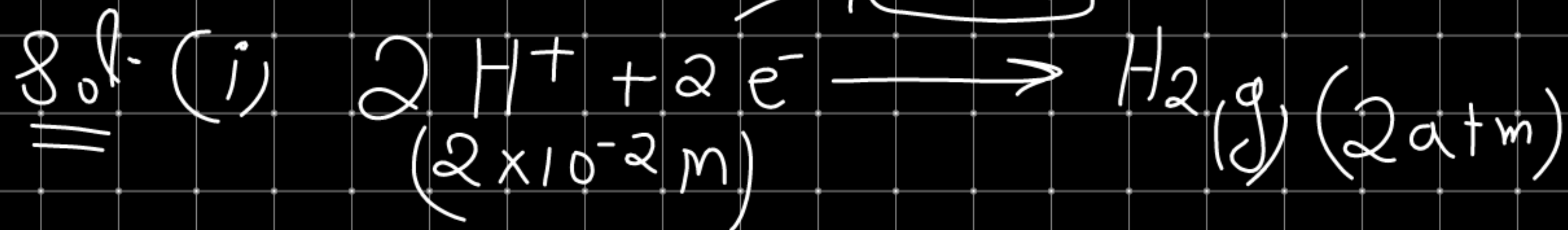
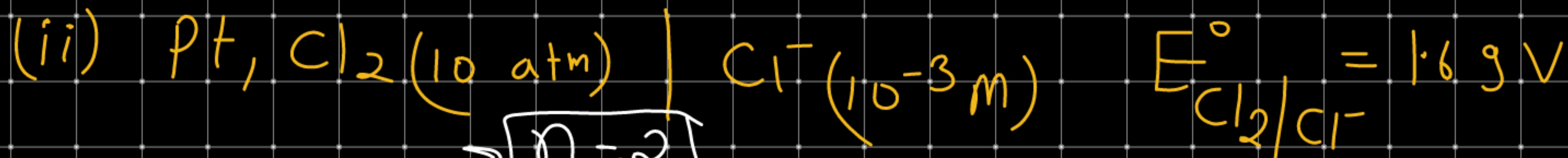
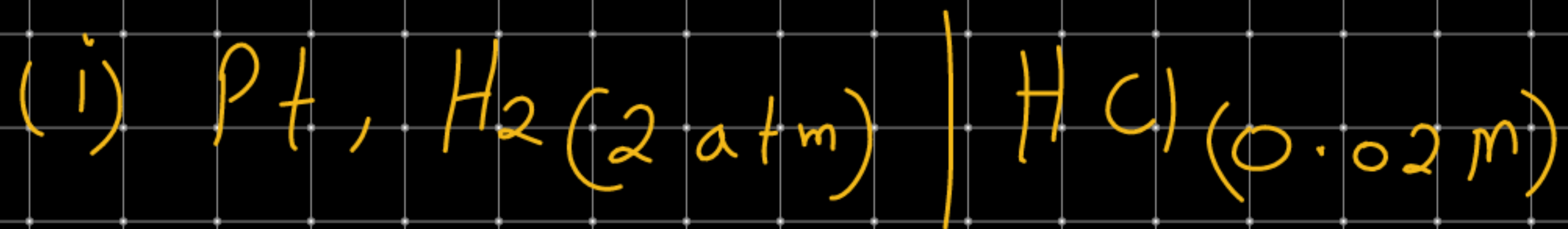


Ques. Cal. reduction potential of following.



$$E_{\text{H}^+/\text{H}_2} = 0 - \frac{0.0591}{2} \log \frac{P_{\text{H}_2}}{[\text{H}^+]^2}$$

$$E_{R.P.} = -\frac{0.03}{2} \log \frac{2}{(2 \times 10^{-2})^2}$$

$$E_{R.P.} = -0.03 \log \frac{2}{4 \times 10^{-4}}$$

$$E_{R.P.} = -0.03 \log \left(\frac{10^4}{2} \right)$$

$$= -0.03 \left[\log(10^4) - \log 2 \right]$$

$$= -0.03 \left[4 \times 1 - 0.30 \right]$$

$$= -0.03 \times 3.70 \text{ V}$$

\Rightarrow

$$E_{R.P.} = -0.11 \text{ V}$$

Q.2. At what pH of HCl solⁿ, of H₂ electrode
reduction potential is -0.188 V

Sol. $E_{Rp} = -0.0591 \times \text{pH}$
 $+0.188 = -0.0591 \times \text{pH}$

$$\text{pH} = \frac{0.188}{0.0591} = 3.1$$

Q.3 In H_2 electrode pH of HCl solⁿ Change from 2 to 4, Cal Change in reduction potential

Sol.

$$E_{R.P.1} = -0.0591 \times pH_1 \quad \text{--- (1)}$$

$$E_{R.P.2} = -0.0591 \times pH_2 \quad \text{--- (2)}$$

$$E_{R.P.2} - E_{R.P.1} = 0.0591 (pH_1 - pH_2)$$

$$\Delta E_{R.P.} = 0.0591 \times (2 - 4)$$
$$= \underline{-0.1182}$$

Reduction potential decreases \downarrow when pH \uparrow

Q.4 A solⁿ of $ZnSO_4$ in which Zn rod is dipped,
is diluted to 10 times
then reduction potential of Zn electrode will be -

- (a) \uparrow by 30 mV
- (b) \uparrow by 60 mV
- (c) \downarrow by 30 mV
- (d) \downarrow by 60 mV



initially

$$E_{RP} = E_{RP}^{\circ} - \frac{0.059}{2} \log \left(\frac{1}{[Zn^{2+}]} \right) \quad \text{--- (1)}$$

