PHYSICAL CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 42

Total Marks : 26

Max. Time : 26 min.

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]

1. $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$,

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.

2. For the equilibrium $CuSO_4.5H_2O(s) \rightleftharpoons CuSO_4.H_2O(s) + 4H_2O(g)$, the equilibrium constant $K_p = 2.56 \times 10^{-10}$ atm^4 at 27ºC. 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 27ºC is 12.5 torr.

(A) Mass of $CuSO_4.5H_2O$ will increase.

(B) Mass of $CuSO_4.5H_2O$ will decrease.

(C) Mass of $CuSO_4.H_2O$ will increase.

(D) Mass of $CuSO_4.H_2O$ will decrease.

3. $2Pb(NO_3)_2(s) \rightleftharpoons 2PbO(s) + 4NO_2(g) + O_2(g)$, $\Delta H > 0$

Above equilibrium is established by taking some amount of $Pb(NO_3)_2$ (s) in a closed container at 1600 K. Then which of the following is the INCORRECT option :

(A) moles of PbO(s) will increase with the increase in temperature

(B) If the volume of the container is doubled at equilibrium, then partial pressure of $NO_2(g)$ will change at new equilibrium.

(C) If the volume of the container is halved, partial pressure of $O_2(g)$ at new equilibrium will remain same

(D) If two moles of He gas is added at constant pressure, then the moles of PbO(s) will increase.

4.* 1 mole each of $N_2(g)$ and $O_2(g)$ are introduced in a 1L evacuated vessel at 523K and equilibrium $N_2(g) + O_2(g) \rightleftharpoons 2NO$ (g) is established. The concentration of NO(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, $\frac{1}{2}H_2(g) + \frac{1}{2}I_2(g) \rightleftharpoons HI(g)$

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.

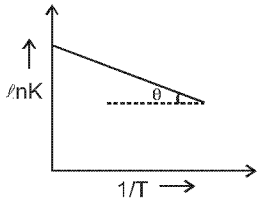
(D) Equilibrium will shift in the forward direction.

Comprehension # (Q. 6 to Q. 8)

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

$K = Ae^{-\frac{\Delta H^\circ}{RT}}$ (A – 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 $T \to \infty$, $\ell nK = 46.06$

(2) $\theta = 30^\circ$

(3) Use $\ell n\, K = 2.303 \log_{10} K$

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.

Answer Key

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

Hints & Solutions

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2. $K_p = (p_{H_2O})^4 = 2.56 \times 10^{-10}\ atm^4$

$\therefore \quad p_{H_2O} = 4^2 \times 10^{-3}\ atm = 4 \times 10^{-3} \times 760 = 3.04\ torr.$

Partial pressure of water vapour in air = $\frac{40}{100} \times 12.5 = 5$

So, the amount of water vapour in air should decrease to decrease value of partial pressure of water vapour from 5 torr to the equilibrium value (3.04 torr).
so, mass of $CuSO_4.5H_2O$ will increase and mass of $CuSO_4.H_2O$ will decrease.

3. (A) As reaction is endothermic therefore it will go in the forward direction hence moles of PbO will increase.
(B) With the increase or decrease of volume partial pressure of the gases will remain same.
(C) Due to the addition of inert gas at constant pressure reaction will proceed in the direction in which more number of gaseous moles are formed.

4.* $N_2(g) + O_2(g) \rightleftharpoons 2NO\ (g)$

(A) For changing pressure volume has to be changed, though number of moles of NO(g) do not get changed but its concentration will get changed.
(B) Temperature change will change K_p and hence concentration.
(C) Volume change will change concentration, not the number of moles.
(D) Catalyst does not change equilibrium concentrations.

5.* Number of moles will remain unchanged but due to decreased volume pressure will get increased and also the concentrations.

6. Slope = $-\tan 30° = \frac{-1}{\sqrt{3}} = \frac{-\Delta H°}{R}$

$\therefore \quad \Delta H° = \frac{R}{\sqrt{3}}$

7. As $T \to \infty$, $K = A$

$\therefore \quad \ell nA = \ell nK = 46.06$

$\therefore \quad 2.303 \log_{10} A = 46.06$

$\therefore \quad A = 10^{20}$

8. $\Delta H° > O$ $\quad \therefore$ Endothermic reaction

Y – intercept = +ve $\quad \therefore \Delta S° > 0$

for endothermic reaction, as $T\uparrow$, $K\uparrow$.

The value of equilibrium constant K is unaffected by pressure changes.