Determine the enthalpy change of the reaction: C₃H₈ (g) + H₂ (g) → C₂H₆ (g) + CH₄ (g) at 25 °C, using the given enthalpy of combustion values under standard condition :

Compound	H ₂ (g)	CH ₄ (g)	C ₂ H ₆ (g)	C (graphite)
ΔH ⁰ (kJ/mole)	- 286	- 890	- 1560	- 393.5

 The standard enthalpy of formation of C₃H₈ (g) is - 104 kJ/mole.
- The standard molar enthalpies of formation of cyclohexane (l) and benzene (l) at 25° C are -156 and +49 KJ mol⁻¹ respectively. The standard enthalpy of hydrogenation of cyclohexene (l) at 25°C is -119 KJ mol⁻¹. Use these data to estimate the resonance energy of benzene in KJ mol⁻¹.
- The enthalpy of solution of anhydrous CuSO₄ is - 15.9 kCal/mol and that of CuSO₄ . 5 H₂O is 2.8 kCal/mol. Calculate the enthalpy of hydration of CuSO₄.
- Calculate Δ_fH⁰ for chloride ion (aq) from the following data :

$$\frac{1}{2} \text{H}_2 (\text{g}) + \frac{1}{2} \text{Cl}_2 (\text{g}) \longrightarrow \text{HCl} (\text{g}) \quad \Delta \text{H}_f^0 = - 92.4 \text{ kJ}$$

$$\text{HCl} (\text{g}) + n \text{H}_2\text{O} \longrightarrow \text{H}^+ (\text{aq}) + \text{Cl}^- (\text{aq}) \quad \Delta \text{H}_{298}^0 = - 74.8 \text{ kJ}$$

$$\Delta \text{H}_f^0 (\text{H}^+)_{\text{aq}} = 0.0 \text{ kJ}$$

Topic : Thermodynamics & Thermochemistry

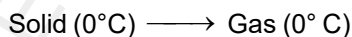
Type of Questions

		M.M., Min.
Single choice Objective ('-1' negative marking) Q.1	(3 marks, 3 min.)	[3, 3]
Subjective Questions ('-1' negative marking) Q.2 to Q.4	(4 marks, 5 min.)	[12, 15]
Comprehension ('-1' negative marking) Q.5 to Q.9	(3 marks, 3 min.)	[15, 15]

- For a gas having molar mass M , specific heat at constant pressure can be given as :
 (A) $\frac{\gamma R}{M(\gamma - 1)}$ (B) $\frac{\gamma}{RM}$ (C) $\frac{M}{R(\gamma - 1)}$ (D) $\frac{\gamma RM}{\gamma + 1}$
- 1 mole of ice at 0°C and 4.6 mm Hg pressure is converted to water vapour at constant temperature and pressure. Find ΔH and ΔE if the latent heat of fusion of ice is 80 Cal/g and latent heat of vaporisation of liquid water at 0°C is 596 Cal/g and the volume of ice in comparison to that of water vapour is neglected.
- Calculate q , W and ΔE when 100 g of calcite form of CaCO_3 is converted into its aragonite form at 100 bar pressure. Given density of calcite = 2 g/cc, density of aragonite = 2.5 g/cc and
 $\text{CaCO}_3 \rightleftharpoons \text{CaCO}_3 \quad \Delta H = 2 \text{ kJ/mole}$
 Calcite Aragonite
- A person inhales 640 g of O_2 per day. If all the O_2 is used for converting sugar into CO_2 and H_2O , how much sucrose ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$) is consumed in the body in one day and what is the heat evolved? ΔH (combustion of sucrose) = -5472 kJ/mol .

Comprehension # (Q.5 to Q.9)

Enthalpy of sublimation may be determined experimentally, but instead of that let us explore an easier route for its calculation. Figure-1 shows the three phases of water on an enthalpy scale. Since enthalpy is a state function, enthalpy changes depend only on the initial and the final states and not on the path. Therefore, we must find the same value for enthalpy change whether the system goes directly from solid to gas or through the intermediate state of liquid. Therefore, $\Delta H_{\text{sub}} = \Delta H_{\text{fus}} + \Delta H_{\text{vap}} \dots(1)$
 There is a small oversight in the way we obtained ΔH_{sub} . Equation (1) is true only if enthalpies are independent of temperature or if their values are measured or deduced at the same temperature. Suppose we have enthalpy data at different temperatures as is usually the case. How do we proceed then?
 We will illustrate the procedure with an estimate of ΔH_{sub} at 0°C from ΔH_{vap} at 100°C and ΔH_{fus} at 0°C . In order to calculate ΔH_{sub} at 0°C , figure-2 shows that the heat absorbed in the process



is equal to the heat absorbed in the process

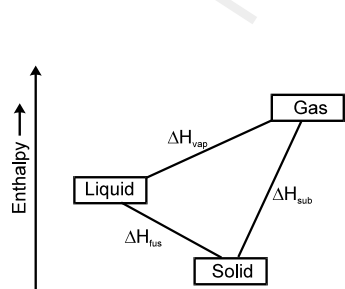
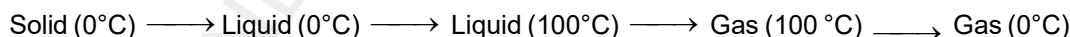


Figure-1

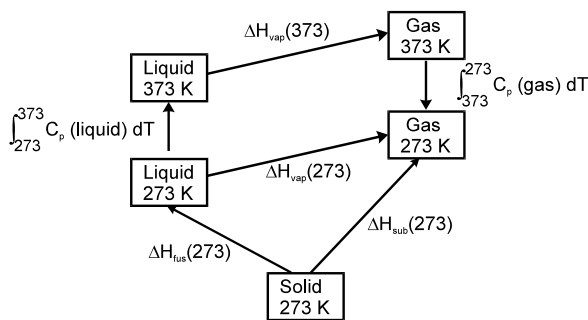


Figure-2

The enthalpy of sublimation at 0°C is therefore given by :

$$\Delta H_{\text{sub}}(0^\circ\text{C}) = \Delta H_{\text{fus}}(0^\circ\text{C}) + \int_{273}^{373} C_p(\text{liquid}) dT + \Delta H_{\text{vap}}(100^\circ\text{C}) + \int_{373}^{273} C_p(\text{gas}) dT$$

During chemical reactions also, we may not obtain the products at the temperature at which reactant were present initially. Then too, we can calculate the enthalpy change during the reaction at temperature of reactants. The basis of Kirchoff's equations in thermodynamics is also the same. The Kirchoff's equations are :

At constant pressure :

$$\Delta H_2^\circ = \Delta H_1^\circ + \int_{T_1}^{T_2} \Delta C_p dT$$

Where ΔH_1° is enthalpy change of reaction at temperature T_1 , and ΔH_2° is enthalpy change of reaction at temperature T_2 . ΔC_p is difference in molar heat capacities at constant pressure of products and reactants. Similarly

At constant volume :

$$\Delta E_2^\circ = \Delta E_1^\circ + \int_{T_1}^{T_2} \Delta C_v dT$$

USE THE FOLLOWING DATA :

Molar heat capacity of

- $\text{H}_2\text{O}(\text{solid}) = 40 \text{ J K}^{-1} \text{ mol}^{-1}$
- $\text{H}_2\text{O}(\text{liquid}) = 75 \text{ J K}^{-1} \text{ mol}^{-1}$
- $\text{H}_2\text{O}(\text{vapour}) = 30 \text{ J K}^{-1} \text{ mol}^{-1}$
- Latent heat of vaporisation = 40 kJ mol^{-1}
- Latent heat of fusion of $\text{H}_2\text{O} = 6 \text{ kJ mol}^{-1}$

