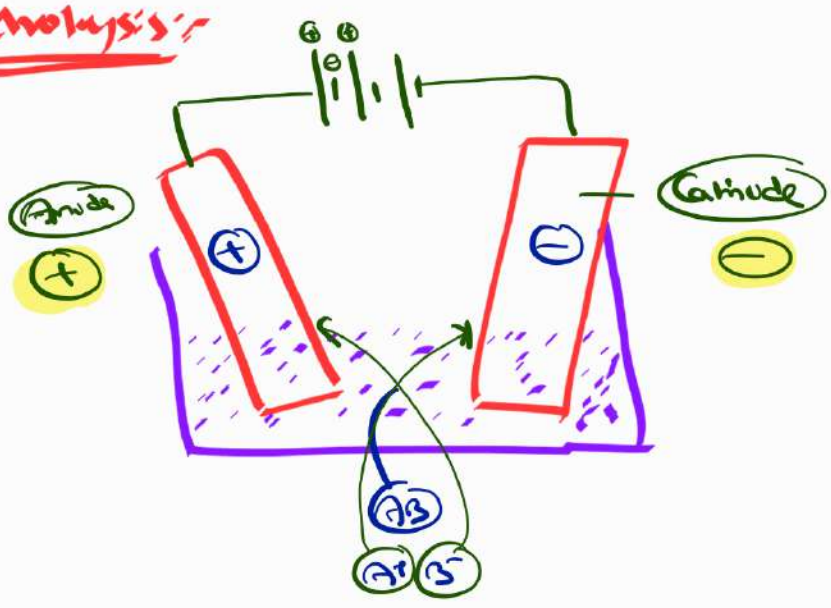
# Electro Chemistry-3

## Electrolysis :-




EC-Cell

A = −ve

C = +ve

## ① Deposition :- (gas | metal)

### Cations

Discharge potentials

C H A P A

$Li^{+1} > K^{+1} > Ca^{+2} > Na^{+1} > Mg^{+2} > Al^{+3} > Zn^{+2} > Cr^{+3} > Fe^{+2} > H^{+} > Cu^{+2} > Hg^{+2} > Ag^{+1} > Pt^{+1} > Au^{+1}$

