VOLUME II

ANSWERS

UNIT 8

MCQ

1. $Ag_2C_2O_4 \rightleftharpoons 2Ag^+ + C_2O_4^{2-}$

$[Ag^+] = 2.24\times10^{-4} \text{ mol } L^{-1}$

$[C_2O_4^{2-}] = \frac{2.24\times10^{-4}}{2} \text{ mol } L^{-1}$

$= 1.12\times10^{-4} \text{ mol } L^{-1}$

$K_{sp} = [Ag^+]^2 [C_2O_4^{2-}]$

$= (2.24\times10^{-4} \text{ mol } L^{-1})^2 (1.12\times10^{-4} \text{ mol } L^{-1})$

$= 5.619\times10^{-12} \text{ mol}^3 L^{-3}$

[Option (d)]

2. iii) 75 ml $\frac{M}{5}$ HCl + 25ml $\frac{M}{5}$ NaOH

No of moles of HCl = $0.2\times75\times10^{-3} = 15 \times 10^{-3}$

No of moles of NaOH = $0.2 \times 25 \times 10^{-3} = 5 \times 10^{-3}$

No of moles of HCl after mixing = $15 \times 10^{-3} - 5 \times 10^{-3}$

$= 10 \times 10^{-3}$

$\therefore$ concentration of HCl = $\frac{\text{No of moles of HCl}}{\text{Vol in litre}}$

$= \frac{10\times10^{-3}}{100\times10^{-3}} = 0.1M$

for (iii) solution, pH of 0.1M HCl = $-\log_{10}(0.1)$

$= 1.$

[Option (d)].

3. $BaSO_4 \rightleftharpoons Ba^{2+} + SO_4^{2-}$

$K_{sp} = (s)\ (s)$

$K_{sp} = (s)^2$

$= (2.42\times10^{-3} \text{ g } L^{-1})^2$

$= \left(\frac{2.42\times10^{-3} \text{ g } L^{-1}}{233 \text{g mol}^{-1}}\right)^2$

$= (0.01038\times10^{-3})^2$

$= (1.038\times10^{-5})^2$

$= 1.077\times10^{-10}$

$= 1.08\times10^{-10} \text{ mol}^2 \text{ } L^{-2}$

[Option (c)]

4. $Ca(OH)_2 \rightleftharpoons Ca^{2+} + 2OH^-$

Given that pH=9

pOH=14-9=5

$[pOH = -\log_{10}[OH^-]]$

$\therefore [OH^-] = 10^{-\text{ pOH}}$

$[OH^-] = 10^{-5} \text{ M}$

$K_{sp} = [Ca^{2+}][OH^-]^2$

$= \frac{10^{-5}}{2} \times (10^{-5})^2$

$= 0.5\times10^{-15}$

[Option (a)]

5. $\underset{\text{acid 1}}{H_2O} + \underset{\text{base 1}}{H_2O} \rightleftharpoons \underset{\text{acid 2}}{H_3O^+} + \underset{\text{base 2}}{OH^-}$

$\underset{\text{acid 1}}{HF} + \underset{\text{base 1}}{H_2O} \rightleftharpoons \underset{\text{acid 2}}{H_3O^+} + \underset{\text{base 2}}{F^-}$

$\therefore$ Conjugate bases are OH^- and F^- respectively

i.e.,[Option (c)]

6. Basic buffer is the solution which has weak base and its salt

$$\underset{200\,ml}{NH_4OH} + \underset{100\,ml}{HCl} \longrightarrow \underset{Salt}{NH_4Cl} + H_2O + \underset{(100\,ml\ weak\ base)}{NH_4OH}$$

i.e.,[Option (c)]

7. $BF_3 \rightarrow$ elctron deficient $\rightarrow$ Lewis acid

$PF_3 \rightarrow$ electron rich $\rightarrow$ lewis base

$CF_4 \rightarrow$ neutral $\rightarrow$ neither lewis acid nor base

$SiF_4^- \rightarrow$ neutral $\rightarrow$ neither lewis acid nor base

[option (b)]

8. $BF_3 \rightarrow$ elctron deficient $\rightarrow$ Lewis acid

$PF_3 \rightarrow$ electron rich $\rightarrow$ lewis base

$CO \rightarrow$ having lone pair of electron $\rightarrow$ lewis base

$F^- \rightarrow$ unshared pair of electron $\rightarrow$ lewis base

[option (a)]

9. $HCOONa + H\cdot OH \rightleftharpoons \underset{\text{strong base}}{NaOH} + \underset{\text{weak acid}}{H\text{-}COOH}$

Basic in nature.

$$C_6H_5NH_3Cl^- + H\cdot OH \rightleftharpoons \underset{acidic}{H_3O^+} + C_6H_5\text{-}NH_2 + Cl^-$$

$$KCN + H - OH \rightleftharpoons \underset{\text{strong base}}{KOH} + \underset{\text{weak acid}}{HCN}$$

basic

[option (b)] basic, acidic, basic is correct.

10. $C_5H_5N + H\text{-}OH \rightleftharpoons C_5H_5\overset{+}{N}H + OH^-$

$$\frac{\alpha^2 C}{1-\alpha} = K_b$$

$$\alpha^2 C \simeq K_b$$

$$\alpha = \sqrt{\frac{K_b}{C}} = \sqrt{\frac{1.7\times10^{-9}}{0.1}}$$

$$= \sqrt{1.7}\times10^{-4}$$

Percentage of dissociation $= \sqrt{1.7 \times 10^{-4}} \times 100$

$= 1.3 \times 10^{-2} = 0.013\ \%$

[Option (b)]

11. $pH = -\log_{10}[H^+]$

$\therefore [H^+] = 10^{-pH}$

Let the volume be x mL

$V_1M_1 + V_2M_2 + V_3M_3 = VM$

$\therefore$ x mL of 10^{-1}M + x mL of 10^{-2}M + x mL of 10^{-3} M

= 3x mL of $[H^+]$

$$\therefore [H^+] = \frac{x[0.1+0.01+0.001]}{3x}$$

$$= \frac{0.1+0.01+0.001}{3}$$

$$= \frac{0.111}{3}$$

$= 0.037$

$= 3.7 \times 10^{-2}$

[Option (a)]

12. $AgCl_{(s)} \rightleftharpoons Ag^+(aq) + Cl^-(aq)$

$\underset{0.1\ M}{NaCl} \longrightarrow \underset{0.1\ M}{Na^+} + \underset{0.1\ M}{Cl^-}$

$K_{sp} = 1.6 \times 10^{-10}$

$K_{sp} = [Ag^+][Cl^-]$

$K_{sp} = (s)(s+0.1)$

$0.1 >>> s$

$\therefore s + 0.1 \simeq 0.1$

$$\therefore S = \frac{1.6 \times 10^{-10}}{0.1} = 1.6 \times 10^{-9}$$

[Option (b)]

13. $PbI_2(s) \rightleftharpoons Pb^{2+}(aq) + 2I^-(aq)$

$K_{sp} = (s)(2s)^2$

$3.2 \times 10^{-8} = 4s^3$

$$s = \left(\frac{3.2 \times 10^{-8}}{4}\right)^{1/3}$$

$= (8 \times 10^{-9})^{1/3}$

$= 2 \times 10^{-3}$M [Option (a)]

14. Addition of salt KY (having a common ion Y^-) decreases the solubility of MY and NY_3 due to common ion effect.

Option (a) and (b) are wrong.

For salt MY , $MY \rightleftharpoons M^+ + Y^-$

$K_{sp} = (s)(s)$

$6.2 \times 10^{-13} = s^2$

$\therefore s = \sqrt{6.2 \times 10^{-13}} \simeq 10^{-7}$

for salt NY_3,

$NY_3 \rightleftharpoons N^{3+} + 3Y^-$

$K_{sp} = (s)(3s)^3$

$K_{sp} = 27s^4$

$$s = \left(\frac{6.2 \times 10^{-13}}{27}\right)^{1/4}$$

$s. \simeq 10^{-4}$

The molar solubility of MY in water is less than of NY_3

[Option (d)]

15. x ml of 0.1 M NaOH + x ml of 0.01 M HCl

No of moles of NaOH = $0.1 \times x \times 10^{-3} = 0.1x \times 10^{-3}$

No of moles of HCl = $0.01 \times x \times 10^{-3} = 0.01x \times 10^{-3}$

No of moles of NaOH after mixing = $0.1x \times 10^{-3} - 0.01x \times 10^{-3}$

$= 0.09x \times 10^{-3}$

$$\text{Concentration of NaOH} = \frac{0.09x \times 10^{-3}}{2x \times 10^{-3}} = 0.045$$

$[OH^-] = 0.045$

$P^{OH} = -\log(4.5 \times 10^{-2})$

$= 2 - \log 4.5$

$= 2 - 0.65 = 1.35$

$pH = 14 - 1.35 = 12.65$

[Option (d)]