5. Molar enthalpy of vaporisation of H_2O at 0°C is :
 (A) 44 kJ mole^{-1} (B) $44.5 \text{ kJ mole}^{-1}$ (C) $50.5 \text{ kJ mole}^{-1}$ (D) $-44.5 \text{ kJ mole}^{-1}$
6. Molar enthalpy of sublimation of H_2O at 223 K is :
 (A) 48 kJ mole^{-1} (B) 40 kJ mole^{-1} (C) 51 kJ mole^{-1} (D) 53 kJ mole^{-1}
7. If enthalpy change of reaction :
 $\text{H}_2\text{O}(\ell) \longrightarrow \text{H}_2\text{O}(\text{g})$ at 300 K is $43285 \text{ J mole}^{-1}$, then enthalpy change at 400 K will be :
 (A) $34285 \text{ J mole}^{-1}$ (B) $43285 \text{ J mole}^{-1}$ (C) $47785 \text{ J mole}^{-1}$ (D) $38785 \text{ J mole}^{-1}$
8. For a chemical reaction, ΔC_p is negative ($\Delta C_p < 0$).
 The heat required to increase temperature of reactants of this reaction by a certain amount = q_1 and heat required to increase temperature of products of the same reaction by same amount = q_2 . Then :
 (A) $q_1 > q_2$
 (B) $q_1 < q_2$
 (C) $q_1 = q_2$
 (D) q_1 may or may not be equal to q_2 and it will depend on nature of reactants and products.
9. If for reaction :
 $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \longrightarrow 2\text{NH}_3(\text{g})$, $\Delta H_1^\circ = -30 \text{ kJ/mole}$ at temperature 300 K and if specific heat capacities of different species are $s_{\text{P, N}_2} = 1 \text{ J/g}^\circ\text{C}$, $s_{\text{P, H}_2} = 10 \text{ J/g}^\circ\text{C}$ and $s_{\text{P, NH}_3} = 2 \text{ J/g}^\circ\text{C}$, then ΔH_2° at 400 K for the same reaction will be : (assume heat capacities to be constant in given temperature range)
 (A) -32 kJ/mole (B) -28 kJ/mole (C) -32.7 kJ/mole (D) -27.3 kJ/mole

PHYSICAL CHEMISTRY

DPP
 DAILY PRACTICE PROBLEMS

DPP No. 54

Total Marks : 32

Max. Time : 33 min.

Topic : Thermodynamics & Thermochemistry

Type of Questions

M.M., Min.

Single choice Objective ('-1' negative marking) Q.1 to Q.4, 6, 7, 9, 10 (8 marks, 8 min.) [24, 24]

Multiple choice objective ('-1' negative marking) Q.5 (4 marks, 4 min.) [4, 4]

Subjective Questions ('-1' negative marking) Q.8 (4 marks, 5 min.) [4, 5]

1. In which of the following cases, generally entropy decreases :

(A) Solid changing to liquid	(B) Expansion of a gas
(C) Crystal dissolves	(D) Polymerisation

2. Predict which of the following reaction(s) have a positive entropy change ?

I. $\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \longrightarrow \text{BaSO}_4(\text{s})$			
II. $\text{CaCO}_3(\text{s}) \longrightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$			
III. $2\text{SO}_3(\text{g}) \longrightarrow 2\text{SO}_2(\text{g}) + \text{O}_2(\text{g})$			
(A) I and II	(B) III	(C) II and III	(D) II

3. Which of the following reactions is expected to have the most negative change in entropy ?

(A) $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \longrightarrow 2\text{NH}_3(\text{g})$	(B) $\text{C}_2\text{H}_2(\text{g}) + 2\text{H}_2(\text{g}) \longrightarrow \text{C}_2\text{H}_6(\text{g})$
(C) $\text{C}(\text{s}) + \text{O}_2 \longrightarrow \text{CO}_2(\text{g})$	(D) $2\text{NO}_2(\text{g}) \longrightarrow \text{N}_2\text{O}_4(\text{s})$

4. Which statement regarding entropy is correct ?

(A) A completely ordered deck of cards has more entropy than a shuffled deck in which cards are arranged randomly.

(B) A perfect ordered crystal of solid nitrous oxide has more entropy than a disordered crystal in which the molecules are oriented randomly.

(C) 1 mole N_2 gas at STP has more entropy than 1 mole N_2 gas at 273 K in a volume of 11.2 litre.

(D) 1 mole N_2 gas at STP has more entropy than 1 mole N_2 gas at 273 K and 0.25 atm.

- 5*. Select the correct option(s) :

(A) Specific volume and molar heat capacity are intensive parameters.

(B) For an irreversible adiabatic compression process, entropy change of surrounding will be equal to zero.

(C) Change in internal energy for an ideal gas for an isobaric process is expressed as $\Delta U = nC_V(T_2 - T_1)$, where the terms used have their usual meaning.

(D) Free expansion is a reversible process.

6. Two moles of an ideal gas ($\gamma = 4/3$) is made to expand reversibly and adiabatically to 4 times its initial volume. The change in entropy of the system during expansion is : (Given : $R = 2 \text{ cal/K/mole}$, $\log_{10} 2 = 0.3$, $\log_{10} 3 = 0.48$)

(A) 5.6 cal/k	(B) 11.2 cal/k	(C) 2.8 cal/k	(D) None of these
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7. Two moles of an ideal monoatomic gas expands isothermally against a constant external pressure of 2 atm from an initial volume of 22.4 L to a state where its final pressure becomes equal to external pressure. If the initial temperature of gas is 273°C, then the entropy change of system in the above process is :
 [Given : 1 mole of an ideal gas occupies 22.4 L at STP conditions]
 (A) $R \ln 16$ (B) $R \ln 4$ (C) $R \ln 8$ (D) Zero
8. The enthalpy of vapourisation of liquid diethyl ether is 26 kJ/mol at its boiling point (52°C). Calculate ΔS for conversion of : (a) liquid to vapour, and (b) vapour to liquid at 52°C.
9. When two equal sized pieces of the same metal, each of mass m at different temperatures T_h (hot piece) and T_c (cold piece) are brought into contact and isolated from surrounding, the total change in entropy of system is given by : (Specific heat capacity of metal = s)
 (A) $ms \ln \frac{T_c + T_h}{2T_c}$ (B) $ms \ln \frac{T_h}{T_c}$ (C) $ms \ln \frac{(T_c + T_h)^2}{2T_h T_c}$ (D) $ms \ln \frac{(T_c + T_h)^2}{4T_h T_c}$
10. One mole of an ideal monoatomic gas at 27°C is subjected to a reversible isoentropic compression until final temperature reached to 327°C. If the initial pressure was 1.0 atm, then find the value of $\ln P_2$:
 (Given : $\ln 2 = 0.7$).
 (A) 1.75 atm (B) 0.176 atm (C) 1.0395 atm (D) 2.0 atm

PHYSICAL CHEMISTRY

DPP
 DAILY PRACTICE PROBLEMS

DPP No. 55

Total Marks : 37

Max. Time : 42 min.