H. Pot

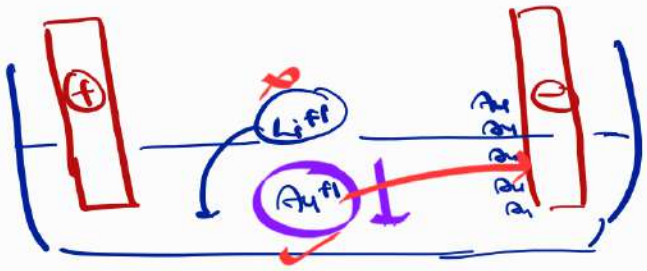
Au Pot

$Li^{+1} \rightarrow Li$

Pot ↑

$Au^{+1} \rightarrow Au$

Pot ↓

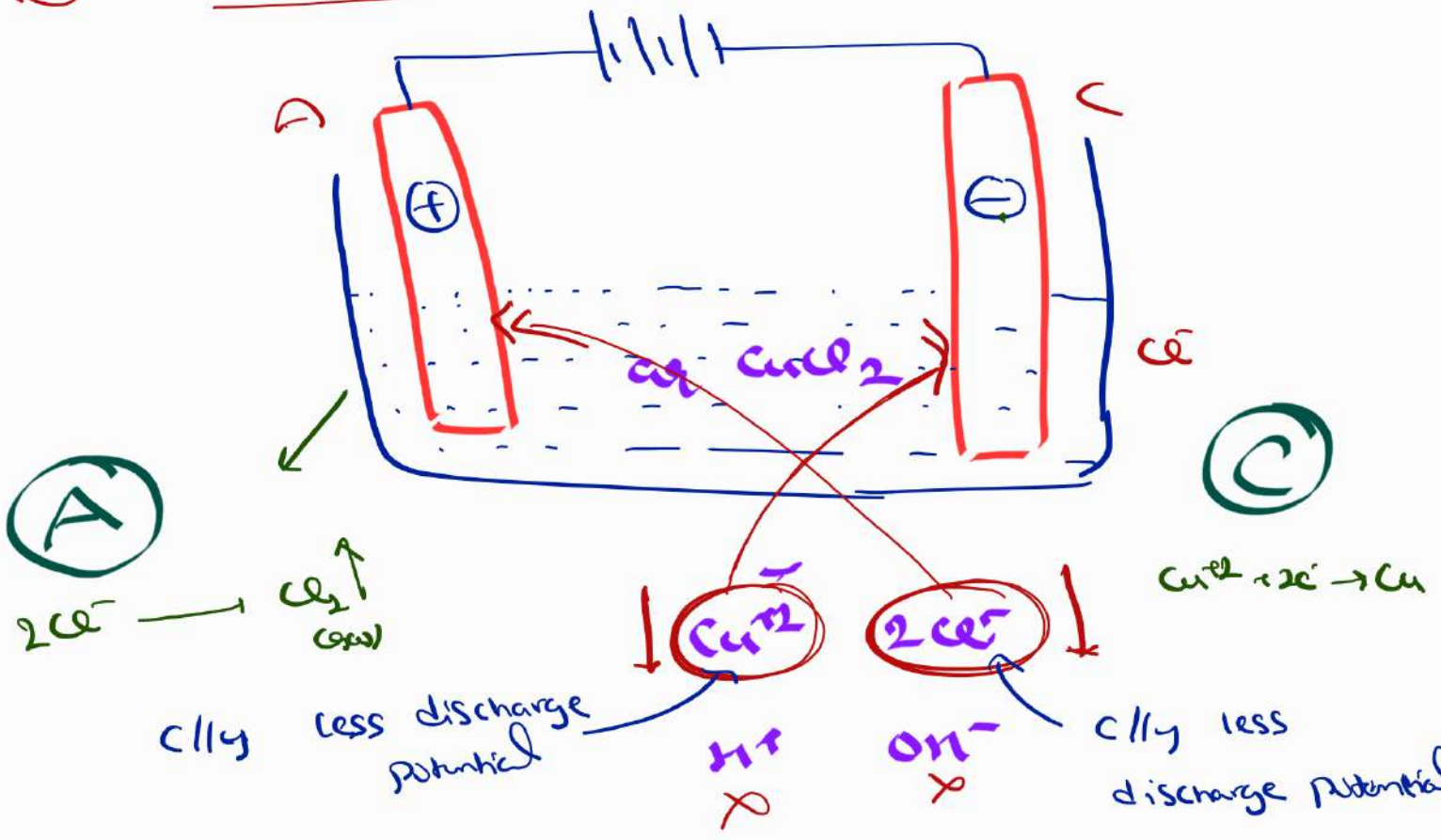



### Anions :-

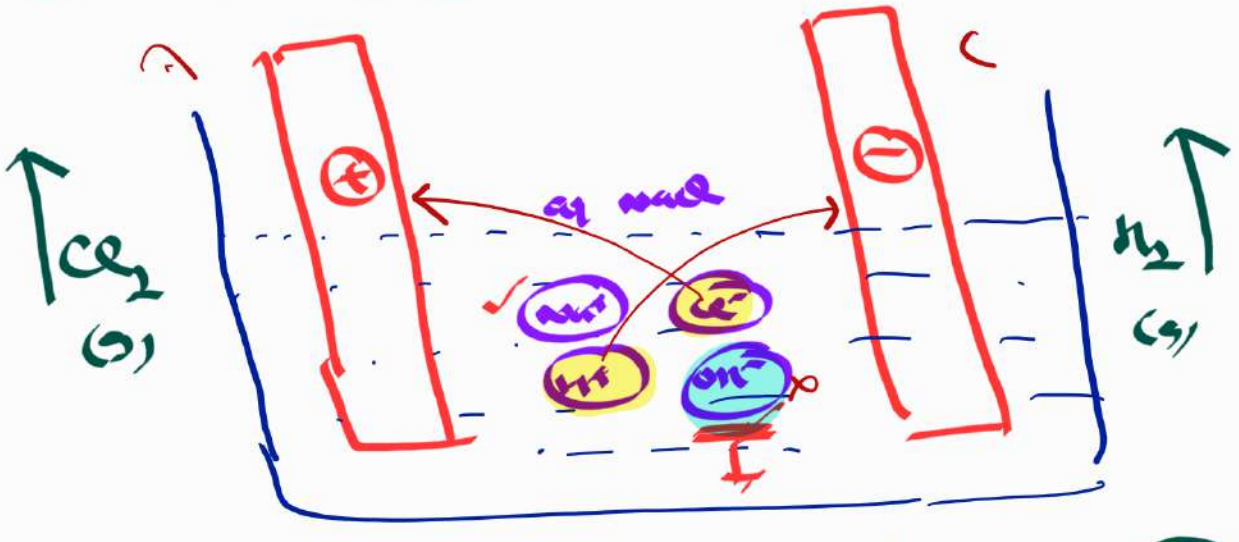
$SO_4^{-2} > NO_3^{-} > OH^{-} > Cl^{-} > Br^{-} > I^{-}$

$SO_4^{-2}$ & $I^{-} \rightarrow I_2 \uparrow$

## ① Electrolysis of aq. $CuCl_2$ :-




## ② electrolysis of aq NaCl :-




Reaction

$Cl^- \rightarrow Cl_2$ (g)

$H^+ \rightarrow H_2$ (g)