16. $K_a = 1 \times 10^{-3}$

$pH = 4$

$\frac{[salt]}{[Acid]} = ?$

$pH = pK_a + \log \frac{[Salt]}{[Acid]}$

$4 = -\log_{10}(1 \times 10^{-3}) + \log \frac{[Salt]}{[Acid]}$

$4 = 3 + \log \frac{[Salt]}{[Acid]}$

$1 = \log_{10} \frac{[Salt]}{[Acid]}$

$\Rightarrow \frac{[Salt]}{[Acid]} = 10^1$

i.e., $\frac{[Acid]}{[Salt]} = \frac{1}{10}$

1:10

[Option (d)]

17. $\underset{10^{-5}m}{KOH} \rightarrow \underset{10^{-5}m}{K^+} + \underset{10^{-5}m}{OH^-}$

$[OH^-] = 10^{-5}M.$

$pH = 14 - pOH$

$pH = 14 - \left(-\log \left[OH^-\right]\right)$

$= 14 + \log [OH^-]$

$= 14 + \log 10^{-5}$

$= 14 - 5$

$= 9.$

[Option (a)]

18. $\underset{\text{acid 1}}{H_3PO_4} + \underset{\text{base 1}}{H - OH} \rightleftharpoons \underset{\text{acid 2}}{H_3O^+} + \underset{\text{base 2}}{H_2PO_4^-}$

$\therefore H_2PO_4^-$ is the conjugate base of H_3PO_4

[Option (c)]

19. HPO_4^{2-} can have the ability to accept a proton to form $H_2PO_4^-$.

It can also have the ability to donate a proton to form PO_4^{-3}

[Option (c)]

20. $pH = -\log_{10}[H^+]$

$\therefore [H^+] = 10^{-pH}$

$= 10^0 = 1$

$[H^+] = 1M$

The solution is strongly acidic

[Option (b)]

21. According to Henderson equation

$pH = pK_a + \log \frac{[salt]}{[acid]}$

ie. $-\log [H^+] = -\log K_a + \log \frac{[salt]}{[acid]}$

$-\log[H^+] = \log \frac{[salt]}{[acid]} \times \frac{1}{K_a}$

$\log \frac{1}{[H^+]} = \log \frac{[salt]}{[acid]} \times \frac{1}{K_a}$

$\therefore [H^+] = K_a \frac{[acid]}{[salt]}$

[option (a)]

22. $h = \sqrt{\frac{K_h}{K_a . K_b}}$

[Option (c)]

23. $K_h = \frac{K_w}{K_b} = \frac{1 \times 10^{-14}}{1.8 \times 10^{-5}}$

$= 0.55 \times 10^{-9}$

$= 5.5 \times 10^{-10}$

[option (b)]

Key answer for short answer question

8. Concentration of HNO_3 = 0.04M

$[H_3O^+]=0.04 \text{ mol dm}^{-3}$

$pH=-\log[H_3O^+]$

$=-\log(0.04)$

$=-\log(4\times10^{-2})$

$=2-\log4$

$=2-0.6021$

$=1.3979 = 1.40$

14. $Ba(OH)_2 \rightarrow Ba^{2+}+2OH^-$

$1.5\times10^{-3}M \qquad 2\times1.5\times10^{-3}M.$

$[OH^-] = 3\times10^{-3}M$

$[\because pH+pOH=14]$

$pH= 14-pOH$

$pH= 14- \left(-\log [OH^-]\right)$

$= 14+ \log [OH^-]$

$=14+\log(3\times10^{-3})$

$=14 + \log 3 + \log 10^{-3}$

$= 14+ 0.4771-3$

$=11+0.4771$

$pH=11.48$

15. Number of moles of $HNO_3 = 0.05 \times 50 \times 10^{-3}$

$=2.5 \times 10^{-3}$

Number of moles of $KOH = 0.025 \times 50 \times 10^{-3}$

$= 1.25 \times 10^{-3}$

Number of moles of HNO_3 after mixing

$= 2.5 \times 10^{-3} - 1.5 \times 10^{-3}$

$= 1.25 \times 10^{-3}$

$\therefore$ concentration of $HNO_3 = \dfrac{\text{Number of moles of } HNO_3}{\text{Volume is litre}}$

After mixing, total volume = 100 ml = 100×10^{-3}L

$\therefore [H^+]=\dfrac{1.25\times10^{-3}\text{moles}}{100\times10^{-3}\text{L}}$

$=1.25\times10^{-2}$ moles L^{-1}

$pH = -\log [H^+]$

$pH = -\log(1.25\times10^{-2}) = 2-0.0969$

$= 1.9031$

16. Given

$K_a=10^{-9}$

$c=0.4M$

$pH=-\log[H^+]$

$[H^+]=\sqrt{K_a\times c.}$

$=\sqrt{10^{-9}\times0.4}$

$=2\times10^{-5}$

$\therefore pH= -\log(2\times10^{-5})$

$=5-\log2$

$=5-0.3010$

$=4.699.$

17. $h = \sqrt{K_h} = \sqrt{\dfrac{K_W}{K_aK_b}} = \sqrt{\dfrac{1\times10^{-14}}{1.8\times10^{-5}\times1.8\times10^{-5}}}$

$= \sqrt{\dfrac{1}{1.8}\times10^{-4}}$

$= 0.7453\times10^{-2}$

$pH = \frac{1}{2} pK_w + \frac{1}{2} pK_a - \frac{1}{2} pK_b$

Given that $K_a = K_b = 1.8 \times 10^{-5}$

if $K_a = K_b$, then, $pK_a = pK_b$

$\therefore pH = \frac{1}{2} pK_w = \frac{1}{2} (14) = 7$

19. Given that $K_{sp} = 1 \times 10^{-12}$

$$\underset{s}{Ag_2CrO_4}(s) \rightleftharpoons \underset{2s}{2Ag^+_{(aq)}} + \underset{s}{CrO_4^{-2}}(aq)$$

$$\underset{0.01M}{AgNO_3}(s) \rightleftharpoons \underset{0.01M}{Ag^+_{(aq)}} + \underset{0.01M}{NO_3^-}(aq)$$

$$K_{sp} = [Ag^+]^2\,[CrO_4^{2-}]$$

$$\begin{bmatrix} [Ag^+] = 2s + 0.01 \\ 0.01 >> 2S \\ \therefore\ [Ag^+] = 0.01M \\ [CrO_4^{2-}] = s \end{bmatrix}$$

$$1 \times 10^{-12} = (0.01)^2\ (s)$$

$$(s) = \frac{1 \times 10^{-12}}{(10^{-2})^2} = 1 \times 10^{-8}\,M$$

20. $\underset{s}{Ca_3(PO_4)_2} \rightleftharpoons \underset{3s}{3Ca^{2+}} + \underset{2s}{2PO_4^{3-}}$

$K_{sp} = [Ca^{2+}]^3[PO_4^{3-}]^2$

$K_{sp} = (3s)^3(2s)^2$

$K_{sp} = 27s^3.4s^2$

$K_{sp} = 108s^5$

21. $CaF_2(s) \rightleftharpoons Ca^{2+}_{(aq)} + 2F^-(aq)$

$[F^-] = 2\,[Ca^{2+}] = 2 \times 3.3 \times 10^{-4}M$

$= 6.6 \times 10^{-4}M$

$K_{sp} = [Ca^{2+}][F^-]^2$

$= (3.3 \times 10^{-4})(6.6 \times 10^{-4})^2$

$= 1.44 \times 10^{-10}$

22. $AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$

x= solubility of AgCl in 1M $AgNO_3$

$\underset{1M}{AgNO_3}(aq) \rightleftharpoons Ag^+(aq) + \underset{1M}{NO_3^-}(aq)$

$[Ag^+] = x + 1 \simeq 1M \qquad (\because x << 1)$

$[Cl^-] = x$

$K_{sp} = [Ag^+][Cl^-]$

$1.8 \times 10^{-10} = (1)(x)$

$x = 1.8 \times 10^{-10}\,M$

23. $Ag_2CrO_4(s) \rightleftharpoons 2Ag^+_{(aq)} + CrO_4^{2-}(aq)$

$K_{sp} = [Ag^+]^2[CrO_4^{2-}]$

$= (5 \times 10^{-5})^2(4.4 \times 10^{-4})$

$= 1.1 \times 10^{-12}$

24. $\underset{s}{Hg_2Cl_2} \rightleftharpoons \underset{s}{Hg_2^{2+}} + \underset{2s}{2Cl^-}$

$K_{sp} = [Hg_2^{2+}][Cl^-]^2$

$= (s)(2s)^2$

$K_{sp} = 4s^3$

25. $\underset{x}{Ag_2CrO_4} \rightleftharpoons \underset{2x}{2Ag^+} + \underset{x}{CrO_4^{2-}}$

x is the solubility

of Ag_2CrO_4 in 0.1M K_2CrO_4

$\underset{0.1M}{K_2CrO_4} \rightleftharpoons \underset{0.2\ M}{2K^+} + \underset{0.1\ M}{CrO_4^{2-}}$