Topic : Thermodynamics & Thermochemistry

Type of Questions

		M.M., Min.
Single choice Objective ('-1' negative marking) Q.6 to Q.8	(3 marks, 3 min.)	[9, 9]
Subjective Questions ('-1' negative marking) Q.1, 2, 5, 9, 10	(4 marks, 5 min.)	[20, 25]
Multiple choice objective ('-1' negative marking) Q.3 to Q.4	(4 marks, 4 min.)	[8, 8]

- A sample of certain mass of an ideal polyatomic non-linear gas is expanded against constant pressure of 1 atm adiabatically from volume 2 L, pressure 6 atm and temperature 300 K to a state, where its final volume is 8 L. Then calculate entropy change of system (in J/K) in the process : (Neglect vibrational degrees of freedom) [1L atm = 100 J, log 2 = 0.3, log 3 = 0.48, log e = 2.3]
- 2 moles of an ideal monoatomic gas undergo a reversible process for which $P^2V = \text{constant}$. The gas sample is made to expand from initial volume of 1L to final volume of 4L starting from initial temperature of 300K. Find the value of ΔS_{sys} for the above process. Report your answer as 'X' where $\Delta S_{\text{sys}} = XR \ln 2$.
- * For Isothermal expansion against constant external pressure of an ideal gas :
 (A) $\Delta S_{\text{univ}} > 0$ (B) $\Delta S_{\text{sys}} > 0$
 (C) $\Delta S_{\text{surr}} < 0$ (D) $\Delta S_{\text{surr}} = 0$
- * For an adiabatic free expansion of an ideal gas against vacuum, which of the following parameters has/have zero value :
 (A) q (B) ΔH
 (C) ΔS_{surr} (D) ΔS_{sys}
- How many of the given statements are correct :
I : Molar entropy of a substance follows the order $(S_m)_{\text{Solid}} < (S_m)_{\text{liquid}} < (S_m)_{\text{gas}}$
II : Entropy change of system for the reaction $\text{H}_2(\text{g}) \longrightarrow 2\text{H}(\text{g})$ is +ve.
III : Molar entropy of a non-crystalline solid will be zero at absolute zero.
IV : If the path of an irreversible process is reversed, then both system and surroundings shall be restored to their original states.
V : Refractive index and molarity are intensive properties.
- The spontaneous nature of a reaction is impossible if :
 (A) ΔH is +ve and ΔS is also +ve (B) ΔH is -ve and ΔS is also -ve
 (C) ΔH is -ve ; ΔS is +ve (D) ΔH is +ve ; ΔS is -ve
- If a chemical reaction is non-spontaneous at high temperatures and spontaneous at low temperatures, then:
 (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 $\Delta S < 0$
- For the process $\text{H}_2\text{O}(\ell) (1 \text{ bar}, 373 \text{ K}) \rightleftharpoons \text{H}_2\text{O}(\text{g}) (1 \text{ bar}, 373 \text{ K})$, the correct set of thermodynamic parameters is:
 (A) $\Delta G = 0$ (B) $\Delta S > 0$
 (C) $\Delta H > 0$ (D) $\Delta G = -\text{ve}$
- For a perfectly crystalline solid, $(C_p)_m = aT^3$, where a is a constant. If $(C_p)_m$ at 10K is 0.375 J/K-mol, then find the value of molar entropy at 20K (in J/K-mol).
- What is the free energy change (ΔG) in KCal, when 144 g of water at 100°C and 1 atm pressure is converted into steam at 100°C and 4 atm pressure ? (Take $R = 2 \text{ Cal/K/mole}$, $\ln 2 = 0.7$).
 Give your answer rounding it off to the nearest whole number.

PHYSICAL CHEMISTRY

DPP
 DAILY PRACTICE PROBLEMS

DPP No. 56

Total Marks : 120

Max. Time : 120 min.

Topic : Mole Concept and Atomic Structure

Type of Questions

M.M., Min.

Topic : Mole Concept

Single choice Objective ('-1' negative marking) Q.1 to Q.20 (3 marks, 3 min.) [60, 60]

Topic : Atomic Structure

Single choice Objective ('-1' negative marking) Q.1 to Q.20 (3 marks, 3 min.) [60, 60]

- The weight of a molecule of the compound $C_6H_{12}O_6$ is about :
 (A) 180 g (B) 3×10^{-22} g (C) 22×10^{-23} g (D) 132 g
- A person adds 1.71 gram of sugar ($C_{12}H_{22}O_{11}$) in order to sweeten his tea. The number of carbon atoms added are : (Mol. mass of sugar = 342)
 (A) 3.6×10^{22} (B) 3×10^{21} (C) 3.6×10^{23} (D) 3×10^{22}
- If V ml of the vapours of substance at NTP weight W mg, then mol. wt. of substance in amu is :
 (A) $(W/V) \times 22400$ (B) $\frac{V}{W} \times 22.4$ (C) $(V/W) \times 22400$ (D) $\frac{W}{V} \times 22.4$
- Percentage of Se in peroxidase anhydrous enzyme is 0.5% by weight. Then min. mol. wt. of peroxidase anhydrous enzyme is : (at. wt. of Se = 78.4 amu)
 (A) 1.568×10^4 (B) 1.568×10^3 (C) 15.68 (D) 1.568×10^2
- Caffeine has a molecular weight of 194. It contains about 30% by mass of nitrogen. The number of atoms of nitrogen in one molecule of it is :
 (A) 2 (B) 3 (C) 4 (D) 5
- Vapour density of a gas, if its density is $\frac{1}{5.6}$ g/L at NTP, is :
 (A) 1 (B) 2 (C) 4 (D) 8
- Assuming that petrol is iso-octane (C_8H_{18}) and has a density 0.8 g ml^{-1} , 1.425 litre of petrol on complete combustion will consume what amount of oxygen :
 (A) 250 L (B) 125 L (C) 125 mole (D) 250 mole
- The volume of gas at NTP produced by reaction of 128 g of CaC_2 with excess of water is :
 (A) 44.8 litre (B) 89.6 litre (C) 67.2 litre (D) 22.4 litre
- If 0.5 mole of $BaCl_2$ is mixed with 0.1 mole of Na_3PO_4 , the maximum number of mole of $Ba_3(PO_4)_2$ that can be formed is :
 (A) 0.166 (B) 0.05 (C) 0.6 (D) 0.1
- A 21.6 g silver coin is dissolved in HNO_3 . When NaCl is added to this solution, all silver is precipitated as AgCl. The weight of AgCl is found to be 14.35 g. Then % of silver in coin is :
 (A) 50% (B) 75% (C) 100% (D) 15%
- What is the concentration of nitrate ions if equal volumes of 0.1 M $AgNO_3$ and 0.1 M NaCl solutions are mixed together :
 (A) 0.1 M (B) 0.2 M (C) 0.05 M (D) 0.25 M
- 300 ml of 3.0 M NaCl is added to 200 ml of 4.0 M $BaCl_2$ solution. The concentration of Cl^- ions in the resulting solution is :
 (A) 4.5 M (B) 3.4 M (C) 6 M (D) 5 M