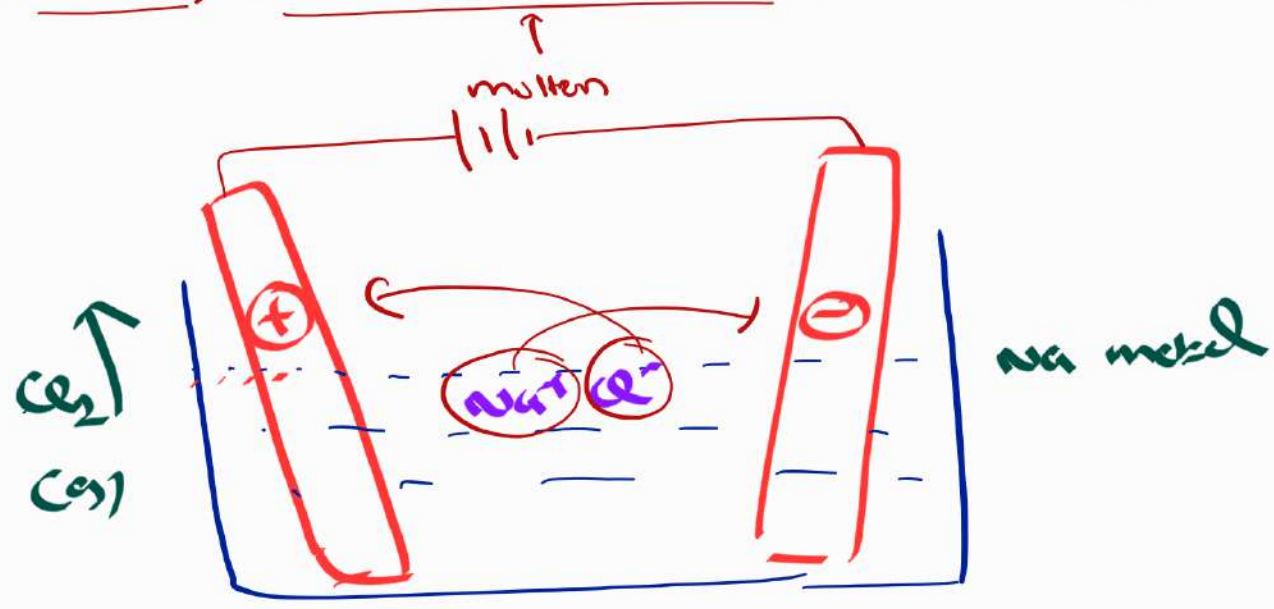
$Na^+$ $OH^-$

Soln

||

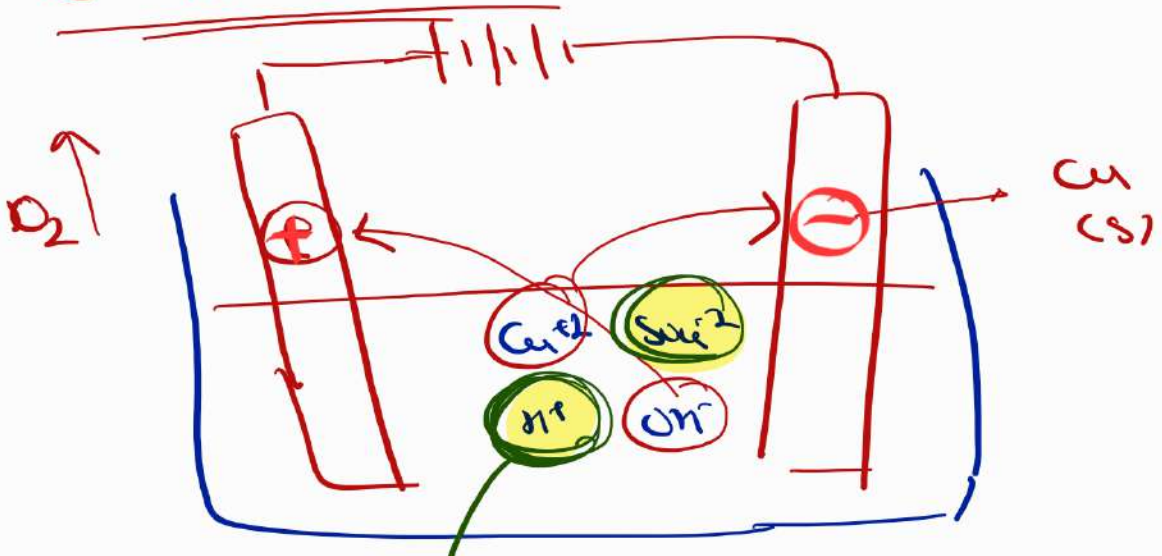
Resultant Soln is **Basic** in nature

③ Electrolysis of fused NaCl :- q2




## Nature of Resultant Soln after Electrolysis :-

① Electrolysis of $CuSO_4$ :-

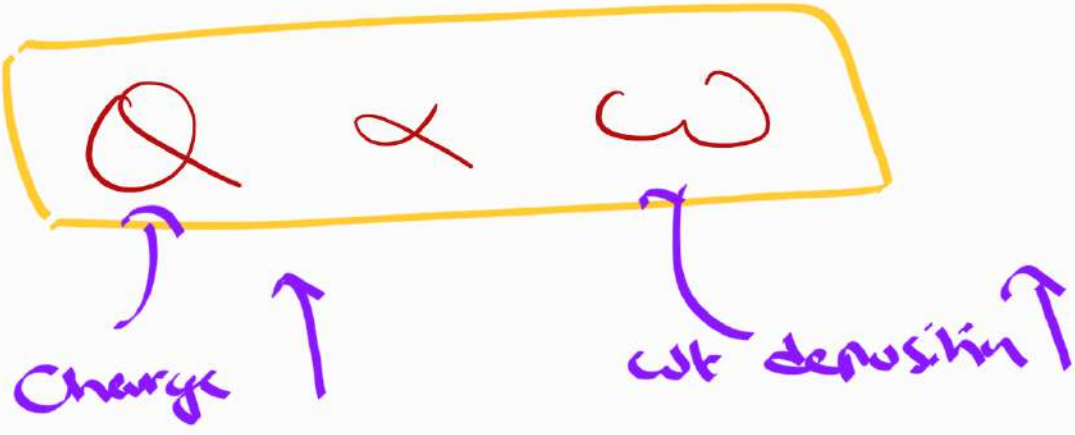



$4OH^- \longrightarrow O_2 + 2H_2O + 4e^-$

resultant soln → acidic

# faradays law :-

## ① faradays first law :-




$$\omega \propto Q$$

$$\omega = zQ$$

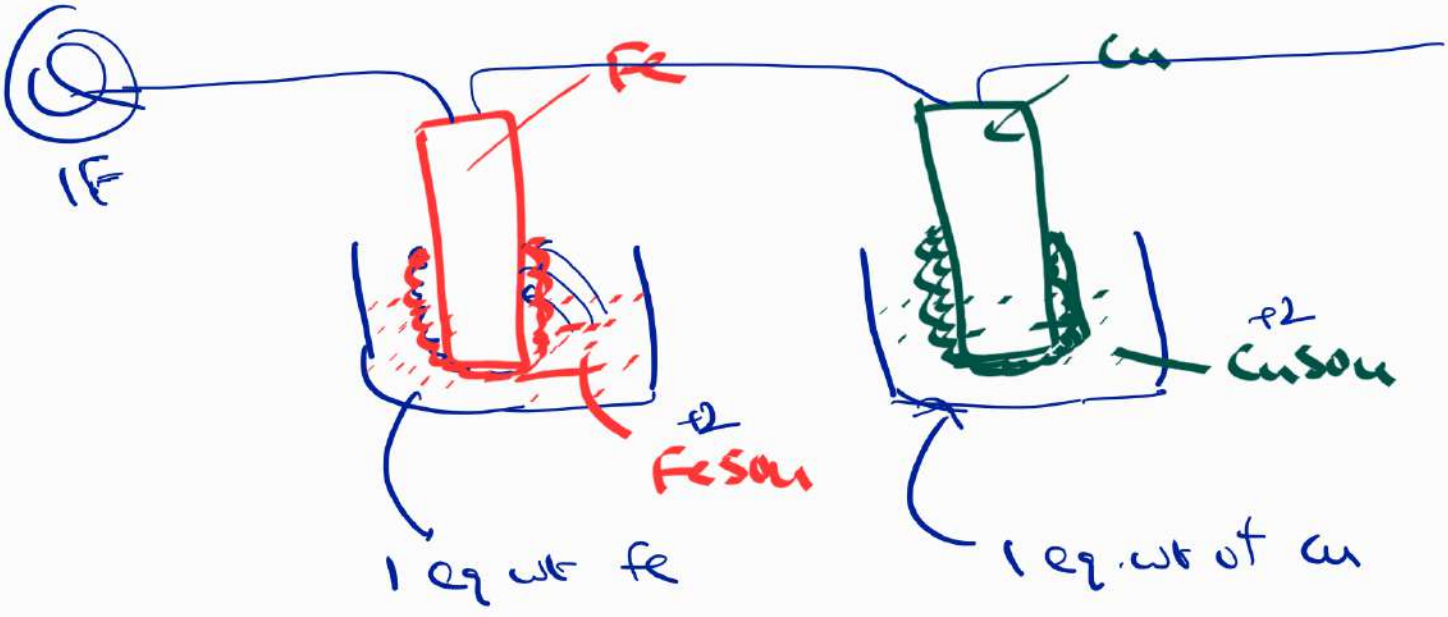
$$= z(it)$$

z → Electrochemical equivalent

$$\omega = \frac{E}{96500} \times it$$

E → Eq. wt

# ii) Faraday Second Laws :-




$$\text{Eq wt} = \frac{\text{m.wt}}{n} = \frac{56}{2} = 28$$

$$\text{Eq wt} = \frac{\text{m wt}}{n} = \frac{63.5}{2} = 31.75$$

$n = \frac{\text{wt}}{\text{m.wt}}$

$$n_{eq} \text{ of } M_1 = n_{eq} \text{ of } M_2$$

($M_1$: Con gas; $M_2$: Cu gas)

