Nishant Jindal

Q. Given $E^{\circ}_{Fe^{3+}/Fe^{2+}} = 0.5$ volt $\quad E^{\circ}_{Fe^{2+}/Fe} = -0.8$ volt

$E^{\circ}_{Fe^{3+}/Fe} = ?$

$Fe^{3+} + e^- \longrightarrow Fe^{2+} \quad E^{\circ}_1 = 0.5$

$Fe^{2+} + 2e^- \longrightarrow Fe \quad E^{\circ}_2 = -0.8$

$Fe^{3+} + 3e^- \longrightarrow Fe \quad E^{\circ}_3$

$n_3E_3 = n_1E_1 + n_2E_2$

$3 \times E_3 = 1 \times 0.5 + 2 \times -0.8$

$E_3 = -1.1/3$

1.3
1.8
2.1
-0.3

$-1.1/3$

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Q. $E^{-o}_{Mn^{7+}/Mn^{2+}} = 1.5$ volt

$E^{o}_{Mn^{4+}/Mn^{2+}} = -0.5$ volt

$E^{o}_{Mn^{7+}/Mn^{4+}} = ?$

$Mn^{7+} + 5e^- \longrightarrow \cancel{Mn^{2+}}$ 1.5

$\cancel{Mn^{2+}} \longrightarrow Mn^{4+} + 2e^-$ 0.5

$Mn^{7+} + 3e^- \longrightarrow Mn^{4+}$

$n_3E_3 = n_1E_1 + n_2E_2$

$3 \times E_3 = 5 \times 1.5 + 2 \times 0.5$

$E = \frac{8.5}{3}$

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$E^0_{Cr_2O_7^{2-}/Cr^{3+}} = 1 \text{ volt}$

$E^0_{Cr/Cr^{3+}} = 0.4 \text{ volt}$

$E^0_{Cr_2O_7^{2-}/Cr} = ?$

$$6\bar{e} + \overset{+6}{Cr_2O_7^{2-}} + 14H^+ \longrightarrow \overset{+3}{2Cr^{3+}} + 7H_2O \quad 1 \text{ volt}$$

$$2Cr^{3+} + 6e^- \longrightarrow 2Cr \quad -0.4 \text{ volt}$$

$$Cr_2O_7^{2-} + 12e^- + 14H^+ \longrightarrow 2Cr + 7H_2O$$

$$n_3E_3 = n_1E_1 + n_2E_2$$

$$12 \times E_3 = 6 \times 1 + 6 \times (-0.4)$$

$$E_3 = \frac{0.5 + -0.4}{2}$$

$$= \underline{0.3}$$

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Q. Can $Zn(s)$ reduce Cu^{2+} from its aqueous soln

$E^{\circ}_{Zn/Zn^{2+}} = 0.76$ volt $\quad E^{\circ}_{Cu/Cu^{2+}} = -0.34$ volt

✓ $Zn + Cu^{2+} \longrightarrow Cu + Zn^{2+} \quad E^{\circ}$

Redn

$Zn \longrightarrow Zn^{2+} + 2e^- \quad E^{\circ} = 0.76$

$2e^- + Cu^{2+} \longrightarrow Cu \quad E^{\circ} = 0.34$

$E^{\circ} = 1.1$ volt

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Relationship betⁿ K_{eq} & E°

$$-nFE^\circ = \Delta G^\circ = -RT \ln K_{eq}$$

$$E^\circ = \frac{2.303\,RT}{nF} \log K_{eq}$$

If $T = 298\,K$

$$E^\circ = \frac{0.059}{n} \log K_{eq} \simeq \frac{0.06}{n} \log K_{eq}$$

Q. ΔG_1 $AgCl(s) \longrightarrow \cancel{Ag^+_{(aq)}} + Cl^-_{(aq)}$ $K_{sp} = 10^{-10}$

ΔG_2 $\cancel{Ag^+} + e^- \longrightarrow Ag(s)$ $E^\circ = 0.8$ volt

ΔG_3 $AgCl(s) + e^- \longrightarrow Ag(s) + Cl^-(aq)$ $E_1^\circ = ?$

0.2
0.6
1.4

$$\Delta G_3 = \Delta G_1 + \Delta G_2$$

$$-\eta F E_1^\circ = -RT \ln K_{sp} - \eta F E^\circ$$

$$E_1^\circ = \frac{2.303RT}{\eta F} \log K_{sp} + E^\circ$$

$$E_1^\circ = 0.06 \log 10^{-10} + 0.8$$

$$= -0.6 + 0.8 = 0.2$$

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Q. $2H_2O + 2e^- \longrightarrow H_2 + 2OH^-$ $E^\circ = ? = -0.8277$