13. One mole of potassium chlorate is thermally decomposed and excess of aluminium is burnt in the gaseous product. How many mole of aluminium oxide are formed :
 (A) 1 (B) 1.5 (C) 2 (D) 3
14. Calculate the mole of FeO produced from 1.34 g VO & 4.8 g Fe₂O₃ :
 VO + Fe₂O₃ → FeO + V₂O₅ (At. wt. of V = 51)
 (A) 0.06 (B) 0.03 (C) 0.12 (D) 0.015
15. Mole fraction of A in aqueous solution is 0.2. The molality of solution is :
 (A) 13.9 (B) 15.5 (C) 14.5 (D) 16.8
16. What is the quantity of water that should be added to 16 g methanol to make the mole fraction of methanol in solution as 0.25 :
 (A) 27 g. (B) 12 g. (C) 18 g. (D) 36 g.
17. If 100 ml of 1M H₂SO₄ solution is mixed with 100 ml of 9.8%(w/w) H₂SO₄ solution (d = 1 g/ml), then :
 (A) concentration of solution increases (B) concentration of solution decreases
 (C) mass of H₂SO₄ in the solution is 1.96 g (D) mass of H₂SO₄ in the solution is 19.6 g
18. Match List-I (Compounds) with List-II (Oxidation states of Nitrogen) and select answer using the codes given below the lists :
- | | | | |
|-----|-------------------------------|-----|---------|
| | List-I | | List-II |
| (a) | NaN ₃ | (1) | +5 |
| (b) | N ₂ H ₂ | (2) | +2 |
| (c) | NO | (3) | -1/3 |
| (d) | N ₂ O ₅ | (4) | -1 |
- (Code) :
- | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | (a) | (b) | (c) | (d) | | (a) | (b) | (c) | (d) |
| (A) | 3 | 4 | 1 | 2 | (B) | 4 | 3 | 2 | 1 |
| (C) | 3 | 4 | 2 | 1 | (D) | 4 | 3 | 1 | 2 |
19. The incorrect order of decreasing oxidation number of S in compounds is :
 (A) H₂S₂O₇ > Na₂S₄O₆ > Na₂S₂O₃ > S₈
 (B) H₂SO₅ > H₂SO₃ > SCl₂ > H₂S
 (C) H₂SO₄ = H₂S₂O₈ > SO₂ > H₂S
 (D) SO₃ > SO₂ > H₂S > S₈
20. For the redox reaction MnO₄⁻ + C₂O₄²⁻ + H⁺ → Mn²⁺ + CO₂ + H₂O,
 the correct whole number stoichiometric coefficients of MnO₄⁻, C₂O₄²⁻ and H⁺ are respectively :
 (A) 2, 5, 16 (B) 5, 2, 8 (C) 2, 5, 8 (D) 5, 2, 16

Topic : Atomic Structure

1. The charge-to-mass ratio for A³⁺ ion is about $\frac{1}{9} \times 10^8$ C kg⁻¹. Calculate the approximate mass of A atom :
 (A) 4.5×10^{-26} kg (B) 1.5×10^{-26} kg (C) 1.5×10^{-28} kg (D) 4.5×10^{-28} kg
2. Which of the following is isoelectronic with P³⁻ :
 (A) Cl⁻ (B) Mg²⁺ (C) Both (A) & (B) (D) None of these
3. Light of wavelength λ falls on metal having work function hc/λ_0 . Photoelectric effect will take place only if :
 (A) $\lambda \geq \lambda_0$ (B) $\lambda \geq 2\lambda_0$ (C) $\lambda \leq \lambda_0$ (D) $\lambda \leq \lambda_0/2$
4. A photon of X region is more energetic than of the visible region. X may be :
 (A) Infrared (B) Ultra violet (C) Microwave (D) Radio wave
5. A bulb of 40 W is producing a light of wavelength 620 nm with 80% of efficiency. Then the number of photons emitted by the bulb in 20 seconds are :
 (A) 2×10^{18} (B) 10^{18} (C) 10^{21} (D) 2×10^{21}
6. The ionization energy of He⁺ is 19.6×10^{-18} J ion⁻¹. The energy of the first stationary state of Be³⁺ will be :

(A) 15.68×10^{-17} J/ion (B) 78.4×10^{-18} J/ion (C) 4.9×10^{-18} J/ion (D) 39.2×10^{-18} J/ion

7. Which of the following electron transition in a hydrogen atom will require the largest amount of energy :
 (A) From $n = 1$ to $n = 2$ (B) From $n = 2$ to $n = 3$ (C) From $n = \infty$ to $n = 1$ (D) From $n = 3$ to $n = 5$
8. S_1 : Potential energy of the two opposite charge system increases with the decrease in distance.
 S_2 : When an electron make transition from higher orbit to lower orbit, its kinetic energy increases.
 S_3 : When an electron make transition from lower energy to higher energy state, its potential energy increases.
 S_4 : 11eV photon can free an electron from the 1st excited state of He⁺ ion.
 (A) T T T F (B) F T T F (C) F T F T (D) T F F T
9. If r_1 is the radius of the first orbit of hydrogen atom, then the radii of second, third and fourth orbits in terms of r_1 are :
 (A) r_1^2, r_1^3, r_1^4 (B) $8r_1, 27r_1, 64r_1$ (C) $4r_1, 9r_1, 16r_1$ (D) $2r_1, 3r_1, 4r_1$
10. If the series limit wavelength of the Lyman series for the hydrogen atom is 912 Å, then the series limit wavelength for the Balmer series of the Li²⁺ ion is :
 (A) $912 \times \frac{9}{4}$ Å (B) $912 \times \frac{4}{9}$ Å (C) $912 \times \frac{2}{9}$ Å (D) $912 \times \frac{4}{3}$ Å
11. In hydrogen spectrum, which of the following has some of its lines in the wavelength range 350 –700 nm :
 (A) Balmer series (B) Lyman series (C) Brackett series (D) Paschen series
12. In a sample of H-atom, electrons make transition from 5th excited state upto ground state, producing all possible types of photons. Then, maximum number of lines in infrared region are :
 (A) 4 (B) 5 (C) 6 (D) 3
13. Calculate wavelength of 3rd line of Bracket series in hydrogen spectrum :
 (A) $\frac{33}{784R}$ (B) $\frac{33R}{784}$ (C) $\frac{784R}{33}$ (D) $\frac{784}{33R}$
14. A ball weighs 25 g and moves with a velocity of 6.6×10^4 cm/sec. Then find out the de Broglie wavelength :
 (A) 0.4×10^{-33} cm (B) 0.4×10^{-31} cm (C) 0.4×10^{-35} cm (D) 0.4×10^{-37} cm
15. Calculate the de-Broglie wavelength of the electron in the ground state of hydrogen atom :
 (A) 3.3284×10^{-10} m (B) 1.6642×10^{-10} m (C) 6.6568×10^{-10} m (D) Cannot be determined.
16. The uncertainty in position and velocity of an object are 10^{-10} m and 5.27×10^{-24} ms⁻¹ respectively. Calculate the mass of the object :
 (A) 0.1 g (B) 1 g (C) 10 g (D) 100 g
17. A given orbital is labelled by the magnetic quantum number $m = -1$. This could be :
 (A) p-orbital (B) d-orbital (C) f-orbital (D) All of these
18. An electron with $n = 3$ is in an orbital with only one radial node. The orbital angular momentum of the electron will be :
 (A) 0 (B) $\sqrt{6} \frac{h}{2\pi}$ (C) $\sqrt{2} \frac{h}{2\pi}$ (D) $\sqrt{6} \frac{h}{\pi}$
19. After np orbitals are filled, the next orbital filled will be :
 (A) nd (B) $(n + 1) p$ (C) $(n + 1) s$ (D) $(n - 1) s$
20. The correct set of four quantum numbers for the valence electron of Rubidium ($Z = 37$) is :
 (A) $n = 6, \ell = 0, m = 0, s = + \frac{1}{2}$ (B) $n = 5, \ell = 1, m = 0, s = + \frac{1}{2}$
 (C) $n = 6, \ell = 1, m = 1, s = + \frac{1}{2}$ (D) $n = 5, \ell = 0, m = 0, s = + \frac{1}{2}$

Topic : Gaseous State

Type of Questions

Single choice Objective ('-1' negative marking) Q.1 to Q.20

(3 marks, 3 min.)

M.M., Min.