$[Ag^+] = 2x$

$[CrO_4^{2-}] = (x + 0.1) \approx 0.1 \qquad \because x << 0.1$

$K_{sp} = [Ag^+]^2[CrO_4^{2-}]$

$1.1 \times 10^{-12} = (2x)^2(0.1)$

$1.1 \times 10^{-12} = 0.4x^2$

$x^2 = \frac{1.1 \times 10^{-12}}{0.4}$

$x = \sqrt{\frac{1.1 \times 10^{-12}}{0.4}}$

$x = \sqrt{2.75 \times 10^{-12}}$

$x = 1.65 \times 10^{-6}M$

26. When two are more solution are mixed, the resulting concentrations are differnet from the original.

Total volume = 0.250L

$$\underset{0.1\ M}{Pb(NO_3)_2} \rightleftharpoons \underset{0.1\ M}{Pb^{2+}} + \underset{0.2\ M}{2NO_3^-}$$

Number of moles

Pb^{2+} = molarity × Volume of the solution in lit

$= 0.1 \times 0.15$

$$[Pb^{2+}]_{mix} = \frac{0.1 \times 0.15}{0.25} = 0.06\ M$$

$$\underset{0.2\ M}{NaCl} \rightleftharpoons \underset{0.2\ M}{Na^+} + \underset{0.2\ M}{Cl^-}$$

No.of moles $Cl^- = 0.2 \times 0.1$

$$[Cl^-]_{mix} = \frac{0.2 \times 0.1}{0.25} = 0.08\ M$$

Precipitation of $PbCl_2$ (s) occurs if

$[Pb^{2+}][Cl^-]^2 > K_{sp}$

$[Pb^{2+}][Cl^-]^2 = (0.06)(0.08)^2$

$= 3.84 \times 10^{-4}$

Since ionic product $[Pb^{2+}][Cl^-]^2 > K_{sp}$, $PbCl_2$ is precipitated

27. $Al(OH)_3 \rightleftharpoons Al^{3+}(aq) + 3OH^-(aq)$

$K_{sp} = [Al^{3+}][OH^-]^3$

$Al(OH)_3$ precipitates when

$[Al^{3+}][OH^-]^3 > K_{sp}$

$(1 \times 10^{-3})[OH^-]^3 > 1 \times 10^{-15}$

$[OH]^3 > 1 \times 10^{-12}$

$[OH^-] > 1 \times 10^{-4} M$

$[OH^-] = 1 \times 10^{-4} M$

$POH = -\log_{10}[OH^-] = -\log(1 \times 10^{-4}) = 4$

pH = 14-4= 10

Thus, $Al(OH)_3$ precipitates at a pH of 10

Evaluate yourself

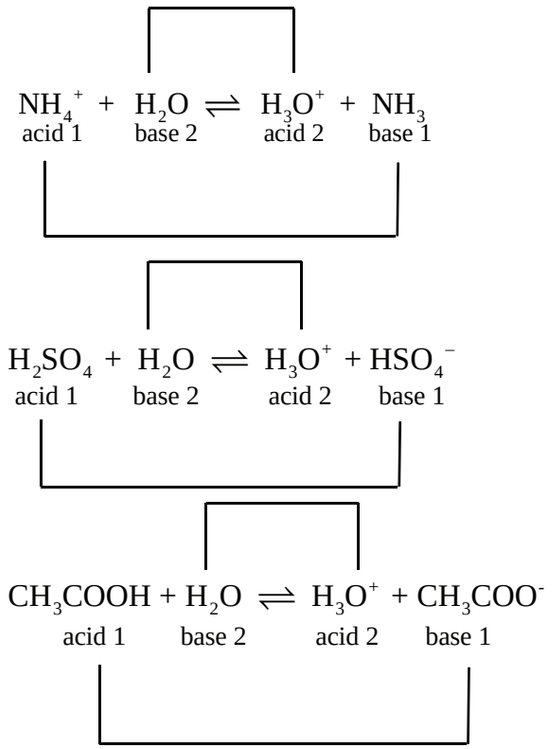
Key

Evaluate yourself – 1

acid : (i) HNO_3 iii) H_3PO_3 iv) CH_3COOH

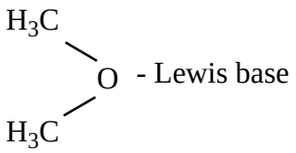
base : ii) $Ba(OH)_2$

Evaluate yourself – 2



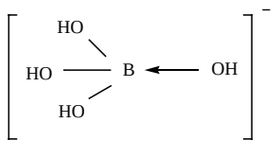
Evaluate yourself – 3

i) CaO - Lewis base ; CO_2 -Lewisacid

ii)  - Lewis base

$AlCl_3$ - Lewis acid

Evaluate yourself – 4

 ; electron pair acceptor - Lewis acid

Evaluate yourself – 5

Given solution is neutral

$\therefore [H_3O^+] = [OH^-]$ Let $[H_3O^+] = x$; then $[OH^-] = x$

$K_w = [H_3O^+][OH^-]$

$4 \times 10^{-14} = x \cdot x$

$x^2 = 4 \times 10^{-14}$

$x = \sqrt{4 \times 10^{-14}} = 2 \times 10^{-7}$

Evaluate yourself – 6

a) Answer

$$\underset{10^{-8}\ M}{H_2SO_4} \xrightarrow{H_2O} \underset{2\times10^{-8}}{2H_3O^+} + \underset{10^{-8}\ M}{SO_4^{2-}}$$

In this case the concentration of H_2SO_4 is very low and hence $[H_3O^+]$ from water cannot be neglected

$\therefore [H_3O^+] = 2\times10^{-8}$ (from H_2SO_4) + 10^{-7} (from water)

$=10^{-8}(2+10)$

$=12\times10^{-8} = 1.2 \times10^{-7}$

$pH = -\log_{10}[H_3O^+]$

$= -\log_{10}(1.2\times10^{-7})$

$=7 - \log_{10}1.2$

$=7 - 0.0791 = 6.9209$

b) Answer

pH of the solution = 5.4

$[H_3O^+]$ = antilog of (-pH)

= anitlog of (-5.4)

= antilog of $(-6 + 0.6) = \bar{6}.6$

$= 3.981\times10^{-6}$

i.e., 3.98×10^{-6} mol dm^{-3}

c) Answer

No of moles of HCl $= 0.2\times 50 \times 10^{-3} = 10 \times 10^{-3}$

No of moles of NaOH $= 0.1 \times 50 \times 10^{-3} = 5 \times 10^{-3}$

No of moles of HCl after mixing $= 10 \times 10^{-3} - 5 \times 10^{-3}$

$= 5 \times 10^{-3}$

after mixing total volume = 100mL

$\therefore$ Concentration of HCl in moles per litre = $\frac{5\times10^{-3}\text{mole}}{100 \times 10^{-3}\text{L}}$

$[H_3O^+]=5\times10^{-2}$ M

$pH = -\log(5 \times 10^{-2})$

$= 2 - \log 5$

$= 2 - 0.6990$

$= 1.30$

Evaluate yourself - 7

$$\alpha = \sqrt{\frac{K_b}{C}} = \sqrt{\frac{1.8\times10^{-5}}{6\times10^{-2}}}$$

$= \sqrt{3 \times 10^{-4}}$

$= 1.732 \times 10^{-2}$

$= \frac{1.732}{100} = 1.732\%$

Evaluate yourself – 8

a) Answer

Dissociation of buffer components

$$NH_4OH\ (aq) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$$

$$NH_4Cl \rightarrow NH_4^+ + Cl^+$$

Addition of H+

The added H^+ ions are neutralized by NH_4OH and there is no appreciable decrease in pH.

$$NH_4OH(aq) + H^+ \rightarrow NH_4^+(aq) + H_2O(l)$$

Addition of OH^-

$$NH_4^+(aq) + OH^-(aq) \rightarrow NH_4OH\ (aq)$$

The added OH^- ions react with NH_4^+ to produce unionized NH_4OH. Since NH_4OH is a weak base, there is no appreciable increase in pH

b) Answer

pH of buffer

$$\underset{0.4-\alpha}{CH_3COOH(aq)} \rightleftharpoons \underset{\alpha}{CH_3COO^-(aq)} + \underset{\alpha}{H^+(aq)}$$

$$\underset{0.4}{CH_3COONa(aq)} \longrightarrow \underset{0.4}{CH_3COO^-(aq)} + \underset{0.4}{Na^+(aq)}$$

$$[H^+] = \frac{K_a[CH_3COOH]}{[CH_3COO^-]}$$

$[CH_3COOH] = 0.4 - \alpha \simeq 0.4$

$[CH_3COO^-] = 0.4 + \alpha \simeq 0.4$

$$\therefore [H^+] = \frac{K_a(0.4)}{(0.4)}$$

$[H^+] = 1.8\times10^{-5}$

$\therefore pH = -\log(1.8\times10^{-5}) = 4.74$

Addition of 0.01 mol HCl to 500ml of buffer

$$\text{Added } [H^+] = \frac{0.01\text{ mol}}{500\text{ mL}} = \frac{0.01\text{ mol}}{\frac{1}{2}\text{L}}$$