$E^\circ_{H_2/H^+} = 0$ $K_w = 10^{-14}\ M^2$

O-I

1–15

$H_2O \longrightarrow H^+ + OH^-$ $K_w = 10^{-14}$

$2H_2O \longrightarrow 2H^+ + 2OH^-$ 10^{-28} ΔG_1

$2H^+ + 2e^- \longrightarrow H_2$ $E^\circ = 0$ ΔG_2

$2H_2O + 2e^- \longrightarrow H_2 + 2OH^-$ ΔG_3

$\Delta G_3 = \Delta G_1 + \Delta G_2^\circ$

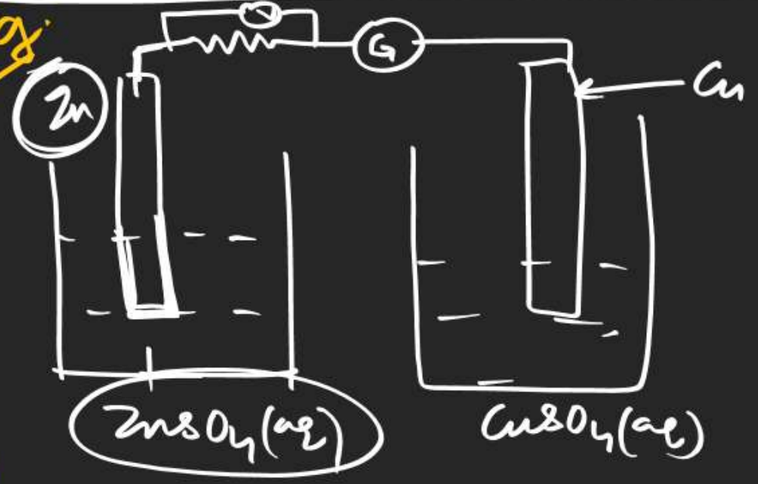
$-nFE^\circ = -RT\ln K$

$E^\circ = \frac{0.06}{2} \log 10^{-28}$

$E^\circ = -0.84$

Cell representation & types of half cell :→

e.g.



Anode || cathode

$Zn(s)|ZnSO_4(M_1)||Cu^{2+}(M_2)|Cu(s)$

Daniel cell

Rules to represent a cell

1. Anode and cathode are separated by double vertical line
2. Anode is written on its left side
3. An interface is represented by a vertical line.

① Metal- Metal ion half cell

$M \longrightarrow M^{3+} + 3e^-$

$M(s)|M^{3+}||$

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4. When one drop of a concentrated HCl solution is added to one liter of pure water at 25°C the pH drops suddenly from 7 to about 4 . When the second drop of the same acid is added, the pH of the solution further drops to about:

(A) 4.3 (B) 2.3 (C) 2.0 (D) 3.7

$[H^+] = 10^{-4}$

$n_{H^+} = 10^{-4} \times 2$

7. Which of the following mixtures will function as buffer?

(A) $HCl + NH_4OH$ (1: 1 molar ratio)

(B) $HCl + CH_3COONa$ (1: 2 molar ratio)

(C) $NaOH + HCOONa$ (1: 1 molar ratio)

(D) $NH_4Cl + (NH_4)_2SO_4$ (2:1 molar ratio)

NH_4^+ NH_4^+

10. 50 mL of 0.05 M Na_2CO_3 is titrated against 0.1 M HCl. On adding 40 mL of HCl pH of the solution will be

[Given :For H_2CO_3, $pK_1 = 6.35$, $pK_2 = 10.33$; log 3 = 0.477]

(A) 6.35 (B) 6.526 (C) 8.34 (D) 6.174

2.5

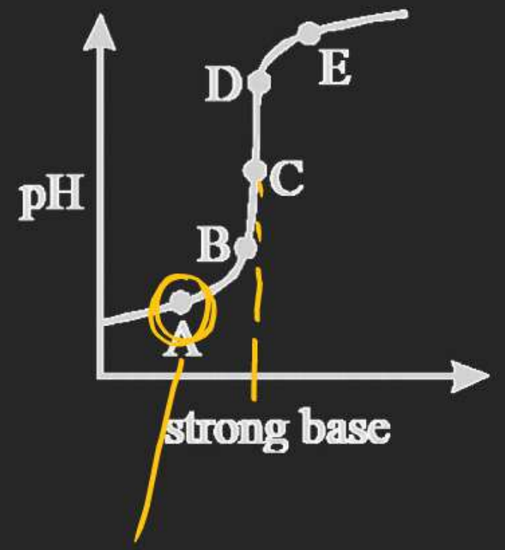
$NaHCO_3 + HCl \rightarrow H_2CO_3 + NaCl$