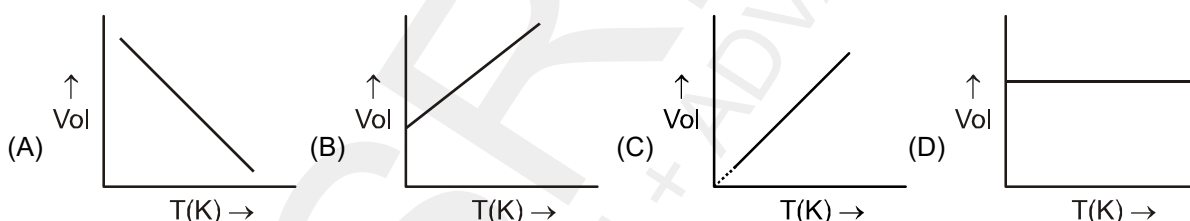
[60, 60]

Subjective Questions ('-1' negative marking) Q.21

(4 marks, 5 min.)

[4, 5]

- At constant temperature, if pressure of an ideal gas increases by 1 %, the percentage decrease of volume is :
 (A) 1 % (B) 100/101% (C) 1/101% (D) 1/100%
- A sample of ideal gas occupies 100 ml at 27°C and 740 mm pressure. When its volume is changed to 80 ml at 740 mm pressure, the temperature of the gas will be :
 (A) 21.6 °C (B) 33°C (C) - 33°C (D) - 21.6°C
- The correct representation of Charles' law is given by :



- The ratio of fraction pressure of a gaseous component to the total pressure of the gas mixture is equal to :
 (A) mass fraction of the component (B) mole fraction of the component
 (C) mass % of the component (D) mole % of the component
- Same mass of CH_4 and H_2 is taken in a container. The partial pressure caused by H_2 (where total pressure is P) is:
 (A) $\frac{8}{9} P$ (B) $\frac{1}{9} P$ (C) $\frac{1}{2} P$ (D) $\frac{3P}{4}$
- The molecular weight of a gas which diffuse through a porous plug at 1/6th of the speed of hydrogen under identical conditions is :
 (A) 12 (B) 72 (C) 36 (D) 24
- The densities of hydrogen and oxygen are 0.09 and 1.44 g L⁻¹ under same T and P conditions. If the rate of diffusion of hydrogen is 1, then that of oxygen in the same units will be :
 (A) 4 (B) 1/4 (C) 16 (D) 1/16
- 50 ml of hydrogen diffuses out through a small hole from a vessel in 20 minutes. The time needed for 40 ml of oxygen to diffuse out under identical conditions is :
 (A) 4 min (B) 64 min (C) 96 min (D) 48 min
- At the same temperature and pressure, which of the following gases will have the highest average translational kinetic energy per mole ?
 (A) Hydrogen (B) Oxygen (C) Methane (D) All have the same value
- The ratio among most probable speed, average speed and root mean square speed is given by :
 (A) 2 : 8/π : 3 (B) 8/π : 2 : 3 (C) $\sqrt{8/\pi} : \sqrt{2} : \sqrt{3}$ (D) $\sqrt{2} : \sqrt{8/\pi} : \sqrt{3}$

11. The average translational kinetic energy for 14 grams of nitrogen gas at 127°C is nearly :
 (A) 25 J (B) 50 J (C) 2500 J (D) 5000 J
12. The temperature at which rms speed of SO₂ molecules is half that of He molecules at 300 K is :
 (A) 75 K (B) 600 K (C) 2400 K (D) 1200 K
13. A real gas most closely approaches the behaviour of an ideal gas at :
 (A) 15 atm and 200 K (B) 1 atm and 273 K (C) 0.5 atm and 500 K (D) 15 atm and 500 K
14. An ideal gas can't be liquefied because :
 (A) its critical temperature is always above 0°C.
 (B) its molecules are relatively smaller in size.
 (C) it solidifies before becoming a liquid.
 (D) forces operative between its molecules are zero.
15. The compressibility factor for an ideal gas is :
 (A) 0 (B) 1 (C) 3/8 (D) ∞
16. The Vander Waal's parameters for gases W, X, Y and Z are :

Gas	a(atm L ² mol ⁻²)	b(L mol ⁻¹)
W	4.0	0.027
X	8.0	0.030
Y	6.0	0.032
Z	12.0	0.027

- Which of these gases has the highest critical temperature ?
 (A) W (B) X (C) Y (D) Z
17. Densities of two ideal gas samples containing same gas are in the ratio 1 : 2 and their temperatures are in the ratio 2 : 1. Then the ratio of their respective pressure is :
 (A) 1 : 1 (B) 1 : 2 (C) 2 : 1 (D) 4 : 1
18. The root mean square speed of an ideal gas at constant pressure varies with density (d) as :
 (A) d² (B) d (C) √d (D) 1/√d
19. A 4 : 1 molar ratio mixture of helium and methane is contained in a vessel at 10 bar pressure. Due to a hole in the vessel, the gas mixture leaks out. The molar ratio composition of the mixture effusing out initially is :
 (A) 8 : 1 (B) 16 : 1 (C) 32 : 1 (D) 6 : 1
20. A 4.0 dm³ flask containing N₂ at 4.0 bar was connected to a 6.0 dm³ flask containing helium at 6.0 bar, and the gases were allowed to mix isothermally. Then the total pressure of the resulting mixture will be :
 (A) 4.8 bar (B) 5.2 bar (C) 5.6 bar (D) 5.4 bar
21. A mixture of formic acid and oxalic acid is heated with concentrated H₂SO₄. The gases produced are collected and on its treatment with KOH solution, the volume of the gas decreased by one-sixth. Calculate the molar ratio of the two acids in the original mixture.

PHYSICAL CHEMISTRY

DPP
 DAILY PRACTICE PROBLEMS

DPP No. 58

Total Marks : 60

Max. Time : 60 min.

Topic : Chemical Equilibrium

Type of Questions

Single choice Objective ('-1' negative marking) Q.1 to Q.20

(3 marks, 3 min.)

M.M., Min.

[60, 60]

- The equilibrium constant of the reaction $\text{SO}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \rightleftharpoons \text{SO}_3(\text{g})$ is $4 \times 10^{-3} \text{ atm}^{-1/2}$. The equilibrium constant of the reaction $2\text{SO}_3(\text{g}) \rightleftharpoons 2\text{SO}_2(\text{g}) + \text{O}_2(\text{g})$ would be :
 (A) 250 atm (B) $6.25 \times 10^3 \text{ atm}$ (C) $0.25 \times 10^4 \text{ atm}$ (D) $6.25 \times 10^4 \text{ atm}$
- $\log \frac{K_p}{K_c} + \log RT = 0$ is the relationship for the following gaseous phase reaction :
 (A) $\text{PCl}_5 \rightleftharpoons \text{PCl}_3 + \text{Cl}_2$ (B) $2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_3$ (C) $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$ (D) $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$
- For the reaction $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$, the value of K_C does not depends upon :
 (a) Initial concentration of the reactants (b) Pressure (c) Temperature (d) Catalyst
 (A) Only c (B) Only a,b (C) Only a,b,d (D) Only b,d
- When alcohol ($\text{C}_2\text{H}_5\text{OH}$) and acetic acid are mixed together in equimolar ratio at 27°C , 33% is converted into ester. Then the K_C for the following equilibrium is :

$$\text{C}_2\text{H}_5\text{OH}(\ell) + \text{CH}_3\text{COOH}(\ell) \rightleftharpoons \text{CH}_3\text{COOC}_2\text{H}_5(\ell) + \text{H}_2\text{O}(\ell).$$