$= 0.02M$

$$\underset{0.4-\alpha}{CH_3COOH(aq)} \rightleftharpoons \underset{\alpha}{CH_3COO^-(aq)} + \underset{\alpha}{H^+(aq)}$$

$$\underset{0.4}{CH_3COONa} \rightarrow \underset{0.4}{CH_3COO^-} + \underset{0.4}{Na^+}$$

$$\underset{(0.02)}{CH_3COO^-} + \underset{0.02}{HCl} \rightarrow \underset{0.02}{CH_3COOH} + \underset{0.02}{Cl^-}$$

$\therefore$ $[CH_3COOH] = 0.4 - \alpha + 0.02 = 0.42 - \alpha \simeq 0.42$

$[CH_3COO^-] = 0.4 + \alpha - 0.02 = 0.38 + \alpha \simeq 0.38$

$$[H^+] = \frac{(1.8 \times 10^{-5})(0.42)}{(0.38)}$$

$[H^+] = 1.99 \times 10^{-5}$

$pH = - \log (1.99 \times 10^{-5})$

$= 5 - \log 1.99$

$= 5 - 0.30$

$= 4.70$

Evaluate yourself – 9

a) answer

$$pOH = pK_b + \log \frac{[salt]}{[base]}$$

We know that

$pH + pOH = 14$

$\therefore 9 + pOH = 14$

$\Rightarrow pOH = 14 - 9 = 5$

$$5 = 4.7 + \log \frac{[NH_4Cl]}{[NH_4OH]}$$

$$0.3 = \log \frac{[NH_4Cl]}{0.1}$$

$$\frac{[NH_4Cl]}{0.1} = \text{antilog of } (0.3)$$

$[NH_4Cl] = 0.1M \times 1.995$

$= 0.1995\ M$

$= 0.2M$

Amount of NH_4Cl required to prepare 1 litre 0.2M solution = Strength of NH_4Cl × molar mass of NH_4Cl

$= 0.2 \times 53.5$

$= 10.70\ g$

10.70 g ammonium chloride is dissolved in water and the solution is made up to one litre to get 0.2M solution. On mixing equal volume of the given NH_4OH solution and the prepared NH_4Cl solution will give a buffer solution with required pH value (pH = 9).

b)answer

$$pH = pK_a + \log \frac{[salt]}{[acid]}$$

$$4 = 3.75 + \log \frac{[\text{sodium formate}]}{[\text{formic acid}]}$$

[Sodium formate] = number of moles of HCOONa

$= 0.6 \times V \times 10^{-3}$

[formic acid] = number of moles of HCOOH

$= 0.8 \times 100 \times 10^{-3}$

$= 80 \times 10^{-3}$

$$4 = 3.75 + \log \frac{0.6V}{80}$$

$$0.25 = \log \frac{0.6V}{80}$$

$$\text{antilog of } 0.25 = \frac{0.6V}{80}$$

$0.6V = 1.778 \times 80$

$= 1.78 \times 80$

$= 142.4$

$$V = \frac{142.4\ mL}{0.6} = 237.33mL$$

Evaluate yourself - 10

Sodium carbonate is a salt of weak acid, H_2CO_3 and a strong base, NaOH, and hence the solution is alkaline due to hydrolysis.

$$Na_2CO_3(aq) \rightarrow 2Na^+(aq) + CO_3^{2-}(aq)$$

$$CO_3^{2-}(aq) + H_2O(l) \rightleftharpoons HCO_3^- + OH^-$$

i) $$h = \sqrt{\frac{K_w}{K_a \times C}}$$

$$= \sqrt{\frac{1 \times 10^{-14}}{5.5 \times 10^{-11} \times 0.05}}$$

$h = 6.03 \times 10^{-2}$

Given that $pK_a = 10.26$

$pK_a = -\log K_a$

i.e., K_a = antilog of $(-pK_a)$

= antilog of (-10.26)

= antilog of (-11 + 0.74)

$= 10^{-11} \times 5.5$

[antilog of 0.74 = 5.49 $\simeq$ 5.5]

ii) $K_h = \frac{K_w}{K_a} = \frac{1 \times 10^{-14}}{5.5 \times 10^{-11}}$

$= 1.8 \times 10^{-4}$

iii) $pH = 7 + \frac{pK_a}{2} + \frac{\log C}{2}$

$= 7 + \frac{10.26}{2} + \frac{\log 0.05}{2} = 7 + 5.13 - 0.65$

$= 11.48$

Unit 9 Electro Chemistry

1. 1F = 96500 C = 1 mole of e^- = 6.023×10^{23} e^-

$\therefore$ 9650 C = $\frac{6.22 \times 10^{23}}{96500} \times 9650 = 6.022 \times 10^{22}$

Option (C)

2. $Mn^{2+} + 2e^- \rightarrow Mn\ (E^\circ_{red}) = -1.18V$

$2\left[Mn^{2+} \rightarrow Mn^{3+} + e^-\right]\left(E^\circ_{ox}\right) = -1.51V$

$3Mn^{2+} \rightarrow Mn + 2Mn^{3+}$ $E^\circ_{cell} = ?$

$E^\circ_{cell} = \left(E^\circ_{ox}\right) + \left(E^\circ_{red}\right)$

$= -1.51 - 1.18$ and non spontaneous

$= -2.69V$

Since E° is –ve ΔG is +ve and the given

forward cell reaction is non – spontaneous.

(Option (b))

3. Anodic oxidation: (Reverse the given reaction)

$\left(E^\circ_{ox}\right) = 0.76V$ cathodic reduction

$\therefore$ $E^\circ_{cell} = \left(E^\circ_{ox}\right) + \left(E^\circ_{red}\right)$

= 0.76 + 0.34 = 1.1V

(Option (c))

4. $\Lambda = \frac{\kappa}{M} \times 10^{-3}\ mol^{-1}\ m^3$

$= \frac{5.76 \times 10^{-3}\ S\ c\ m^{-1} \times 10^{-3}}{0.5} mol^{-1}\ m^3$

$= \frac{5.76 \times 10^{-3} \times 10^{-3} \times 10^6}{0.5}\ S\ cm^{-1} mol^{-1}\ cm^3.$

$= 11.52\ S\ cm^2\ mol^{-1}$

(Option (b))

5. $(\Lambda_\infty)_{HoAC} = \left[(\Lambda^\circ)_{HCl} + (\Lambda^\circ)_{NaOAC}\right] - (\Lambda^\circ)_{NaCl}$

$= (426.2 + 91) - (126.5)$

$= 390.7$

(Option (c))

6. 1F = 96500 C = charge of 1 mole of e^- = $charge\ of\ 6.022 \times 10^{23}\ e^-$

(Option (b))

7. $7MnO_4^- + 5e^- \rightarrow Mn^{2+} + 4H_2O$

5 moles of electrons i.e., 5F charge is required.

(Option (a))

8. m=ZIt

$= \frac{40 \times 3.86 \times 2500}{2 \times 96500}$

= 2g

41min 40sec = 2500 seconds

$Z = \frac{m}{n \times 96500} = \frac{40}{2 \times 96500}$

(Option (b))

9. m=ZIt (mass of 1 mole of Cl_2 gas = 71)

$t = \frac{m}{ZI}$ ($\therefore$ mass of 0.1mole of Cl_2 gas = 7.1 g mol^{-1})

$= \frac{7.1}{\frac{71}{2 \times 96500} \times 3}$ $(2\ Cl^- \rightarrow Cl_2 + 2e^-)$

$= \frac{2 \times 96500 \times 7.1}{71 \times 3}$

$= 6433.33 sec$

$= 107.2\ min$

(Option (b))

10. $Q = It$

$= 1A \times 60S$

$96500\ C\ \text{charge} \equiv 6.022 \times 10^{23}\ \text{electrons}$

$60\ C\ \text{charge} \equiv \frac{6.022 \times 10^{23}}{96500} \times 60$

$= 3.744 \times 10^{20}\ \text{electrons}$

(Option (C))

11. In general, specific conductance of an electrolyte decreases with dilution. So, 0.002N solution has least specific conductance.