2.5 1.5 1.5

1 0

13. At which point in the graph concentration of weak acid & it's conjugate ion becomes equal in solution during the titration of weak acid (HA) with strong base

(A) A (B) B (C) C (D) D



$HA \longrightarrow A^-$

$a/2 \quad a/2$

16. Select the correct relationship for a reaction-

(A) $\Delta G = \Delta G^\circ + RT\ln K_p$

(B) $\Delta G^\circ = RT\ln K_p$

(C) $\Delta G = RT\ln \frac{Q_P}{K_P}$

(D) $\Delta G = T(\Delta S)_{uni.}$

$$\Delta G^\circ = -RT\ln K$$

$$\Delta G = \Delta G^\circ + RT\ln Q$$

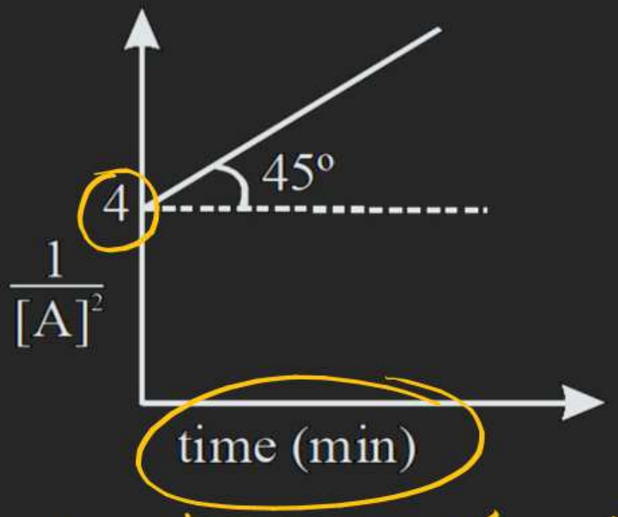
19. Based on the following graph mark the correct option for the reaction : $A \rightarrow P$

(A) II order reaction

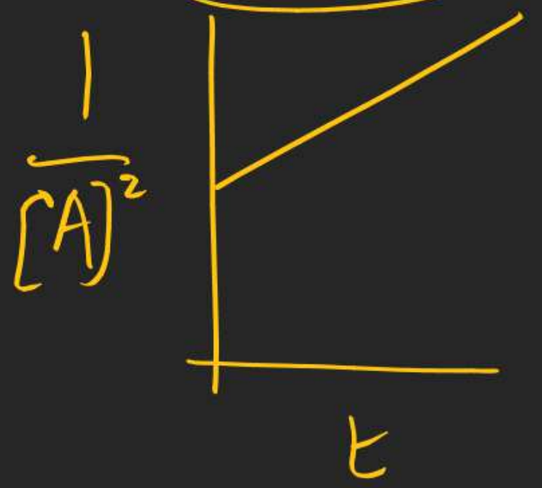
(B) Rate constant is 0.5 $(mol/L)^{1-n}$ sec^{-1}

(C) $[A]_0 = 0.5M$

(D) Reaction complete in finite time



$(n-1)k = \text{slope}$



$n-1=2$

$n=3$

22. If ratio of solubility of $A(OH)_2$ ($K_{sp} = 4 \times 10^{-27}$) in pure water & in presence of 0.001M KOH solution is 10^x then what is value of x.

$A(OH)_2 \longrightarrow A^{2+} + 2OH^-$

$(S) \quad (10^{-7} + 2S)^2 = 4 \times 10^{-27}$

$S = 4 \times 10^{-13}$

25. An ionic solid is HCP of Q^{2-} ions and P^{x+} ions are in half of the tetrahedral voids. The value of x should be:

28. At 300 K, 50% of molecule collide with energy greater than or equal to E_a. At what temperature 25% molecule will have energy greater than or equal to E_a.

$$e^{-E_a/RT_1} \times 100 = 50$$

$$e^{-E_a/RT_2} \times 100 = 25$$