$n_{eq} = \frac{\text{wt}}{\text{Eq wt}}$

$$= \frac{28}{28} = 1 \quad (Fe)$$

$n_{eq} = \frac{\text{wt}}{\text{Eq wt}}$

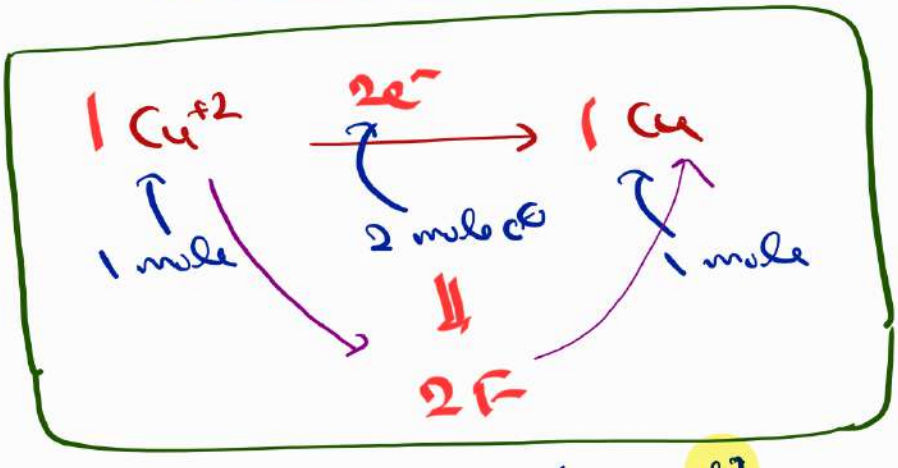
$$= \frac{31.75}{31.75} = 1$$

# faraday :

1 F = Charge of 1 mole $e^{\ominus}$

= $6.023 \times 10^{23}$ $e^{\ominus}$

= 96500 C




to deposit 1 mole of $Cu^{+2}$ ⟶ Cu we need 2F

1 mole of $Fe^{+3}$ ⟶ Fe we need 3F

1 mole of $Na^{+}$ ⟶ Na we need 1F

$Sn^{+4} \xrightarrow{2e^-} Sn^{+2}$ we need 2F

$MnO_4^- \xrightarrow{+5e^-} Mn^{+2}$ we need 5F

{ 5 F
5 · 96500 C
5 mole $e^{\ominus}$

# 1 Faraday / 96500 C / 1 mole of e⁻

1 F will deposit

- $Na^{+}$ → 1 mole Na — 23 g
- $Mg^{+2}$ — $\frac{1}{2}$ mole Mg — 12 g
- $Al^{+3}$ — $\frac{1}{3}$ mole Al — 9 g
- $Ag^{+}$ — $\frac{1}{1}$ mole Ag — 108 g
- $Fe^{+2}$ — $\frac{1}{2}$ mole Fe — 28 g
- $Cu^{+2}$ — $\frac{1}{2}$ mole Cu — $\frac{63.5}{2} = 31.75$
- $Zn^{+2}$ — $\frac{1}{2}$ mole Zn — $\frac{65.5}{2} = 32.75$

$H^{+}$: $2H^{+} + 2e^{-} \rightarrow H_2$

$Cl^{-}$: $2Cl^{-} \rightarrow Cl_2 + 2e^{-}$

$O^{-2}$: $2O^{-2} \rightarrow O_2 + 4e^{-}$

- $H_2$ — $\frac{1}{2}$ mole $H_2 \uparrow$ $\frac{22.4}{2} = 11.2$ L (19)
- $Cl_2$ — $\frac{1}{2}$ mole $Cl_2 \uparrow$ $\frac{22.4}{2} = 11.2$ L (35.5 × 2)
- $O_2$ — $\frac{1}{4}$ mole $O_2 \uparrow$ $\frac{22.4}{4} = 5.6$ L (8 × 2)

**39.** When 0.1 mol $MnO_4^{2-}$ is oxidised, the quantity of electricity required to completely oxidise $MnO_4^{2-}$ to $MnO_4^-$ is

(a) 96500 C (b) 2 × 96500 C

(c) 9650 C (d) 96.50 C **[CBSE AIPMT 2014]**

$1\ MnO_4^{-2} \xrightarrow[-e^-]{} 1\ MnO_4^-$ (+6 → +7)

