

JEE MAIN ANSWER KEY & SOLUTIONS

SUBJECT :- CHEMISTRY

CLASS :- 11th

CHAPTER :- CHEMICAL EQUILIBRIUM

PAPER CODE :- CWT-6

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.

$$2 \ln \frac{P_{400}}{P_{300}} = 2 \times 10^3 \left[\frac{100}{300 \times 400} \right]$$

2. (A)

Sol. $\text{Zn}_{(s)} + \text{CO}_{2(g)} \longrightarrow \text{ZnO}_{(s)} + \text{CO}_{(g)}$

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

$$K \frac{P_{\text{co}}}{P_{\text{co}_2}}$$

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

3. (D)

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

7. (C)

8. (D)

Sol. $K_p = K_c (RT)^{\Delta n_g}$
 $\Delta n_g = 0$

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 decrease. If volume increases, reaction goes in forward direction so extent of dissociation of MgCO_3 will increase.

9. (C)

Sol. $K_p = P_{\text{H}_2\text{O}}$

K_p is temperature dependent only.]

5. (C)

Sol. Solubility of gas $\propto P$
 Exothermic process]

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 dissociation of PCl_5 increases.

\Rightarrow On T \uparrow , $K_c \uparrow$, degree of dissociation \uparrow]

6. (B)

Sol. $K_p = P^2$

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

$$\ln \frac{P_{400}^2}{P_{300}^2} = \frac{16.628 \times 10^3}{8.314} \left[\frac{1}{300} - \frac{1}{400} \right]$$

11. (D)

Sol.

	$\text{N}_2\text{O}_{4(g)} \rightleftharpoons 2\text{NO}_{2(g)}$
Initial moles	1 0
At eq ^m moles	1 - α 2 α

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

$$\frac{4 \times (0.1)^2 \times 3.3}{1 - (0.1)^2} = \frac{4 \times (0.2)^2 \times P}{1 - (0.2)^2}$$

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

12. (B)
Sol. $H_2O_{(l)} \rightleftharpoons H_2O_{(g)}$
 Phase transformation occurs at constant temperature and pressure. For water, boiling temperature is 100°C and pressure is 1 atm. At temperature $> 100^\circ\text{C}$, 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 $Q \propto V \Rightarrow$ 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	$\frac{2}{5} - x$	$\frac{2}{5} - x$	$2x$

$2x = 0.7$
 $x = 0.35 \text{ M}$
 $[A_2] = [B_2] = 0.4 - x = 0.05 \text{ M}$

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

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

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

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

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

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

19. (C)
Sol. $H_2O(g) + CO(g) \rightleftharpoons H_2(g) + CO_2(g) \dots (i)$
 $K_1 = 2$
 $FeO(s) + CO(g) \rightleftharpoons Fe(s) + CO_2(g) \dots (ii)$
 $K_2 = 4$

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

$10^{12} = \frac{4 \times 1}{x \times 4x^2}$
 $x = 10^{-4}$
 $[B] = 2 \times 10^{-4} \text{ M} \Rightarrow y = 2 \text{ Ans.]}$

23. 5
Sol. $2A(g) + H_2O(g) \rightleftharpoons C(g) + 3D(g)$
 $K_p = 3 \times 10^{22} \text{ atm}$

t = 0	2 atm	$\frac{38}{760} = 0.05 \text{ atm}$	2 atm
	2 atm	0.05 atm	3 atm
t _{eq}	2x	0.05	3 - x
			5 - 3x

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

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

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

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

$\therefore P_A = 2x = 2 \times 2.5 \times 10^{-10} = 5 \times 10^{-10} = 5 \text{ Ans.}]$

24. 3
Sol. $A(g) \rightleftharpoons 2B(g)$
 at equilibrium 4 bar + 2 bar $\Rightarrow P_{\text{total}} = 6$ bar
 $\therefore K_p = \frac{2^2}{4} = 1$
 At new equilibrium total pressure = 12 bar
 \therefore Assuming partial pressure of B = P bar
 Partial pressure of A = 12 - P
 $\therefore \frac{P^2}{12-P} = 1$
 $P^2 + P - 12 = 0$
 $(P+4)(P-3) = 0$
 $\therefore P = 3$ atm

25. 8
Sol. $C_2H_5OH(l) \rightleftharpoons C_2H_5OH(g)$
 mole t = 0 0.1 -
 t = t_{eqm} 0.1 - 0.04 0.04
 = 0.06
 For gas PV = nRT
 $\Rightarrow P_{C_2H_5OH(\text{gas})} = \frac{nRT}{V} = \frac{0.04 \times 0.08 \times 300}{12}$
 V.P._{gas} = 0.08 atm (at eq^m)
Ans. = 0.08 \times 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

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

$K_{\text{eq}} = 4$

27. 250

Sol. $\log\left(\frac{K_T}{K_{300}}\right) = \frac{\Delta H}{2.3R}\left(\frac{1}{300} - \frac{1}{T}\right)$
 $\Rightarrow \log 2 = \frac{-2070}{2.3 \times 2}\left(\frac{1}{300} - \frac{1}{T}\right)$
 $\therefore T = \frac{1500}{6} K = 250 K$ 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

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.

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

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

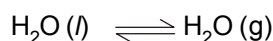
$P_T = 75$ atm]

29. 100
Sol. $A(s) \rightleftharpoons B(g) + C(g)$ $K = 900 = P_1(P_1 + P_2)$
 $\frac{P_1 + P_2}{P_1}$
 $D(s) \rightleftharpoons B(g) + E(g)$ $K = 1600 = P_2(P_1 + P_2)$
 $\frac{P_2 + P_1}{P_2}$ $2500 = (P_1 + P_2)^2$
 $P_1 + P_2 = 50$
Ans. 100 mm of Hg]

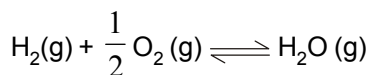
30. 256

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

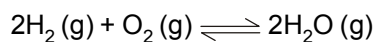
$K_{P_1} = 8 \text{ bar}^{-3/2}$



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



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



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

$K_p^0 = 256$ Ans.