JEE MAIN ANSWER KEY & SOLUTIONS

SUBJECT :- CHEMISTRY
CLASS :- 11th **PAPER CODE :- CWT-6**
CHAPTER :- CHEMICAL EQUILIBRIUM

ANSWER KEY

1.	(D)	**2.**	(A)	**3.**	(D)	**4.**	(C)	**5.**	(C)	**6.**	(B)	**7.**	(C)
8.	(D)	**9.**	(C)	**10.**	(C)	**11.**	(D)	**12.**	(B)	**13.**	(D)	**14.**	(C)
15.	(D)	**16.**	(C)	**17.**	(B)	**18.**	(B)	**19.**	(C)	**20.**	(A)	**21.**	16
22.	2	**23.**	5	**24.**	3	**25.**	8	**26.**	4	**27.**	250	**28.**	75
29.	100	**30.**	256										

SOLUTIONS

1. (D)
Sol. Both forward and backward reactions occur at all times with same speed.

2. (A)
Sol. $Zn_{(s)} + CO_{2(g)} \longrightarrow ZnO_{(s)} + CO_{(g)}$

$\left[P_{zn(s)} = 1\right]\left[P_{zno(s)} = 1\right]$

$K\frac{P_{co}}{P_{co_2}}$

3. (D)
Sol. $K = \frac{(mol/\,liter)^2}{mol/\,liter \times mol/\,liter} = unitless$

4. (C)
Sol. Dissociation of $MgCO_3$ is endothermic. So as temperature increases, reaction goes in forward direction, so extent of dissociation increases. If volume decreases, active mass increases so reaction goes in the direction of decreasing gaseous moles i.e. in the backward direction. So partial pressure of CO_2 will decreases. If volume increases, reaction goes in forward direction so extent of dissociation of $MgCO_3$ will increases.

5. (C)
Sol. Solubility of gas α P
Exothermic process]

6. (B)
Sol. $K_p = P^2$

$$\ln\frac{K_{P_2}}{K_{P_1}} = \frac{\Delta H}{R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

$$\ln\frac{P_{400}^2}{P_{300}^2} = \frac{16.628\times10^3}{8.314}\left[\frac{1}{300} - \frac{1}{400}\right]$$

$$2\ln\frac{P_{400}}{P_{300}} = 2\times10^3\left[\frac{100}{300\times400}\right]$$

$= \frac{10}{12} = \frac{5}{6}$ **Ans.**]

7. (C)

8. (D)
Sol. $K_P = K_C\,(RT)^{\Delta ng}$
$\Delta ng = 0$

9. (C)
Sol. $K_P = P_{H_2O}$

K_P is temperature dependent only.]

10. (C)
Sol. $\Rightarrow$ At constant T , K_C remains constant
$\Rightarrow$ At constant T , On increasing P, reaction moves in backward direction, hence PCl_5 concentration increases.
$\Rightarrow$ On increase in volume, reaction moves in forward direction, degree of dissocition of PCl_5 increases.
$\Rightarrow$ On T $\uparrow$, K_c $\uparrow$, degree of dissociation $\uparrow$]

11. (D)
Sol.

	$N_2O_{4(g)}$ $\rightleftharpoons$	$2NO_{2(g)}$
Initial moles	1	0
At eq^m moles	$1 - \alpha$	2α

$$K_P = \frac{(2\alpha)^2 P}{(1-\alpha^2)} = \frac{4\alpha^2 P}{(1-\alpha^2)}$$

$$\frac{4\times(0.1)^2\times3.3}{1-(0.1)^2} = \frac{4\times(0.2)^2\times P}{1-(0.2)^2}$$

$\frac{3.3}{0.99} = \frac{4P}{0.96}$ $\Rightarrow$ P = 0.8 atm **Ans.**

12. (B)

Sol. $H_2O_{(l)} \rightleftharpoons H_2O_{(g)}$

Phase tranformation occurs at constant temperature and pressure. For water, boiling temperature is 100°C and pressure is 1 atm.