1 mole = 1 F

0.1 mole ⟹ 0.1 F

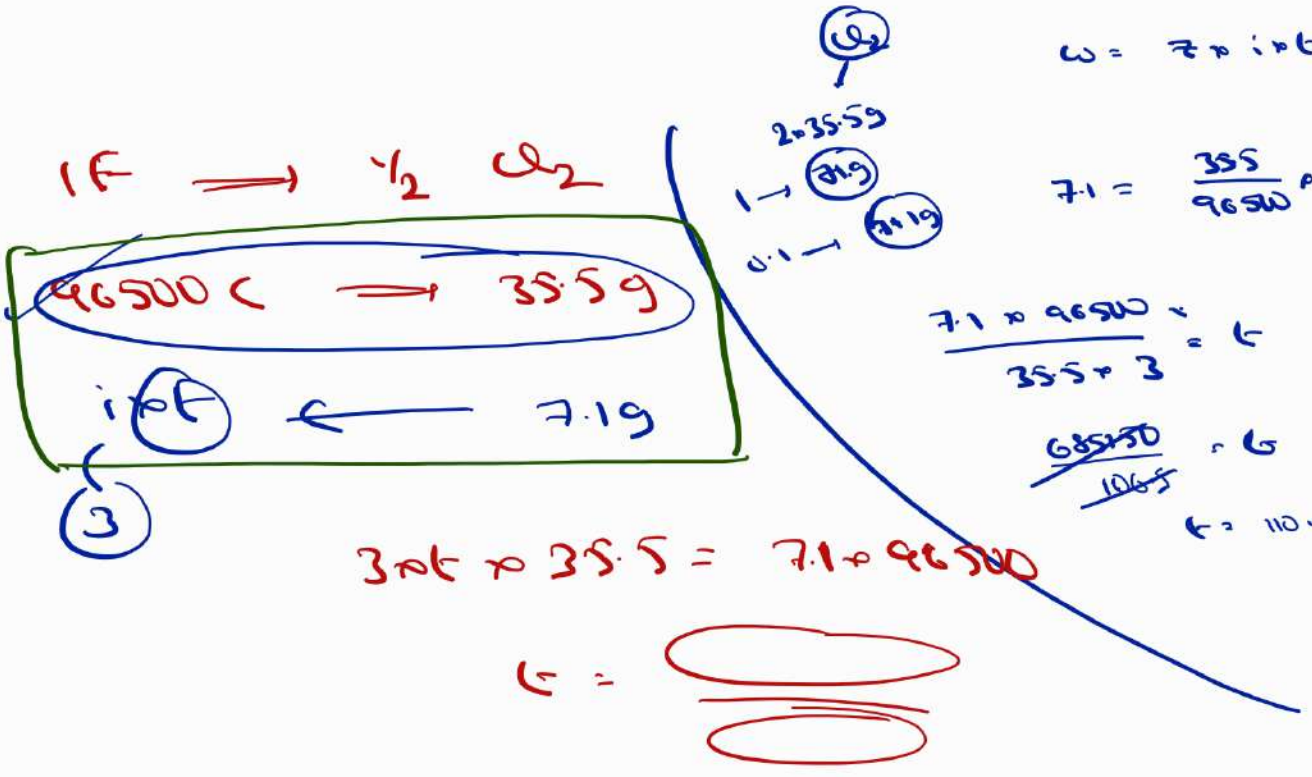
0.1 × 96500

9650 C

46. During the electrolysis of molten sodium chloride, the time required to produce 0.10 mol of chlorine gas using a current of 3 amperes is

(a) 55 minutes (b) 110 minutes

(c) 220 minutes (d) 330 minutes [NEET 2016]



22. $Al_2O_3$ is reduced by electrolysis at low potentials and high currents. If $4.0 \times 10^4$ amperes of current is passed through molten $Al_2O_3$ for 6 hours, what mass of aluminium is produced ?

(Assume 100% current efficiency. At mass of Al = 27 g $mol^{-1}$)

(a) $1.3 \times 10^4$ g (b) $9.0 \times 10^3$ g

(c) $8.05 \times 10^4$ g (d) $2.4 \times 10^5$ g

[CBSE AIPMT 2009]

(M)

1F ⟶ 1/3 Al

3F ⟶ 1 Al

96500 C ⟶ 9 g Al

$4 \times 10^4 \times 6 \times 60 \times 60$ ⟶ ? wt

$$wt = \frac{4 \times 10^4 \times 6^3 \times 10^2 \times 9}{96500}$$

$\doteq$

40. The weight of silver (At. Wt =108) displaced by a quantity of electricity which displaces 5600 mL of $O_2$ at STP will be

(a) 5.4 g (b) 10.8 g

(c) 54.0 g (d) 108.0 g [CBSE AIPMT 2014]

5.6L of $O_2$

||

1 F

||

1 mole Ag

||

108g

Short cut

108 gm of Ag = 5.6 L of $O_2$

12. 4.5 g of Al (atomic mass 27 amu) is deposited at cathode from $Al^{3+}$ solution by a certain quantity of charge. The volume of $H_2$ produced at STP from $H^+$ ions in solution by the same quantity of charge will be :

(a) 11.2 L
(b) 44.8 L
(c) 5.6 L
(d) 22.4 L. [CBSE AIPMT 2005]

Trick

9 g of Al = 11.2 L $H_2$

4.5 g of Al = ?

5.6 L

10. An electric current is passed through silver nitrate solution using silver electrodes. 10.79 g of silver was found to be deposited on the cathode. If the same amount of electricity is passed through copper sulphate solution using copper electrodes, the weight of copper deposited on the cathode is

(a) 6.4 g (b) 2.3 g

(c) 12.8 g (d) 3.2 g [CBSE AIPMT 2004]

Trick

108 g of Ag = 31.75 g of Cu

10.8 g Ag = ?

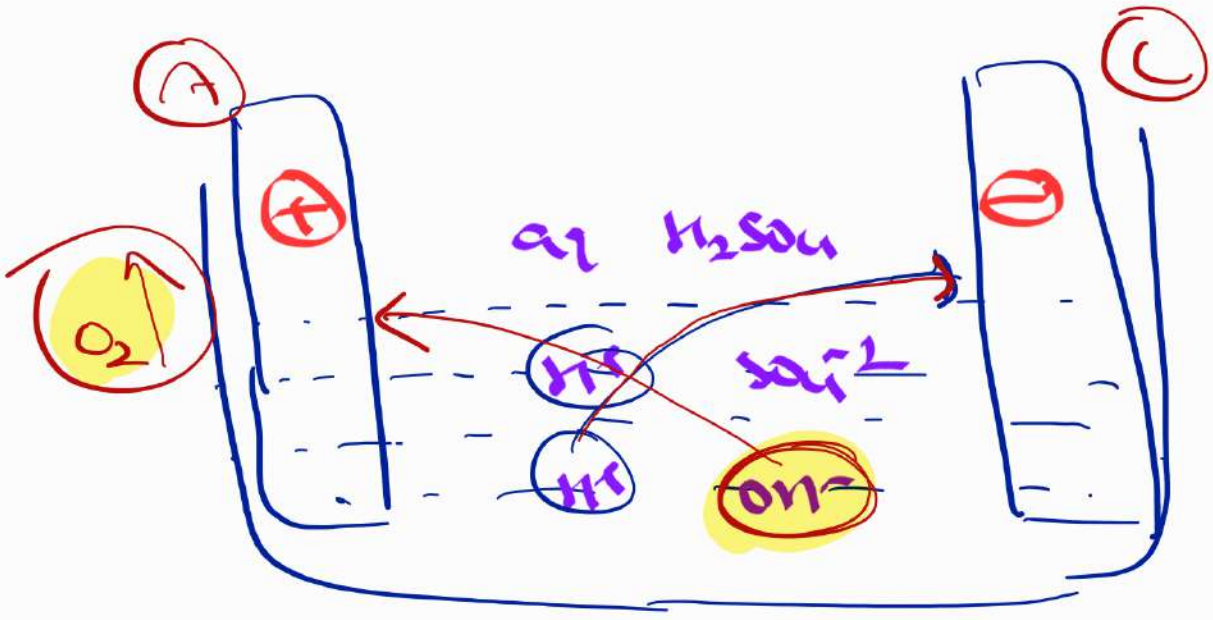
3.175

≃ 32

52. On electrolysis of dilute sulphuric acid using (Pt) platinum electrode, the product obtained at anode will be :

(a) $SO_2$ gas (b) hydrogen gas

(c) Oxygen gas (d) $H_2S$ gas [NEET 2020]



