PHYSICAL CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 41

Total Marks : 29

Max. Time : 30 min.

Topic : Chemical Equilibrium

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

1. For A (g) $\rightleftharpoons$ 2 B (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

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 $\rightleftharpoons$ 2 C	(a) $(\sqrt{K})/(1+\sqrt{K})$
2. 2 A $\rightleftharpoons$ B + C	(b) $(\sqrt{K})/(2+\sqrt{K})$
3. A + B $\rightleftharpoons$ C + D	(c) 2 K / (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

3. 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)

4. In an evacuated closed isolated chamber at 227°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

5. 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°C. What is the value of K_p for the reaction ?

6. For the reaction : $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$, K_p = 1 atm at 727°C. If 20 g of $CaCO_3$ were kept in a 10 litre vessel at 727°C, then the percentage of $CaCO_3$ remaining at equilibrium is :
(A) 40% (B) 60% (C) 46% (D) 66%

7. 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 ρ_{CaO} = 1.12 g cm^{-3}]
(A) 1/2 (B) 1/4 (C) 0.02 (D) 20

8. 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

9.* 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

Answer Key

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

Hints & Solutions

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3. 0.2.

4. $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

0.02   0.01

0.02-x   x   0.01+x

$$D = \frac{PM}{RT}$$

Calculate M_{avg}.

$$\frac{(0.02-x)208.5+137.5x+(0.01+x)71}{0.03+x} = M_{avg}.$$

5. $NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$

P   P

$2P = 1.12$

$P = 0.56$

$K_p = P^2 = (0.56)^2 = 0.3136$ atm^2

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

0.2-x   x   x

$$K_P = P_{CO_2} = 1$$

$$x = \text{mole of } CO_2 = \frac{PV}{RT}$$

Remaining mass of $CaCO_3$ = (0.2 – x) 100 g.

7. $[CaO] = \frac{\rho_{CaO(s)}}{M_{CaO(s)}} = \frac{1.12}{56} \times 1000$

9.* Addition of solids have no effect on equilibrium and temperature favours endothermic direction while increasing pressure will shift equilibrium in backward direction as Δn_g is +ve.