At temperature > 100°C, Pressure > 1 atm]

13. (D)

Sol. Theory based

14. (C)

Sol. Since there is no $NH_2COONH_4(s)$ present in the chamber, pressure will not change

15. (D)

Sol. $Fe^{3+}(aq) + SCN^-(aq) \rightleftharpoons Fe(SCN)^{2+}(aq)$

(A) For given system Q α V ⇒ on addition of water Q > K reaction move backward

(B) $Fe^{+3} + 3OH^- \rightleftharpoons Fe(OH)_3$ (s)

reaction moves backward

16. (C)

Sol. Theory based

17. (B)

Sol. $A_2(g) + B_2(g) \rightleftharpoons 2AB(g)$

initial	$\frac{2}{5}$	$\frac{2}{5}$	
equilibrium	$\frac{2}{5} - x$	$\frac{2}{5} - x$	2x

2x = 0.7

x = 0.35 M

$[A_2] = [B_2] = 0.4 - x = 0.05$ M

18. (B)

Sol. $2NOBr(g) \rightleftharpoons 2NO(g) + Br_2(g)$

$$\left(\frac{1-\alpha}{1+\alpha/2}\right)P \qquad \left(\frac{\alpha}{1+\alpha/2}\right)P \qquad \left(\frac{\alpha/2}{1+\alpha/2}\right)P$$

$$P_{Br_2} = \frac{P}{9} = \left(\frac{\frac{\alpha}{2}}{1+\frac{\alpha}{2}}\right)P \quad \frac{\alpha}{2+\alpha} = \frac{1}{9} \qquad \alpha = \frac{1}{4}$$

so $$p_{NOBr} = \left(\frac{1-\alpha}{1+\frac{\alpha}{2}}\right)P = \frac{3/4}{9/8}P = \frac{2}{3}P$$

$$p_{NO} = \left(\frac{\alpha}{1+\frac{\alpha}{2}}\right)P = \frac{1/4}{9/8}P = \frac{2}{9}P$$

$$p_{Br_2} = \frac{P}{9} \qquad K_P = \frac{\left(\frac{2}{9}P\right)^2 \times \frac{P}{9}}{\left(\frac{2}{3}P\right)^2} = \frac{P}{81}$$

$$K_P / P = \frac{1}{81}$$

19. (C)

Sol. $H_2O(g) + CO(g) \rightleftharpoons H_2(g) + CO_2(g)$... (i)

$K_1 = 2$

$FeO(s) + CO(g) \rightleftharpoons Fe(s) + CO_2(g)$ ...(ii)

$K_2 = 4$

Required reaction : $Fe(s) + H_2O\ (g) \rightleftharpoons FeO\ (s) + H_2\ (g)$ .... (iii)

Equation (iii) = Equation (i) – Equation (ii)

$$K_3 = \frac{K_1}{K_2} = \frac{2}{4} = \frac{1}{2}$$

20. (A)

Sol. Only decreasing temperature, K_{eq} increasing so reaction is exothermic in forward direction.

21. 16

Sol. $$\frac{8^3 \times 12^3}{10 \times (30)^3 \times (40)^4} \times \left(\frac{1}{10}\right)^{-3} = \frac{16}{10^5} = 0016]$$

22. 2

Sol.

A(g) +	2B (g)	$\rightleftharpoons$ C(g) +	D(g)		$K_C = 10^{12}$
t = 0	0.5	1		0.5	3.5
0		0		1	4
x		2x		1–x	4–x

$$10^{12} = \frac{4 \times 1}{x \times 4x^2}$$

$x = 10^{-4}$

$[B] = 2 \times 10^{-4}$ M ⇒ y = 2 **Ans.**]

23. 5

Sol. $2A(g) + H_2O(g) \rightleftharpoons C(g) + 3D(g)$ $K_P = 3 \times 10^{22}$ atm

t = 0	2 atm	$\frac{38}{760} = 0.05$ atm	2 atm	2 atm
t	–	0.05 atm	3 atm	5 atm
t_{eq}	2x	0.05	3 – x	5 – 3x

$$\therefore \quad K_P = \frac{(5-3x)^3(3-x)}{(2x)^2 \times 0.05}$$

$$K_p = \frac{125 \times 3}{4x^2 \times 0.05} = 3 \times 10^{22}$$

$$\Rightarrow \quad x^2 = \frac{2500}{4 \times 10^{22}} = \frac{25}{4} \times 10^{-10}$$

$$\Rightarrow \quad x = \frac{5}{2} \times 10^{-10} = 2.5 \times 10^{-10}$$

$\therefore$ $P_A = 2x = 2 \times 2.5 \times 10^{-10}$

$= 5 \times 10^{-10}$

= 5 Ans.]