43. Zinc can be coated on iron to produce galvanised iron but the reverse is not possible. It is because

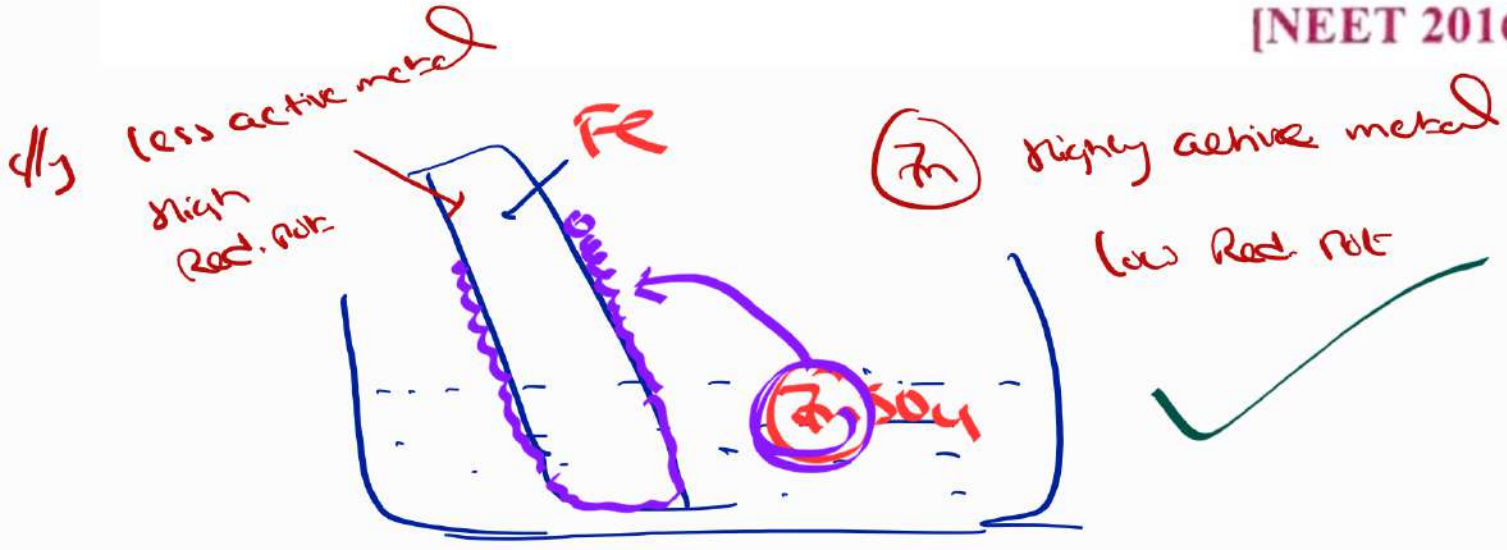
(a) zinc is lighter than iron

(b) zinc has lower melting point than iron

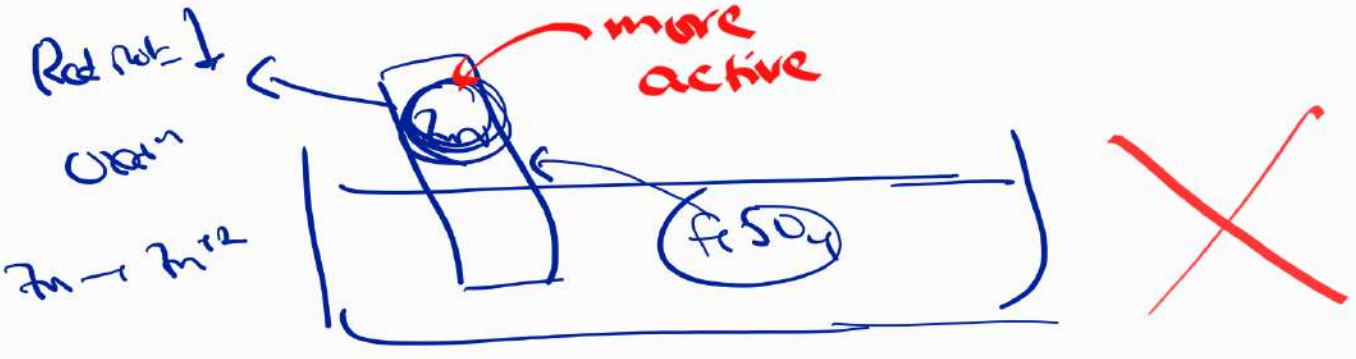
(c) zinc has lower negative electrode potential than iron

(d) zinc has higher negative electrode potential than iron

[NEET 2016]