(Option (b))

12. Charging : anode : $PbSO_4(s) + 2e^- \rightarrow Pb\ (s) + SO_4^{-2}(aq)$

Cathode : $PbSO_4(s) + 2H_2O\ (l) \rightarrow PbO_2\ (s) + SO_4^{-2}(aq) + 2e^-$

(Option (C))

13. Option (a) I and IV

14. $E^o_{Zn^{2+}|Zn} = -0.76V$ and $E^o_{Fe^{2+}|Fe} = -0.44V$ Zinc has higher negative electrode potential than iron, iron cannot be coated on zinc.

Option (d)

15. Both are false

i) Dry air has no reaction with iron

ii) Rust has the composition $Fe_2O_3 . x\ H_2O$

(Option (d))

16. (Option (a))

17. $\alpha = \frac{\Lambda}{\Lambda_o} = \frac{6}{400}$

$K_a = \alpha^2 C$

$= \frac{6}{400} \times \frac{6}{400} \times \frac{1}{36}$

$= 6.25 \times 10^{-6}$

Option (b)

18. $R = \rho . \frac{l}{A}$

$\text{cell constant} = \frac{R}{\rho}$

$= \kappa . R \left(\frac{1}{\rho} = \kappa \right)$

$= 1.25 \times 10^{-3}\ \Omega^{-1} cm^{-1} \times 800\ \Omega$

$= 1\ cm^{-1}$

Option (c)

19. Option (d)

20. $E_{cell}=E^{o}_{cell}-\frac{0.0591}{2}\log\frac{[zn^{2+}]}{[Cu^{2+}]}$

$E_1=E^{o}_{cell}-\frac{0.0591}{2}\log\frac{10^{-2}}{1}$

$E_1=E^{o}_{cell}+0.0591.....(1)$

$Zn(s) \rightarrow Zn^{2+}(aq)+2e^{-}$

$Cu^{2+}(aq)+2e^{-} \rightarrow Cu(s)$

$Zn(s)+Cu^{2+}(aq) \rightarrow Zn^{2+}(aq)+Cu(s)$

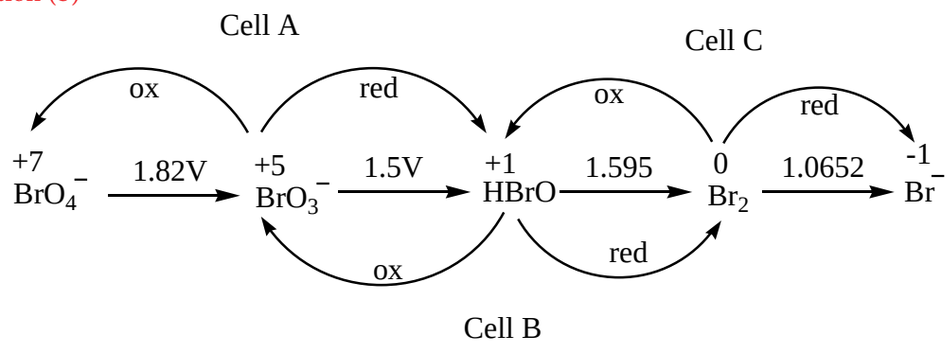
$E_2=E^{o}_{cell}-\frac{0.0591}{2}.\log\frac{1}{10^{-2}}$

$E_2=E^{o}_{cell}-0.0591.....(2)$

$\therefore E_1>E_2$

Option (b)

21.



$(E_{cell})_A=-1.82+1.5=-0.32V$

$(E_{cell})_B=-1.5+1.595=+0.095V$

$(E_{cell})_c=-1.595+1.0652=-0.529V$

$\therefore$ The species undergoing disproportionation is $HBrO$ (Option D)

Short answer

8. Given

$C = 0.01M$ $\quad \lambda^{o}_{cation} = 248.2\ S\ cm^2\ mol^{-1}$

$K= 1.5\times10^{-4}\ S\ cm^{-1}$ $\quad \lambda^{o}_{anion} = 51.8\ S\ cm^2\ mol^{-1}.$

1. Molar conductivity

$\Lambda^{\circ}_{m} = \frac{K(sm^{-1})\times10^{-3}}{C\ (in\ M)}\ mol^{-1}\ m^3$ $\quad K = 1.5\times10^{-4}S\ cm^{-1}$

$= \frac{1.5\times10^{2}\times10^{-3}}{0.01}\ S\ mol^{-1}\ m^2$ $\quad 1\ cm^{-1} = 10^{2}m^{-1}$

$= 1.5\times10^{-3}\ S\ m^2\ mol^{-1}$ $\quad = 1.5\times10^{2}$

2. Degree of dissociation $\alpha = \frac{\Lambda^{\circ}}{\Lambda^{\circ}_{\infty}}$

$\Lambda^{o}_{\infty}=\lambda^{o}_{cation}+\lambda^{o}_{anion}$

$= (248.2+51.8)\ S\ cm^2\ mol^{-1}$

$= 300\ S\ cm^2\ mol^{-1}$

$= 300\times10^{-14}\ s\ m^2\ mol^{-1}$

$$\alpha = \frac{1.5\times10^{-3}\ S\ m^2\ mol^{-1}}{300\times10^{-4}\ S\ m^2\ mol^{-1}}$$

$\alpha = 0.05$

$$K_a = \frac{\alpha^2 c}{1-\alpha}$$

$$= \frac{(0.05)^2(0.01)}{1-0.05}$$

$$= \frac{25\times10^{-4}\times10^{-2}}{95\times10^{-2}}$$

$$= 0.26\times10^{-4}$$

$$= 2.6\times10^{-5}.$$

13. Given

I = 1.608A; t = 50 min = 50×60 = 3000S

V=250 mL

C = 0.5 M

$\eta = 100\%$

Calculate the number of faradays of electricity passed through the $CuSO_4$ solution

$\Rightarrow Q=It$

$Q = 1.608\times3000$

$Q = 4824C$

$\therefore$ number of Faradays of electicity = $\frac{4824\ C}{96500\ C} = 0.05F$

Electrolysis of $CuSO_4$

$Cu^{2+}(aq)+2e^- \rightarrow Cu(s).$

The above equation shows that 2F electricity will deposit 1 mole of Cu^{2+} to Cu.

$\therefore$ 0.05F electricity will

deposit $\frac{1mol}{2F}\times0.05F = 0.025$ mol

Initial number of molar of Cu^{2+} in 250 ml of solution = $\frac{0.5}{1000\ mL}\times250mL$

$= 0.125$ mol

$\therefore$ number of moles of Cu^{2+} after electrolysis = 0.125 - 0.025

= 0.1 mol

$\therefore$ Concentration of $Cu^{2+} = \frac{0.1\ mol}{250\ mL}\times1000\ mL$

= 0.4 M

14. Required half cell reaction

$2\ Br^- \rightarrow Br_2 + 2e^-$ $\quad (E^\circ_{ox}) = -1.09V$

$2\ Fe^{3+} + 2e^- \rightarrow 2Fe^{2+}$ $\quad (E^\circ_{red}) = +0.771V$

$2Fe^{3+} + 2Br^- \rightarrow 2Fe^{2+} + Br_2$ $\quad (E^\circ_{cell}) = ?$

$$E^{\circ}_{cell} = \left(E^{\circ}_{ox}\right) + \left(E^{\circ}_{red}\right)$$
$$= -1.09 + 0.771$$
$$= -0.319V$$

E°_{cell} is – ve; ΔG is +ve and the cell reaction is non spontaneous. Hence Fe^{3+} cannot oxidises Br^{-} to Br_2

.

15. $\left(E^{\circ}_{ox}\right)_{Fe|Fe^{2+}} = 0.44V$ and $\left(E^{\circ}_{red}\right)_{Cu^{2+}|Cu} = 0.34V$.

These +ve emf values shows that iron will oxidise and copper will get reduced i.e., the vessel will dissolve. Hence it is not possible to store copper sulphate in an iron vessel.

16. Metals having higher oxidation potential will liberate H_2 from H_2SO_4. Hence, the metal M_1 having $+xV$, oxidation potential will liberate H_2 from H_2SO_4.
17. oxidation potential of M_1 is more +ve than the oxidation potential of Fe which indicates that it will prevent iron from rusting
18. Cell reactions:

Oxidation at anode: $Cd\,(s) \rightarrow Cd^{2+}(aq) + 2e^{-}$ $\qquad \left(E^{\circ}_{ox}\right)_{Cd|Cd^{2+}} = 0.4V$

Reduction at cathode: $Cu^{2+}(aq) + 2e^{-} \rightarrow Cu\,(s)$ $\qquad \left(E^{\circ}_{red}\right)_{Cu^{2+}|Cu} = 0.34V$

$$Cd(s) + 2e^{-} \rightarrow Cd^{2+}(aq) + Cu(s)$$
$$E^{\circ}_{cell} = \left(E^{\circ}_{ox}\right) + \left(E^{\circ}_{red}\right)_{cathode}$$
$$= 0.4 + 0.34$$
$$= 0.74V.$$

emf is +ve, so ΔG is (-)ve, the reaction is feasible.