24. 3

Sol. $A(g) \rightleftharpoons 2B(g)$

at equilibrium 4 bar + 2 bar ⇒ P_{total} = 6 bar

∴ $K_P = \frac{2^2}{4} = 1$

At new equilibrium total pressure = 12 bar

∴ Assuming partial pressure of B = P bar

Partial pressure of A = 12 – P

∴ $\frac{P^2}{12 - P} = 1$

$P^2 + P - 12 = 0$

$(P + 4)(P - 3) = 0$

∴ P = 3 atm

25. 8

Sol. $C_2H_5OH\ (l) \mid C_2H_5OH\ (g)$

	$C_2H_5OH\ (l)$	$C_2H_5OH\ (g)$
mole t = 0	0.1	–
t = t_{eqm}	0.1 – 0.04 = 0.06	0.04

For gas PV = nRT

$$\Rightarrow P_{C_2H_5OH\ (gas)} = \frac{nRT}{V} = \frac{0.04 \times 0.08 \times 300}{12}$$

V.P.$_{gas}$ = 0.08 atm (at eq^m)

Ans. = 0.08 × 100 = 8

26. 4

Sol.

	$H_2(g)$	+	$Cl_2(g)$	|	2HCl (g)
Initially	1		4		–
Equilibrium	$1 - \frac{x}{2}$		$4 - \frac{x}{2}$		x
New Equilibrium	$6 - \frac{3x}{2}$		$4 - \frac{3x}{2}$		3x

[After adding 5 moles of H_2]

$$K_C = \frac{x^2}{\left(1 - \frac{x}{2}\right)\left(4 - \frac{x}{2}\right)} = \frac{(3x)^2}{\left(4 - \frac{3x}{2}\right)\left(6 - \frac{3x}{2}\right)}$$

x = 1.6

$$K_{eq} = \frac{1.6 \times 1.6}{\left(1 - \frac{1.6}{2}\right)\left(4 - \frac{1.6}{2}\right)}$$

$K_{eq} = 4$

27. 250

Sol. $\log\left(\frac{K_T}{K_{300}}\right) = \frac{\Delta H}{2.3R}\left(\frac{1}{300} - \frac{1}{T}\right)$

$\Rightarrow \log 2 = \frac{-2070}{2.3 \times 2}\left(\frac{1}{300} - \frac{1}{T}\right)$

∴ T = $\frac{1500}{6}$K = 250 K Ans.

28. 75

Sol. $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ K_p = 5 atm

for $PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$ $K_p = \frac{1}{5}$ atm^{-1}

$PCl_3(g)$	$Cl_2(g)$	$PCl_5(g)$	
1	1		
1 – x	1 – x	x	x = 0.75
$\frac{0.25}{1.25}P_T$	$\frac{0.25}{1.25}P_T$	$\frac{0.75}{1.25}P_T$	

Let P_T total pressure at eq.

$$K_p = \frac{\frac{0.75}{1.25} \times P_T}{\frac{0.25}{1.25}P_T \times \frac{0.25}{1.25}P_T}$$

$$K_p = \frac{1 \times 3 \times 1.25}{0.25} = \frac{1}{5}$$

P_T = 75 atm]

29. 100

Sol. $A(s) \rightleftharpoons B(g) + C(g)$ $K = 900 = P_1(P_1 + P_2)$

$P_1 + P_2$ P_1

$D(s) \rightleftharpoons B(g) + E(g)$ $K = 1600 = P_2(P_1 + P_2)$

$P_2 + P_1$ P_2 $2500 = (P_1 + P_2)^2$

$P_1 + P_2 = 50$

Ans. 100 mm of Hg]

30. 256

Sol. $H_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons H_2O(l)$

$K_{P_1} = 8\,\text{bar}^{-3/2}$

$H_2O(l) \rightleftharpoons H_2O(g)$

$K_{P_2} = \text{V.P. of } H_2O = 2\,\text{bar}$

$H_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons H_2O(g)$

$K_P = K_{P_1} \times K_{P_2}$

$2H_2(g) + O_2(g) \rightleftharpoons 2H_2O(g)$

$K_P = (K_{P_1} \times K_{P_2})^2 = (8 \times 2)^2\ \text{bar}^{-1} = 256\ \text{bar}^{-1}$

$K_P^o = 256$ Ans.