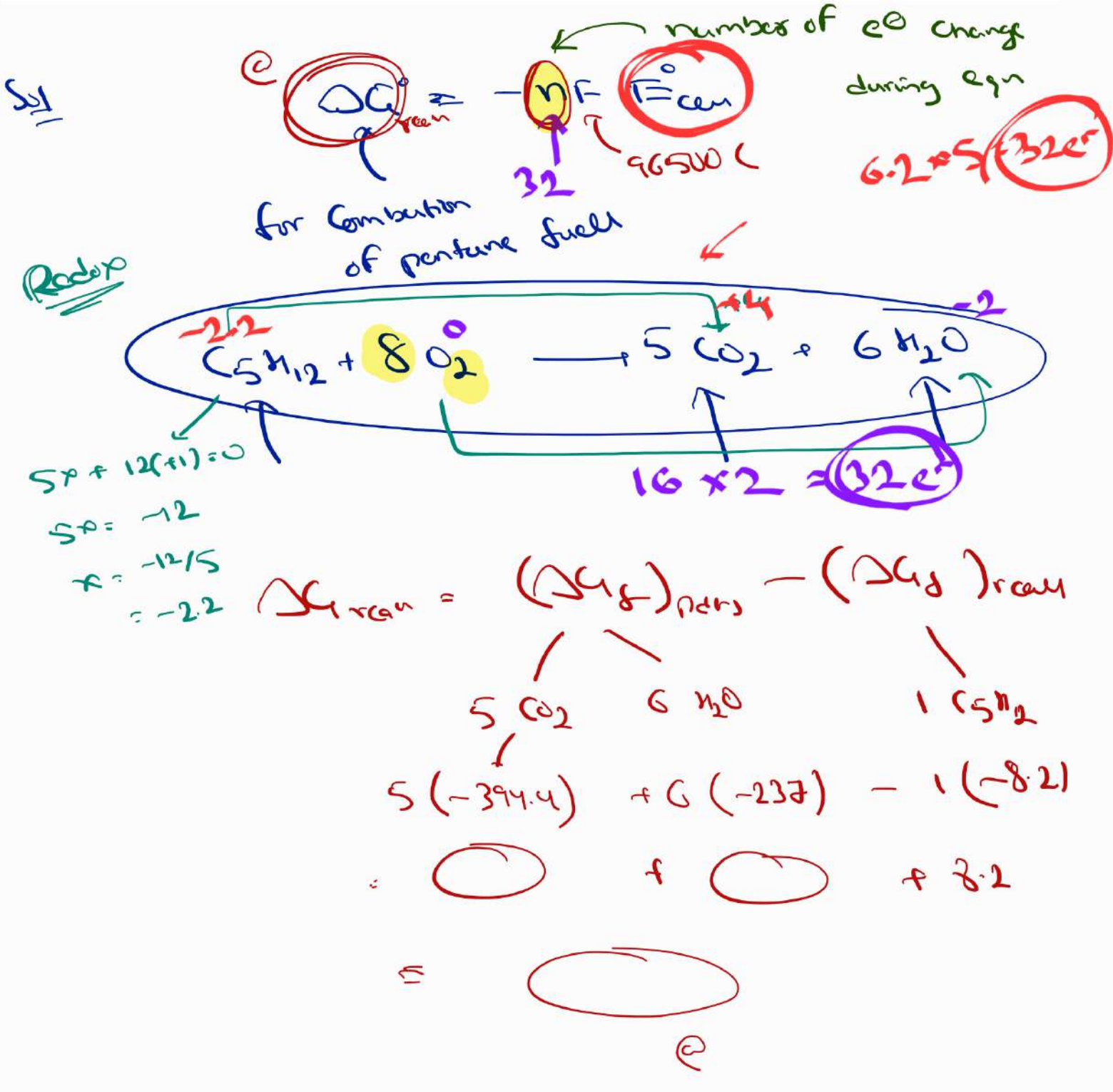

more active metal / low Red. Pot Can be Coated on less active / more Red pot metal



18. Standard free energies of formation (in kJ/mol) at 298 K are –237.2, –394.4 and –8.2 for $H_2O(l)$, $CO_2(g)$ and pentane(g), respectively. The value of $E^\circ_{cell}$ for the pentane-oxygen fuel cell is :

(a) 2.0968 V (b) 1.0968 V

(c) 0.0968 V (d) 1.968 V [CBSE AIPMT 2008]



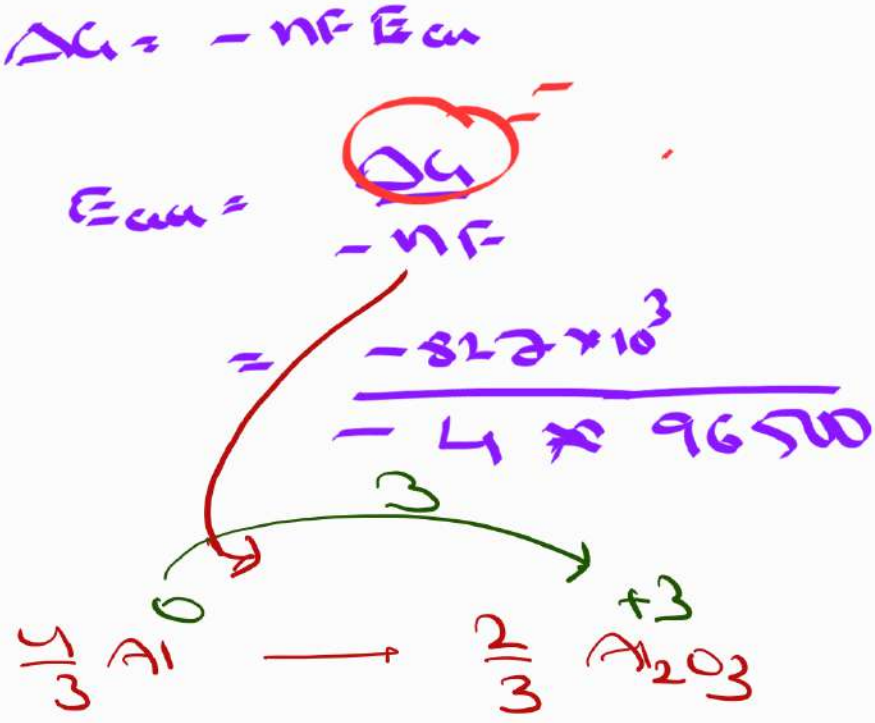
6. On the basis of the information available from the reaction

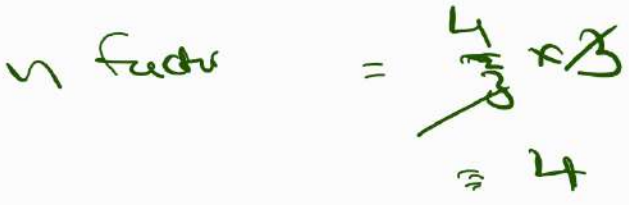
$$\frac{4}{3}\overset{0}{Al} + O_2 \rightarrow \frac{2}{3}Al_2O_3,\ \Delta G = -827\ kJ\ mol^{-1}\ of\ O_2$$

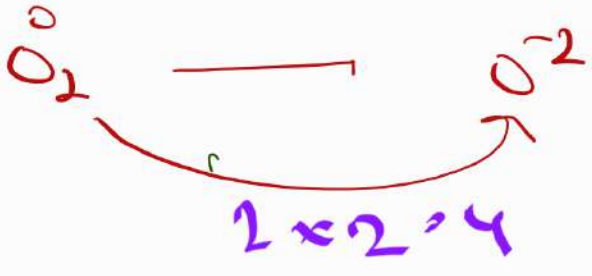
the minimum *emf* required to carry out an electrolysis of $Al_2O_3$ is ($F = 96500\ C\ mol^{-1}$)

(a) 8.56 V (b) 2.14 V

(c) 4.28 V (d) 6.42 V [CBSE AIPMT 2003]



4. In electrolysis of NaCl when Pt electrode is taken then $H_2$ is liberated at cathode while with Hg cathode it forms sodium amalgam because