19. Oxidation at anode:

$2H_2(g) + 4OH^{-}(aq) \rightarrow 4H_2O\,(l) + 4e^{-}$

1 mole of hydrogen gas produces 2 moles of electrons at 25^0C and 1 atm pressure, 1 mole of hydrogen gas occupies = 22.4 litres

$$\therefore \text{ no. of moles of hydrogen gas produced} = \frac{1 \text{ mole}}{22.4 \text{ litres}} \times 44.8 \text{ litres}$$
$$= 2 \text{ moles of hydrogen}$$

$\therefore$ 2 of moles of hydrogen produces 4 moles of electron i.e., 4F charge.

We know that $Q = It$

$$I = \frac{Q}{t}$$
$$= \frac{4F}{10 \text{ mins}}$$
$$= \frac{4 \times 96500 \text{ C}}{10 \times 60 \text{ s}}$$
$$I = 643.33 \text{ A}$$

Electro deposition of copper

$Cu^{2+}(aq) + 2e^{-} \rightarrow Cu(s)$

2F charge is required to deposit

1 mole of copper i.e., 63.5 g
If the entire current produced in the fuel cell ie., 4 F is utilised for electrolysis, then
2× 63.5 i.e., 127.0 g copper will be deposited at cathode.

20. $Ni^{2+}(aq) + 2e^{-} \rightarrow Ni\ (s)$

$Cr^{2+}(aq)+3e^{-} \rightarrow Cr\ (s)$

The above reaction indicates that 2F charge is required to deposit 58.7g of Nickel form nickel nitrate and 3F charge is required to deposit 52g of chromium.

Given that 2.935 gram of Nickel is deposited

$\therefore$ The amount of charge passed through the cell $= \frac{2F}{58.7g} \times 2.935g$

$= 0.1F$

$\therefore$ if 0.1F charge is passed through chromium nitrate the amount of chromium deposited

$= \frac{52g}{3F} \times 0.1F$

$= 1.733g$

21. Given that

$\left[Cu^{2+}\right] = 0.1M$

$E^{\circ}_{Cu^{2+}|Cu} = 0.34$

$E_{cell} = ?$

Cell reaction is

$Cu^{2+}(aq) + 2e^{-} \rightarrow Cu\ (s)$

$$E_{cell} = E^{o} - \frac{0.0591}{n} \log \frac{[Cu]}{\left[Cu^{2+}\right]}$$

$$= 0.34 - \frac{0.0591}{2} \log \frac{1}{0.1}$$

$$= 0.34 - 0.0296$$

$$= 0.31V$$

22. oxidation at anode

$Mg \rightarrow Mg^{2+} + 2e^{-}$.....(1) $\left(E^{o}_{ox}\right) = 2.37V$

Reduction at cathode

$Ag^{+} + e^{-} \rightarrow Ag$ ..... (2) $\left(E^{o}_{red}\right) = 0.80V$

$\therefore\ E^{o}_{cell} = \left(E^{o}_{ox}\right)_{anode} + \left(E^{o}_{red}\right)_{cathode}$

$= 2.37 + 0.80$

$= 3.17V$

Overall reaction

Equation (1) + 2 × equation $(2) \Rightarrow$

$Mg + 2Ag^{+} \rightarrow Mg^{2+} + 2Ag$

$\Delta G^\circ = -nFE^\circ$

$= -2 \times 96500 \times 3.17$

$= -611810$ kJ

$\Delta G^o = -6.12 \times 10^5$ J

$W = 6.12 \times 10^5$ J

$\Delta G^o = -2.303\ RT \log^K C$

$\Rightarrow \log K_c = \dfrac{6.12 \times 10^5}{2.303 \times 8.314 \times 298}$

K_c = Antilog of (107.2)

23. Electrolysis of water

At anode:

$2H_2O \rightarrow 4H^+ + O_2 + 4e^-$.....(1)

At cathode:

$2H_2O + 2e^- \rightarrow H_2 + 2OH^-$

Overall reaction $6H_2O \rightarrow 4H^+ + 4OH^- + 2H_2 + O_2$

(or)

Equation (1) +(2) $\times 2 \Rightarrow 2H_2O \rightarrow 2H_2 + O_2$

$\therefore$ According to faradays Law of electrolysis, to electrolyse two mole of Water $(36g \simeq 36\ mL\ of\ H_2O)$, 4F charge is required alternatively, when 36 mL of water is electrolysed, the charge generated = 4×96500 C.

$\therefore$ When the whole water which is available on the lake is completely electrolysed the amount of charge generated is equal to $\dfrac{4 \times 96500\ C}{36\ mL} \times 9 \times 10^{12} L$

$= \dfrac{4 \times 96500 \times 9 \times 10^{12}}{36 \times 10^{-3}} C$

$= 96500 \times 10^{15}$ C

$\therefore$ Given that in 1 second, 2×10^6 C is generated therefore, the time required to generate

96500×10^{15} C is $= \dfrac{1\ S}{2 \times 10^6 C} \times 96500 \times 10^{15} C$

$= 48250 \times 10^9$ S

$\therefore$ Number of years $= \dfrac{48250 \times 10^9}{365 \times 24 \times 60 \times 60}$

$= 1.5299 \times 10^6$ years

1 year = 365 days

$= 365 \times 24$ hours

$= 365 \times 24 \times 60$ min

$= 365 \times 24 \times 60 \times 60$ sec.

Unit 10 Surface Chemistry

S.No.	Answers		
1.	(c) $\frac{x}{m}=k.p^{1/n}$ $\Rightarrow \log(\frac{x}{m})=\log k+\frac{1}{n}\log p$ $y=c+mx$ $\quad m=\frac{1}{n}$ and $c=\log k$		
2.	The incorrect statement is option (b) Physisorption is an exothermic process. Hence increase in temperature decreases the physisorption.		
3.	(d) Adsorption leads to decrease in randomness (entropy).i.e. $\Delta S< 0$ for the adsorption to occur, ΔG should be -ve. We know that $\Delta G=\Delta H-T\Delta S$ if ΔS is -ve, $T\Delta S$ is +ve. It means that ΔG will become negative only when ΔH is -ve and $\Delta H>T\Delta S$		
4.	(c) dispersion medium-gas dispersed phase-liquid	13.	pyroxylin(nitro cellulose)
5.	(a) (Hardy-Schulze rule)	14.	(d) Both reactant and catalyst are in same phase. i.e(l)
6.	(b)	15.	(a)
7.	(b) Emulsion dispersed phase Dispersion medium -liquid	16.	(a) coagulating power $\alpha \frac{1}{\text{coagulation value}}$
8.	(b) Gel-butter	17.	(d) ΔS is -ve
9.	(d) As_2S_3 is a -vely charged colloid. It will be most effectively coagulated by the cation with greater valency. i.e., Al^{3+}.	18.	(d)
10.	(b)	19.	(a)
11.	(d) Tyndall effect-scattering of light	20.	(d)
12.	(b)		

Unit 11 Alcohols and Ethers

Key answer

1. $2\ R - OH + 2Na \rightarrow 2\ RONa + H_2\uparrow$ 2 moles of alcohol gives 1 mole of H_2 which occupies 22.4L at 273K and 1 atm

$$\therefore \text{ number of moles of alcohol} = \frac{2 \text{ moles of R - OH}}{22.4\,\text{L of } H_2} \times 560 \text{ mL}$$