 (A) 4 (B) 1/4 (C) 9 (D) 1/9
- The equilibrium constant (K_p) for the reaction $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$ is 16 atm. If the volume of the container is reduced to one half its original volume, the value of K_p for the reaction at the same temperature will be :
 (A) 32 atm (B) 64 atm (C) 16 atm (D) 8 atm
- 'a' moles of PCl_5 undergo thermal dissociation as : $\text{PCl}_5 \rightleftharpoons \text{PCl}_3 + \text{Cl}_2$. At equilibrium, the mole fraction of PCl_3 is 0.25 and the total pressure is 2 atm. The value of K_p in atm is :
 (A) 0.25 (B) 1 (C) 0.5 (D) Data insufficient
- A reaction mixture containing H_2 , N_2 and NH_3 has their partial pressure 2 atm, 1 atm and 3 atm respectively at 725 K. If the value of K_p for the reaction : $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$ is 1.25 atm^{-2} at 725 K, in which direction will the net reaction go :
 (A) Forward (B) Backward
 (C) No net reaction (D) Direction of reaction cannot be predicted
- The extent of dissociation of PCl_5 at a certain temperature is 20 % at one atm equilibrium pressure. Calculate the equilibrium pressure in atm at which this substance is half dissociated at the same temperature :
 (A) 0.125 (B) 0.1 (C) 2.5 (D) 0.25
- Consider the following reactions :
 (i) $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$
 (ii) $2\text{HI}(\text{g}) \rightleftharpoons \text{H}_2(\text{g}) + \text{I}_2(\text{g})$
 The addition of an inert gas at constant volume :
 (A) will increase the dissociation of PCl_5 as well as HI.
 (B) will reduce the dissociation of PCl_5 and not affect the dissociation of HI.
 (C) will increase the dissociation of PCl_5 and not affect the dissociation of HI.
 (D) will not disturb the equilibrium of the reactions.

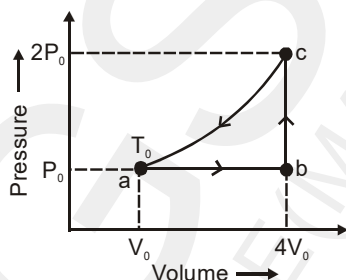
10. The vapour density of N_2O_4 at a certain temperature is 30. What is the percentage dissociation of N_2O_4 at this temperature ?
 (A) 7.5% (B) 10% (C) 15% (D) 20%
11. $aA + bB \rightleftharpoons cC + dD$
 In above gaseous phase reaction, low pressure and high temperature shift the equilibrium in backward direction. So correct set is :
 (A) $(a + b) > (c + d)$, $\Delta H > 0$ (B) $(a + b) < (c + d)$, $\Delta H > 0$
 (C) $(a + b) < (c + d)$, $\Delta H < 0$ (D) $(a + b) > (c + d)$, $\Delta H < 0$
12. On decomposition of NH_4HS , the following equilibrium is established :
 $NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$
 If the total pressure is P atm, then the equilibrium constant K_p is equal to :
 (A) P atm (B) $P^2 \text{ atm}^2$ (C) $P^2 / 4 \text{ atm}^2$ (D) $P^2 / 9 \text{ atm}^2$
13. At room temperature, the equilibrium constant for the reaction $P + Q \rightleftharpoons R + S$ was calculated to be 4.32. At 425°C , the equilibrium constant became 1.24×10^{-2} . This indicates that the reaction :
 (A) is exothermic (B) is endothermic
 (C) could be exothermic or endothermic (D) is not possible
14. Consider the reaction :
 $A(s) \rightleftharpoons 2B(g) + 3C(g)$
 If the concentration of C at equilibrium is doubled, then after the equilibrium is re-established, the concentration of B will be :
 (A) $4/3$ times the original value (B) $3/4$ times the original value
 (C) $1 / 2\sqrt{2}$ times the original value (D) $2\sqrt{2}$ times the original value
15. **Statement-1** : For $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$, if more Cl_2 is added, the equilibrium will shift in backward direction and hence equilibrium constant will decrease.
Statement-2 : Addition of a product to the equilibrium mixture always cause the equilibrium to shift backward.
 (A) Statement-1 is True, Statement-2 is True ; Statement -2 is a correct explanation for Statement-1
 (B) Statement-1 is True, Statement-2 is True ; Statement-2 is NOT a correct explanation for Statement-1
 (C) Statement-1 is True, Statement-2 is False
 (D) Statement-1 is False, Statement-2 is True
 (E) Statement-1 and Statement-2 both are False.
16. 500 ml vessel contains 1.5 moles each of A, B, C and D at equilibrium. If 0.5 mole each of C and D are taken out, the value of K_c for $A + B \rightleftharpoons C + D$ will be :
 (A) 1 (B) $1/9$ (C) $4/9$ (D) $8/9$
17. On adding 0.01 M HCl in some amount in aqueous solution of acetic acid :
 (A) Equilibrium conc. of CH_3COOH decreases. (B) Equilibrium conc. of CH_3COO^- decreases.
 (C) Equilibrium conc. of CH_3COO^- increases. (D) No change will occur.
18. 9.2 gram of N_2O_4 (g) is taken in a closed one litre vessel and heated, till the following equilibrium is reached :
 $N_2O_4(g) \rightleftharpoons 2 NO_2(g)$
 At equilibrium, 50% N_2O_4 (g) is dissociated. What is the equilibrium constant (in mol lit⁻¹) :
 (A) 0.1 (B) 0.2 (C) 0.4 (D) 2
19. A quantity of PCl_5 was heated in a 10 dm^3 vessel at 250°C : $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$. At equilibrium, the vessel contains 0.1 mole of PCl_5 and 0.2 mole of Cl_2 . The equilibrium constant of the reaction is :
 (A) 0.04 mol/L (B) 0.4 mol/L (C) 4 mol/L (D) cannot be determined
20. For the equilibrium :
 $H_2O(l) \rightleftharpoons H_2O(g)$,
 what happens if pressure is applied :
 (A) More water evaporates (B) The boiling point of water is increased
 (C) No effect on boiling point (D) The boiling point of water is decreased

Topic : Thermodynamics & Thermochemistry

Type of Questions

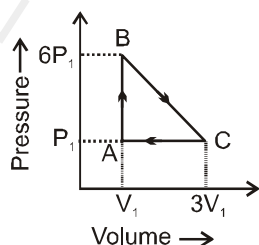
Single choice Objective ('-1' negative marking) Q.1 to Q.14	(3 marks, 3 min.)	M.M., Min.
Multiple choice objective ('-1' negative marking) Q.15 to Q.17 (4 marks, 4 min.)	[12, 12]	
Assertion and Reason (no negative marking) Q.18 to Q.22	(3 marks, 3 min.)	[15, 15]

- An isolated system is that system in which :
 (A) there is exchange of energy with the surroundings.
 (B) there is exchange of mass and energy with the surroundings.
 (C) There is no exchange of mass and energy with the surroundings.
 (D) There is exchange of mass but not energy with surroundings.
- As per the First Law of thermodynamics, which of the following statement would be appropriate :
 (A) Energy of the system remains constant.
 (B) Energy of the surroundings remains constant.
 (C) Entropy of the universe is always increasing in an irreversible process.
 (D) Energy of the universe remains constant.
- One mole of an ideal monoatomic gas is caused to go through the cycle shown in figure. Then the change in the internal energy of gas from a to b and b to c is respectively :



- (A) $\frac{9P_0V_0}{2}, 6RT_0$ (B) $\frac{9P_0V_0}{2}, 10RT_0$ (C) $\frac{15P_0V_0}{2}, 6RT_0$ (D) $\frac{15P_0V_0}{2}, 10RT_0$