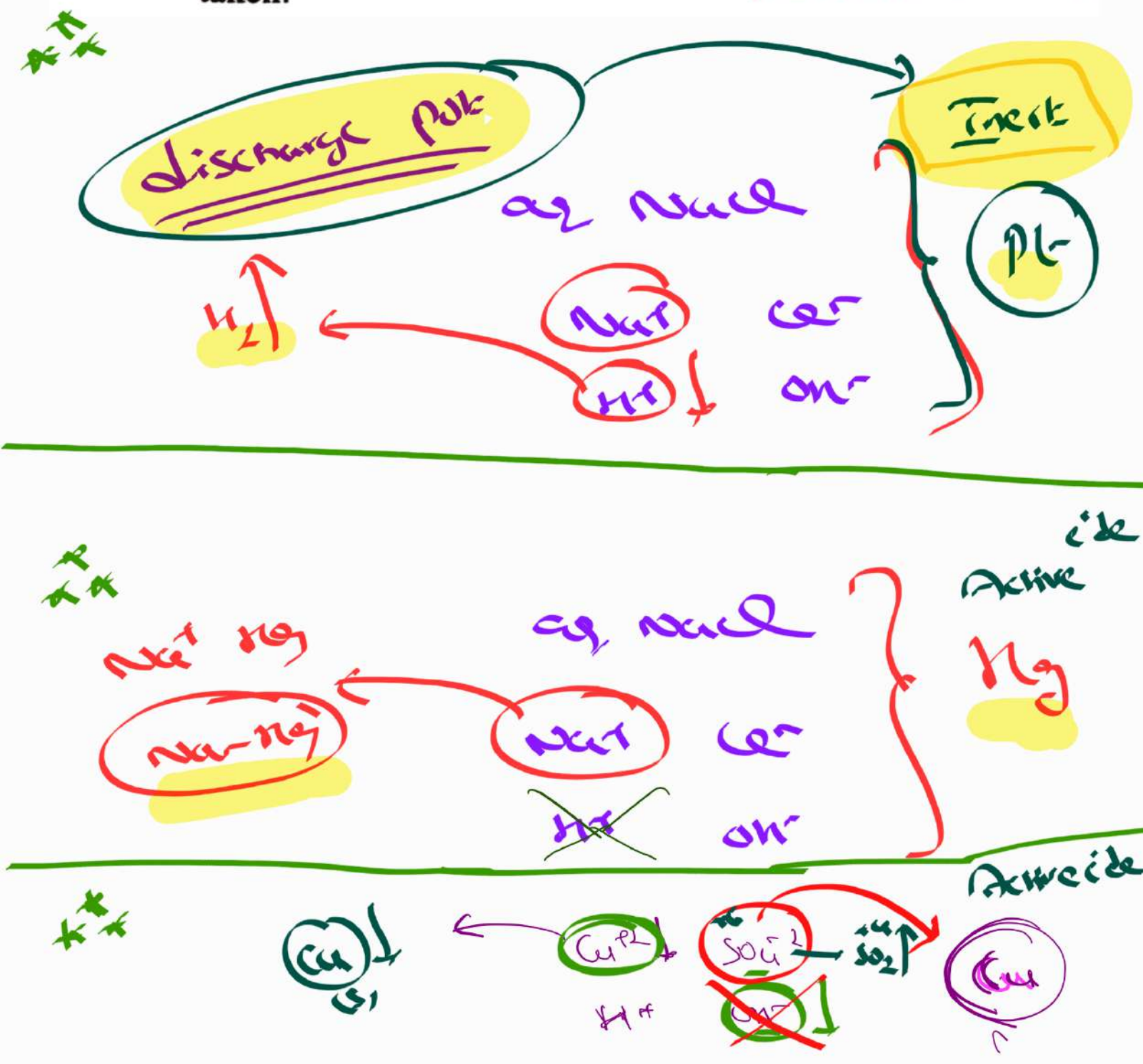
(a) Hg is more inert than Pt

(b) more voltage is required to reduce $H^+$ at Hg than at Pt

(c) Na is dissolved in Hg while it does not dissolve in Pt.

(d) Concentration of $H^+$ ions is larger when Pt electrode is taken.

[CBSE AIPMT 2002]



2. The most convenient method to protect the bottom of the ship made of iron is

(a) white tin plating

(b) coating it with red lead oxide

(c) connecting it with Mg block

(d) connecting it with Pb block

[CBSE AIPMT 2001]

Sn, Pb High Red Pot

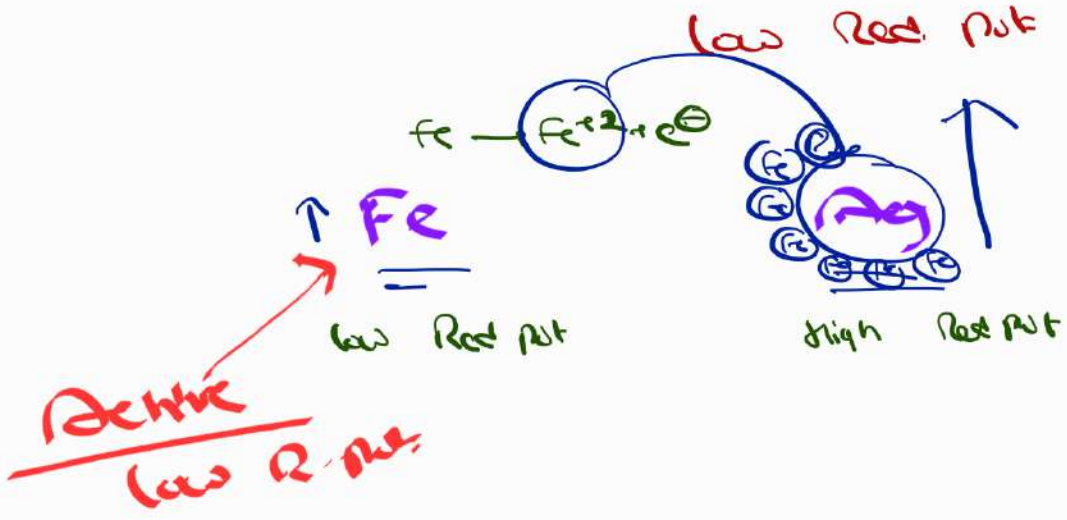
Mg low Red Pot

High Active

Sacrificial Anode

Electroplating

Sacrificial Anode




Note :- metals with Low Reduction potentials will act as Sacrificial Anode.