$$= 0.05 \text{ moles}$$

$$\therefore \text{ no. of moles} = \frac{\text{mass}}{\text{molar mass}}$$

$$\Rightarrow \text{ molar mass} = \frac{3.7}{0.05} = 74 \text{ g mol}^{-1}$$

General formula for R - OH $C_n\ H_{2n+1}$ - OH

$$\therefore n(12) + (2n+1)(1) + 16+1=74$$

$$14n = 74 - 18$$

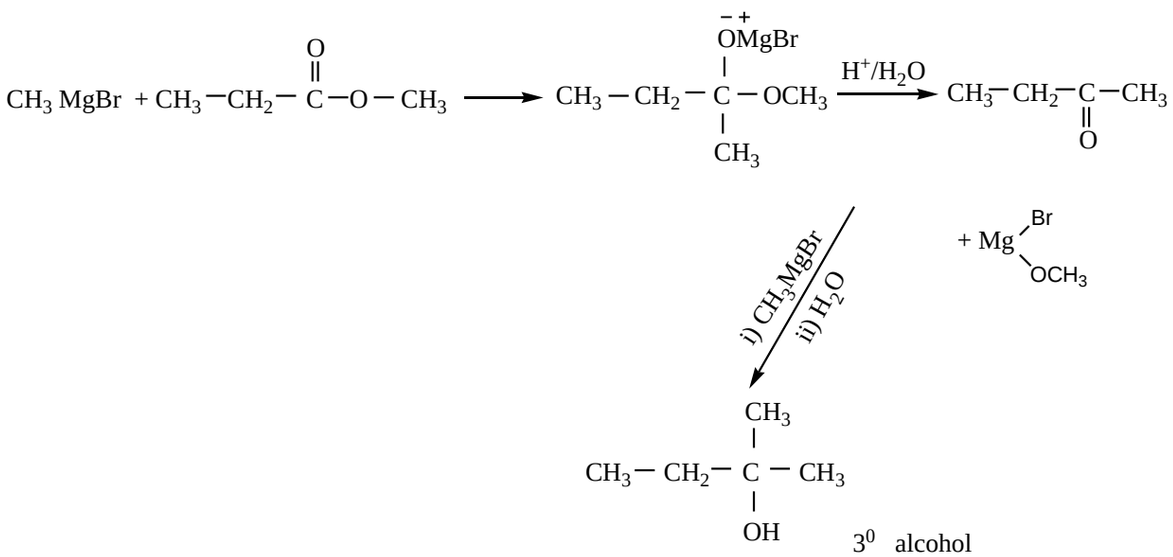
$$14n = 56$$

$$\therefore n = \frac{56}{14} = 4$$

The 2° alcohol which contains 4 carbon is $CH_3CH(OH)CH_2CH_3$

Option (a)

2.

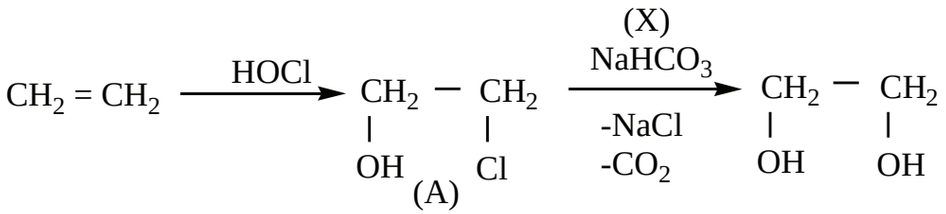


Option (c)

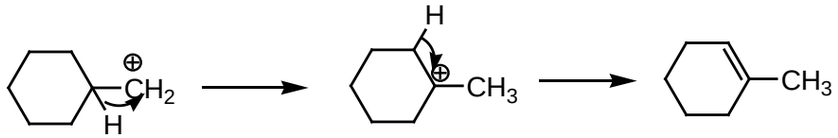
3. Hydro boration – Anti markownikoft product i.e., $CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - OH$

Option (a)

4.



5. (c) 4 – nitrophenol
6. Option (b) saytzeff rule

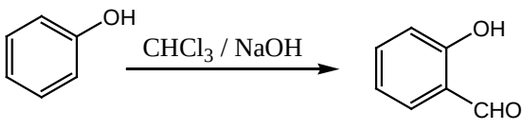


major product

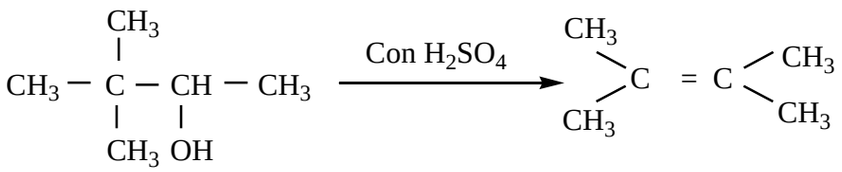
7. Carbolic acid is

   a) phenol

8. Riemer – Tiemann reaction (option (c))



9.

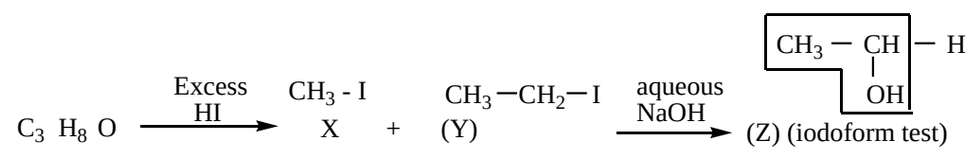


Option (b)

10. Option (a)
11. Option (a)
12. $CH_3 - CH_2 - OH \xrightarrow{PCl_5} CH_3 - CH_2 - Cl \xrightarrow{ale.KOH} CH_2 = CH_2 \xrightarrow{H_2SO_4/H_2O} CH_3 - CH_2 - OH$

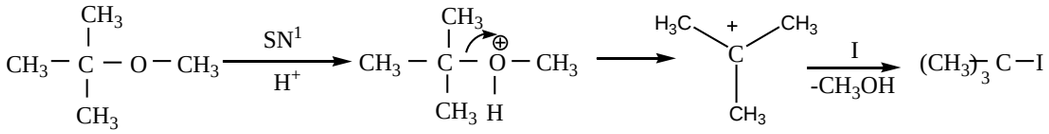
    (Z) ethanol

13. Cyclic alcohol → sodium cyclic alkoxide → williamson ether synthesis option (c)
14. Option (d) phenol
15. Option (a)
16. Option (c)
17. Option (d)
18. Option (c)
19.



Option (d)

20.

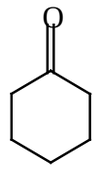


option (a)

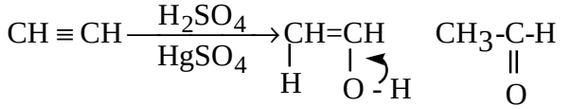
21. Option (b) SN^2 reaction
22. Violet color option (b)

Unit 12 Carbonyl Compounds and Carboxylic Acids

Key Answers



1. Option (b)
2. (d)
3. (c)
4. (b)



(X)

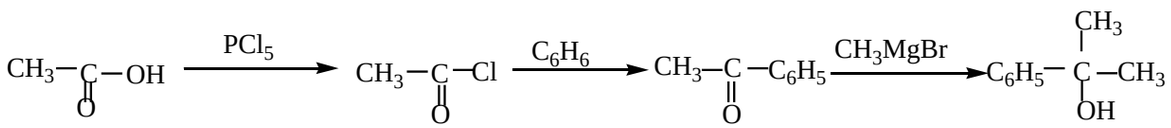
(x) reduces tollens reagent and Fehling solution and it also answers iodoform test.

5) (c)

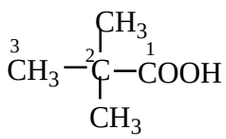
X-HCHO

$Y\text{-}(CH_2)_6N_4$

6) option (a)



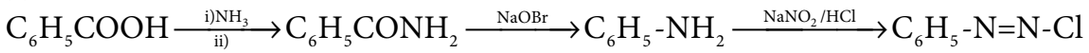
7) option (a)



8) (b)

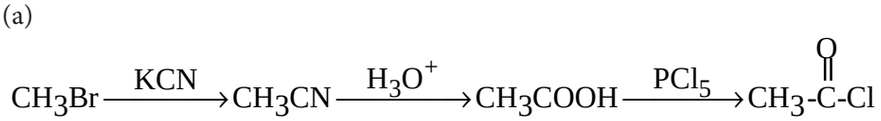
-I effect increases the acidity. If electronegativity is high, -I effect is also high.

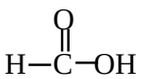
9) (c)



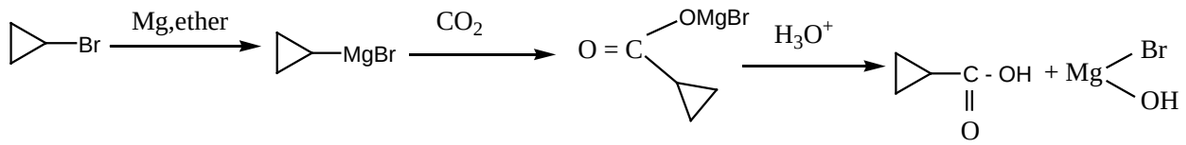
(A) (B)

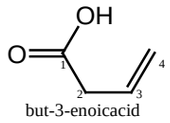
10. (c)
11. (a)



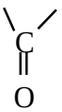
12. (a) formic acid 

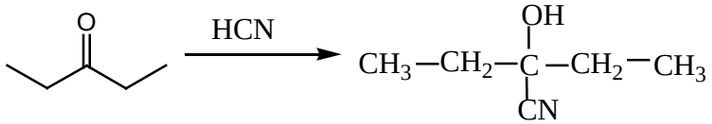
13. (b)



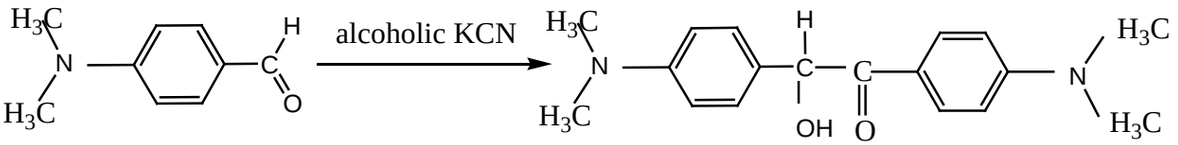
14. (a) 

but-3-enoicacid

15. (d)  group is reduced to CH_2 - (Wolff-kishner reduction)