- An ideal gas is taken around the cycle ABCA as shown in P-V diagram. The net work done during the cycle is equal to :



- (A) $7 P_1V_1$ (B) $-5 P_1V_1$ (C) $5 P_1V_1$ (D) $-7 P_1V_1$

- 1 mole of SO_2 gas at 27°C is expanded in reversible adiabatic condition to make volume 8 times. Final temperature and work done respectively are: (take $2^{1.2} = 2.3$)
 (A) 150 K, 900 cal (B) 150 K, 750 cal (C) 130.5 K, 847.5 cal (D) 130.5 K, 508.5 cal

6. The work done in an adiabatic process on an ideal gas by a constant external pressure would be :
 (A) Zero (B) ΔE (C) ΔH (D) q
7. One mole of an ideal monoatomic gas at temperature T and volume $1L$ expands to $2L$ against a constant external pressure of one atm under adiabatic conditions. Then final temperature of gas will be :
 (A) $T + \frac{2}{3 \times 0.0821}$ (B) $T - \frac{2}{3 \times 0.0821}$ (C) $\frac{T}{2^{5/3-1}}$ (D) $\frac{T}{2^{5/3+1}}$
8. One mole of an ideal gas ($C_v = \frac{3}{2}R$) at $300 K$ and $5 atm$ is expanded adiabatically to a final pressure of $2 atm$ against a constant pressure of $2 atm$. Final temperature of the gas is :
 (A) $228 K$ (B) $240 K$ (C) $248.5 K$ (D) $200 K$
9. The enthalpy of formation of ammonia = $46.0 kJ mol^{-1}$. The enthalpy change for following reaction is :

$$2NH_3 \longrightarrow N_2 + 3H_2$$
 (A) $-92.0 kJ$ (B) $46.0 kJ$ (C) $-46.0 kJ$ (D) $92.0 kJ$
10. The standard enthalpy of formation of B_2O_3 is equal to :
 (A) $\Delta H^\circ_C (B(s))$ (B) $1/2 \Delta H^\circ_C (B(s))$
 (C) $2\Delta H^\circ_C (B(s))$ (D) $3/2 \Delta H^\circ_C (B(s))$
11. Calculate the average O–H bond energy in H_2O with the help of following data :
 (1) $H_2O_{(l)} \longrightarrow H_2O_{(g)} ; \Delta H = + 40.5 kJ mol^{-1}$
 (2) $2H_{(g)} \longrightarrow H_{2(g)} ; \Delta H = - 435.0 kJ mol^{-1}$
 (3) $O_{2(g)} \longrightarrow 2O_{(g)} ; \Delta H = + 489.5 kJ mol^{-1}$
 (4) $2H_{2(g)} + O_{2(g)} \longrightarrow 2H_2O_{(l)} ; \Delta H = - 571.5 kJ mol^{-1}$
 (A) $217.75 kJ mol^{-1}$ (B) $217.25 kJ mol^{-1}$ (C) $462.5 kJ mol^{-1}$ (D) $925 kJ mol^{-1}$
12. For the equations :
 $C(\text{diamond}) + 2H_2(g) \rightarrow CH_4(g) ; \Delta H_1$ and $C(g) + 4H(g) \rightarrow CH_4(g) ; \Delta H_2$
 Select the correct option :
 (A) $\Delta H_1 = \Delta H_2$ (B) $\Delta H_1 > \Delta H_2$
 (C) $\Delta H_1 < \Delta H_2$ (D) Nothing can be said with certainty.
13. Enthalpy of polymerisation of ethylene, as represented by the reaction, $nCH_2=CH_2 \longrightarrow (-CH_2-CH_2-)_n$ is $-100 kJ$ per mole of ethylene. Given that bond enthalpy of $C=C$ bond is $600 kJ mol^{-1}$. Enthalpy of $C-C$ bond (in $kJ mol$) will be :
 (A) 500 (B) 350 (C) 400 (D) indeterminate
14. 1 mole of a diatomic ideal gas at $25^\circ C$ is subjected to expand reversibly and adiabatically to ten times of its initial volume. Calculate the change in entropy of gas during expansion (in $JK^{-1} mol^{-1}$) :
 (A) $R \ln 10$ (B) $1.5 R \ln 10$ (C) $2.5 R \ln 10$ (D) None of these
- 15.* If a process is both endothermic and spontaneous, then :
 (A) $\Delta S_{sys} > 0$ (B) $\Delta S_{sys} < 0$ (C) $\Delta S_{univ} > 0$ (D) $\Delta S_{univ} < 0$
- 16.* The enthalpy change for a given reaction at $298 K$ is $-x J mol^{-1}$ (x being positive). If the reaction occurs spontaneously at $298 K$, the entropy change at that temperature :
 (A) can be negative but numerically larger than $x/298$.
 (B) can be negative but numerically smaller than $x/298$.
 (C) cannot be negative.
 (D) can be positive.

- 17.* The value of $\Delta H_{\text{transition}}$ of C (graphite) \longrightarrow C (diamond) is 1.9 kJ/mol at 25°C entropy of graphite is higher than entropy of diamond. This implies that :
- (A) C (diamond) is more thermodynamically stable than C (graphite) at 25°C.
 (B) C (graphite) is more thermodynamically stable than C (diamond) at 25°C.
 (C) Diamond will provide more heat on complete combustion at 25°C.
 (D) $\Delta G_{\text{transition}}$ of C (diamond) \longrightarrow C (graphite) is -ve.

Assertion / Reason

DIRECTIONS :

The following questions consist of two statements one labelled **ASSERTION** and the another labelled **REASON** . Select the correct answers to these questions from the codes given below :

- (A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
 (B) Both Assertion and Reason are true but Reason is not correct explanation of Assertion.
 (C) Assertion is true but Reason is false.
 (D) Assertion is false but Reason is true.
18. **Assertion** : The increases in internal energy (ΔE) for the vaporisation of one mole of water at 1 atm and 373 K is zero.
Reason : For all isothermal processes on perfect gases, $\Delta E = 0$.
19. **Assertion** : The enthalpy of formation of $\text{H}_2\text{O}(\ell)$ is greater than that of $\text{H}_2\text{O}(\text{g})$ in magnitude.
Reason : Enthalpy change is negative for the condensation reaction :
- $$\text{H}_2\text{O}(\text{g}) \longrightarrow \text{H}_2\text{O}(\ell)$$
20. **Assertion** : Enthalpy of neutralisation of HClO_4 with NaOH is same as that of HCl with NaOH .
Reason : Both HCl and HClO_4 are strong acids.
21. **Assertion** : Decrease of free energy during a process under constant temperature and pressure provides a criteria of its spontaneity.
Reason : A spontaneous change must have positive sign of ΔS_{system} .
22. The standard molar enthalpies of formation of cyclohexane (l) and benzene (l) at 25° C are -156 and $+49$ KJ mol^{-1} respectively. The standard enthalpy of hydrogenation of cyclohexene (l) at 25° is -119 KJ mol^{-1} . Use these data to estimate the resonance energy of benzene.

DPP NO. 36 TO 59 (ANSWER KEY)

DPP No. # 36

1. (C) 2. (C) 3. (B) 4. (A) 5. (C)
 6. (D) 7.* (B,C,D) 8. $[A - r] ; [B - r, s] ; [C - q] ; [D - r]$.

DPP No. # 37

1. (B) 2. (C) 3. (B) 4. (C) 5. (A)
 6. (A) 7. (D) 8. (D)

DPP No. # 38

1. (C) 2. (C) 3. (A) 4. (A) 5. (C)

6. $K_c = \frac{[N_2O_4]}{[NO_2]^2} = \left(= \frac{\text{mol L}^{-1}}{(\text{mol L}^{-1})^2}, K_c \text{ has unit of } L \text{ mol}^{-1} \right)$ $K_p = \frac{P_{N_2O_4}}{P_{NO_2}^2} \left(= \frac{\text{atm}}{\text{atm}^2}, K_p \text{ has unit of } \text{atm}^{-1} \right)$

7. (i) $[PCl_5] = 0.5 \text{ mol L}^{-1} ; [PCl_3] = 1.0 \text{ mol L}^{-1} ; [Cl_2] = 1.0 \text{ mol L}^{-1}$ (ii) $X_{PCl_5} = 0.2 ; X_{PCl_3} = 0.4 ; X_{Cl_2} = 0.4$

(iii) $K_c = 2 \text{ L mol}^{-1}$ 8. $K_c = 4.0$ 9. $\frac{(2n - y)y}{(n - y)^2 \cdot P}$

DPP No. # 39

1. (B) 2. (D) 3. (D) 4. (D) 5. (C)
 6. (C) 7. (C)
 8. $[XO] = 0.985 \text{ M} ; [O_2] = 1.992 \text{ M} ; [XO_2] = 0.0141 \text{ M}$ 9. $K_p = \frac{1}{3} \cdot p$ or $p = 3K_p$.

DPP No. # 40

1. (B) 2. (B) 3. (C) 4. (A) 5. (D)
 6. (A) 7. $p_{H_2} = 2.5 \times 10^{-2} \text{ bar} ; p_{Br_2} = 2.5 \times 10^{-2} \text{ bar} ; p_{HBr} \approx 10 \text{ bar}$ 8. 30%

DPP No. # 41

1. (A) 2. (C) 3. 0.2 4. (D)
 5. 0.3136 atm^2 6. (A) 7. (D) 8. (D) 9.* (C,D)

DPP No. # 42

1. (B) 2. (A,D) 3. (B) 4.* (A,B,C,D) 5.* (A,B)
 6. (D) 7. (B) 8. (C)

DPP No. # 43

1. 1.868 2. (i) 2, (ii) 1.2 mol/L 3. $\alpha = 0.33, K_p = 0.41 \text{ atm.}$ 4. 810
 5.* (BC) 6. (B) 7. (A) 8. (D)

DPP No. # 44

1. (C) 2. (D) 3. (C) 4.* (AC)
 5. State function : a, b, c, d, g, h, j ; Path function : e, f, i, k
 6. Intensive : a, c, d, f, g, h, i, k ; Extensive : b, e, j, l
 7. Open system : b, f, g, i, j ; Closed system : a, c, h ; Isolated system : d, e

DPP No. # 45

1. (A) 2. (D) 3.* (BD) 4. (BC) 5. - 90 J
 6. 4275 J. 7. 6.66 min. (400 sec) 8. (B) 9. (A) 10. (D)

DPP No. # 46

1. (C) 2. (A) 3. (B) 4. (B) 5. (A)
 7. - 859 J 9. (a) F (b) T (c) F (d) T (e) T 6. $W = 240 \text{ L atm.}$

DPP No. # 47

1. (A) 2. (C) 3. (A) 4. (A) 5. (C)
 6. (A) 7. (C) 8. (D) 9. (B) 10. (A)

DPP No. # 48

1. (A) 2. (A) 3. (D) 4. (A) 5. (B)
 6. (C) 7. (A) 8. 3840 calories 9. - 178 R

DPP No. # 49

1. (C) 2. (D) 3. (A) 4. (A) 5. (B)
 6. (C) 7. (A) 8. - 94.6 KCal 9. - 41.4 KCal

DPP No. # 50

1. (C) 2. (B) 3. (C) 4. (B) 5. (B)
 6. 8.33 kg. 7. 10%. 8. 22.8 Cal/g. 9. - 22.1 KCal

DPP No. # 51

1. - 372.0 kCal. 2. - 136.8 kJ. 3. - 121 kJ/mole. 4. $DH = -67710 \text{ Cal}$
 5. - 22 kCal/mol. 6. - 29 kCal/mol 7. 141.7 kCal 8. $= \frac{3y - 4x}{3} \text{ kCal mol}^{-1}.$
 9. 49 kCal/mol. 10. (C) 11. (A)

DPP No. # 52

1. -41.104 kCal. 2. (B) 3. 80 kCal/mol. 4. 100 kJ/mol. 5. (C)
 6. C - H = 99 kCal ; C - C = 82 kCal 7. -56.5 kJ. 8. -152 KJ mol⁻¹
 9. -18.7 kCal 10. -167.2 kJ/mol.

DPP No. # 53

1. (A) 2. DH = 12.168 Kcal ; DE = 11.622 Kcal.
 3. W = 0.1 KJ, q = 2KJ, DE = 2.1 KJ. 4. 570 g of sucrose ; 9120 kJ. 5. (B)
 6. (C) 7. (D) 8. (A) 9. (A)

DPP No. # 54

1. (D) 2. (C) 3. (D) 4. (C)
 5.* (ABC) 6. (D) 7. (B)
 8. (a) 80 JK⁻¹ mol⁻¹ (b) -80 JK⁻¹ mol⁻¹ 9. (D) 10. (A)

DPP No. # 55

1. 3.312 J/K 2. 7 3.* (A,B,C) 4.* (A,B,C) 5. 3
 6. (D) 7. (D) 8. (A,B,C) 9. 1 10. 8

DPP No. # 56

1. (B) 2. (A) 3. (D) 4. (A) 5. (C)
 6. (B) 7. (C) 8. (A) 9. (B) 10. (A)
 11. (C) 12. (D) 13. (A) 14. (A) 15. (A)
 16. (A) 17. (D) 18. (C) 19. (D) 20. (A)

Topic : Atomic Structure

1. (A) 2. (A) 3. (C) 4. (B) 5. (D)
 6. (B) 7. (A) 8. (B) 9. (C) 10. (B)
 11. (A) 12. (C) 13. (D) 14. (A) 15. (A)
 16. (D) 18. (C) 19. (C) 20. (D)

DPP No. # 57

1. (B) 2. (C) 3. (C) 4. (B) 5. (A)
 6. (B) 7. (B) 8. (B) 9. (D) 10. (D)
 11. (C) 12. (D) 13. (C) 14. (D) 15. (B)
 16. (D) 17. (A) 18. (D) 19. (A) 20. (B)
 21. 4 : 1

DPP No. # 58

1. (D) 2. (B) 3. (C) 4. (B) 5. (C)
 6. (A) 7. (A) 8. (A) 9. (D) 10. (C)
 11. (D) 12. (C) 13. (A) 14. (C) 15. (E)
 16. (A) 17. (B) 18. (B) 19. (A) 20. (B)

DPP No. # 59

1. (C) 2. (D) 3. (A) 4. (C) 5. (A)

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|-----|------|-----|-----------------------------|-----|-----|-----|-----|-----|------|
| 6. | (B) | 7. | (B) | 8. | (A) | 9. | (D) | 10. | (C) |
| 11. | (C) | 12. | (B) | 13. | (B) | 14. | (D) | 15. | (AC) |
| 16. | (BD) | 17. | (BCD) | 18. | (D) | 19. | (A) | 20. | (A) |
| 21. | (C) | 22. | $-152 \text{ kJ mole}^{-1}$ | | | | | | |

GGSRDN
NEET, JEE(MAIN + ADVANCED)