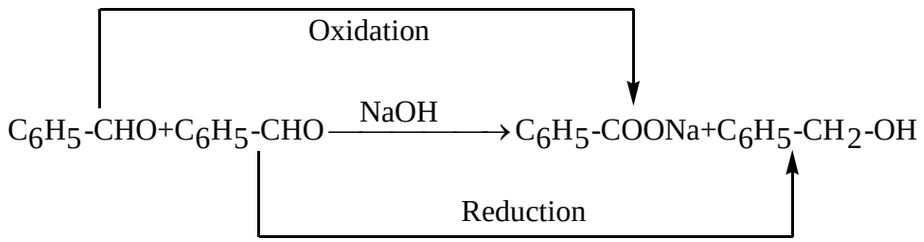
16. (a) 

17. (b)



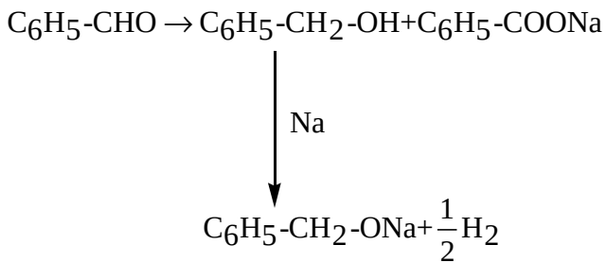
18. (b) Cannizaro reaction

19 (a)

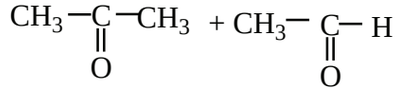


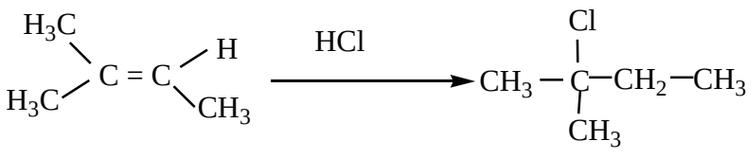
20(b). Fehling's solution

21. (c)



22. (d) Wolf kisher reduction

23. (c) 

alkene 

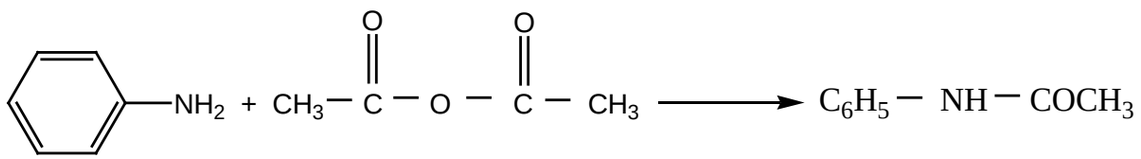
24.(d) formation of intermolecular H-bonding

Unit – 13 Organic Nitrogen compounds

1. Option (a)
2. Option (b)
3. Option (a) only primary amides undergo hoffmann bromamide reaction
4. Option (d) both are wrong
5. $CH_3CH_3Br \xrightarrow{aq\ NaOH} CH_3CH_2\text{-}OH \xrightarrow{KMnO_4} CH_3\text{-}COOH \xrightarrow{NH_3} CH_3CONH_2$

   $\downarrow Br_2/NaOH$

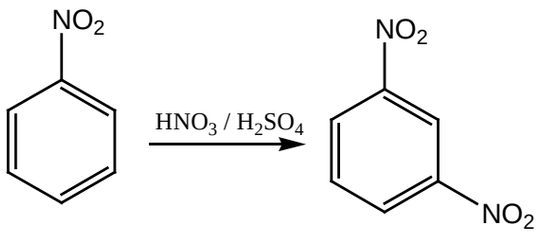
   $CH_3\text{-}NH_2$

   Option (c)
6. Option (c) 3° nitroalkane
7. Option (c)
8. Option (c) Suhiff's base
9. Option (b) p – nitrosation takes places, the product is $(CH_3)_2N$–C$_6$H$_4$–NO
10. 

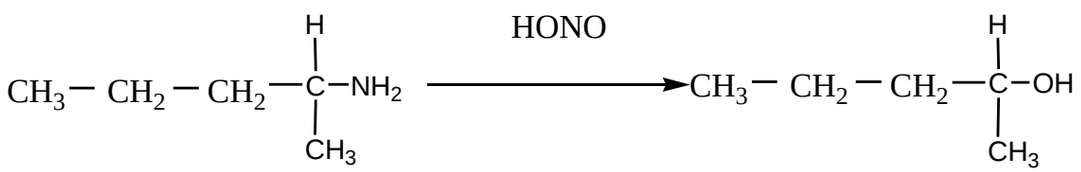
    acetanilide

    Option (d)
11. Option (d)
12. Option (a)
13. Option (a)

    $C_6H_5NO_2 \xrightarrow{Fe/HCl} C_6H_5NH_2 \xrightarrow{NaNO_2\ /\ HCl} C_6H_5\text{-}N_2Cl \xrightarrow{H_2O} C_6H_5\text{-}OH + N_2\uparrow + HCl$
14. (d)

    1,3 - dinitrobenzene
15. (b)

    
16. Option (b) blue solution

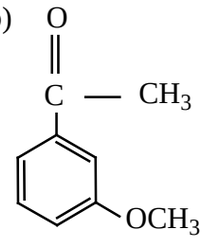
17. (d) triethyl amine (3° amine)

18. Option (b) CH_3 is a+I group, all other – I group. +I group increase the electron density on NH_2 and hence increases the basic nature.

19. Option (a) Ethanol, ammonium hydroxide

20. Option (d)

21. b)



22. (b) $C_6H_5COONH_4 \xrightarrow[\text{Heat}]{P_2O_5} C_6H_5\text{-}C \equiv N \xrightarrow{LiAlH_4} C_6H_5CH_2NH_2 \xrightarrow{HNO_2} C_6H_5CH_2OH$

23. Option (a)

Unit 9 Electro chemistry

1. (c) 2. (b) 3. (c) 4. (b) 5. (c) 6. (b) 7. (a) 8. (b) 9. (b) 10. (c) 11. (b) 12. (c)
13. (a) 14. (d) 15.(d) 16. (a) 17. (b) 18. (c) 19.(d) 20. (b) 21.(d) 22. (a) 23. (b) 24. (a)
25. (a)

Unit 10 – Surface Chemistry

1. (c) 2.(b) 3.(d) 4. (c) 5. (a) 6. (b) 7. (b) 8.(b) 9.(d) 10.(b) 11. (d) 12. (b)
13. (d) 14. (d) 15. (a) 16. (a) 17. (d) 18. (d) 19. (a) 20. (d)

Unit – 11 – Alcohols and Ethers

1. (a) 2. (c) 3. (a) 4. (c) 5. (c) 6.(b) 7.(a) 8.(c) 9.(b) 10.(a) 11.(a) 12.(d)
13. (c) 14. (d) 15. (a) 16.(c) 17.(d) 18.(c) 19.(d) 20.(a) 21.(b) 22. (b)

Unit – 12 Carbonyl Compounds and Carboxylic Acids

1. (b) 2. (d) 3. (c) 4. (b) 5. (c) 6. (a) 7.(a) 8.(b) 9. (c) 10. (c) 11. (a) 12.(a)
13. (b) 14. (a) 15. (d) 16. (a) 17.(b) 18.(b) 19. (a) 20.(b) 21. (c) 22. (d) 23.(c) 24. (d)

Unit – 13 Organic Nitrogen compounds

1. (a) 2. (b) 3. (a) 4. (d) 5. (c) 6. (c) 7.(c) 8.(c) 9. (b) 10. (d) 11. (d) 12.(a)
13. (a) 14. (d) 15. (b) 16. (b) 17.(d) 18.(b) 19. (a) 20.(d) 21. (b) 22.(b) 23.(a) 24. (b)
25. (b)

Unit – 14 Bio molecules

1. (c) 2. (d) 3. (b) 4. (a) 5. (a) 6. (c) 7. (a) 8. (c) 9. (d) 10. (d) 11. (d) 12. (d)
13. (a) 14. (c) 15. (c) 16. (d) 17. (d) 18. (d) 19. (c) 20. (b) 21. (a) 22. (c) 23. (b)
24. (d) 25. (d)

Unit – 15 Chemistry in Action

1. (c) 2. (a) 3. (a) 4. (a) 5.(d) 6.(c) 7. (a) 8. (c) 9. (a) 10.(d) 11. (d) 12. (c)
13.(d) 14.(b) 15. (d)