Now 10 times diluted

$$E'_{RP} = E_{RP}^{\circ} - \frac{0.059}{2} \log \left(\frac{1}{\frac{[Zn^{2+}]}{10}} \right)$$

$$\left(C = \frac{n}{V} \right) \left. \begin{array}{l} \uparrow \\ VT \\ \downarrow \end{array} \right\}$$

$$E'_{Rp} = E^{\circ}_{Rp} - \frac{0.059}{2} \log \left(\frac{10 \times 10^{-3}}{m \times [Zn^{2+}]} \right)$$

$$E'_{Rp} = E^{\circ}_{Rp} - \frac{0.059}{2} \left[\log \left(\frac{1}{[Zn^{2+}]} \right) + \log(10) \right]$$

$$E'_{Rp} = E^{\circ}_{Rp} - \frac{0.059}{2} \log \left(\frac{1}{[Zn^{2+}]} \right) - \frac{0.059}{2} \log(10)$$

from eq ①

$$E'_{Rp} = E_{Rp} - 0.03 \times 1 \Rightarrow E_{Rp} = E^{\circ}_{Rp} - 3 \times 10^{-2} \times 10^{-1} \times 10$$

$$E_{Rp} = E^{\circ}_{Rp} - 30 \text{ mV}$$

divalent metal ion (charge +2)

monvalent metal ion (- " - +1)

Brahmagraha

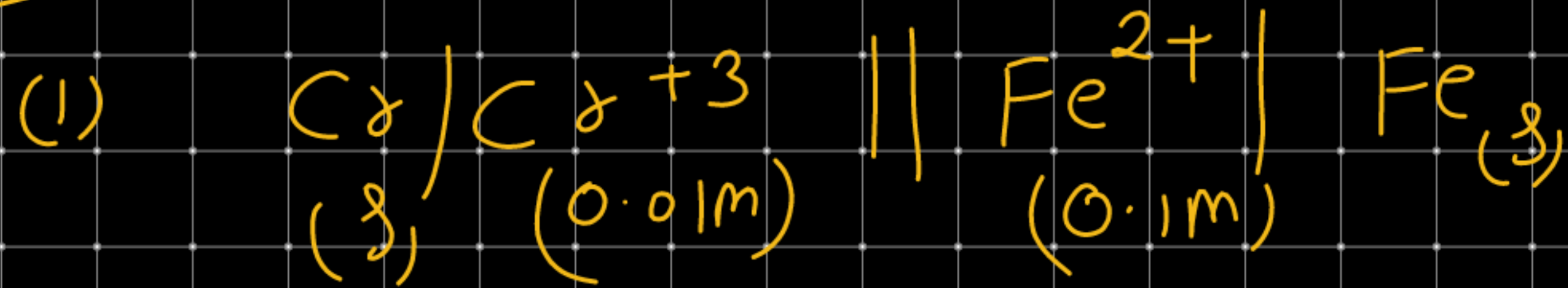
For divalent metal ion

(1) For each and every 10 times dilution
reduction potential decreases by 30mV

(2) For monvalent metal ion

— " — 10 times dilution
reduction potential decreases by 60mV

Q. Cal EMF of Cell in following.



Given $E^\circ_{\text{Cr}^{3+}/\text{Cr}} = -0.75V$, $E^\circ_{\text{Fe}^{2+}/\text{Fe}} = 0.45V$

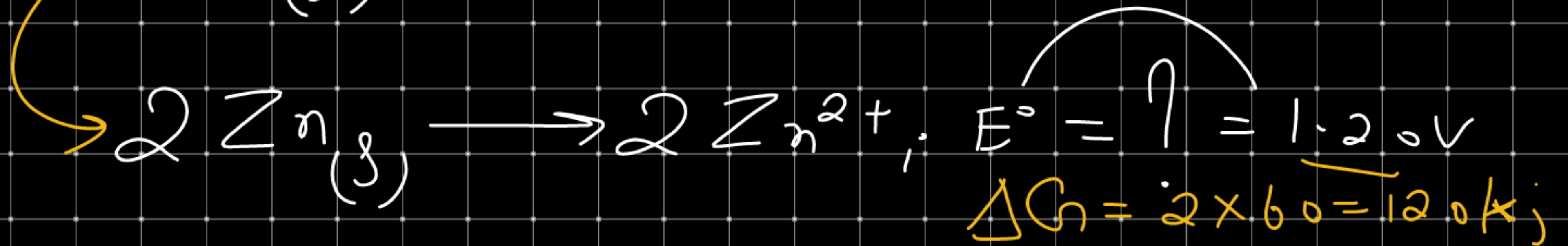
Sol.

$$E^\circ_{\text{cell}} = E^\circ_{\text{Cr}^{3+}/\text{Cr}} + E^\circ_{\text{Fe}^{2+}/\text{Fe}}$$

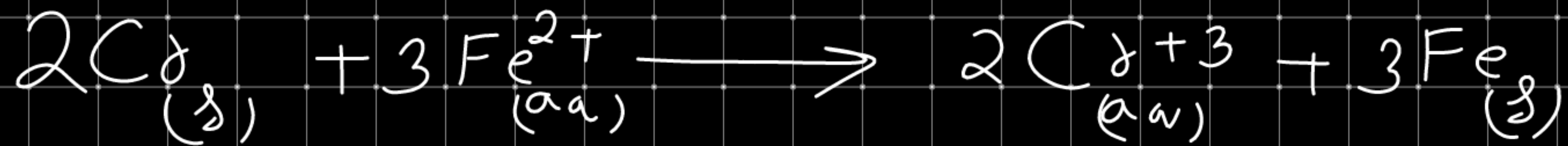
$$= 0.75 + 0.45$$

$$E^\circ_{\text{cell}} = 1.20V$$

Notes:



- (1) Electrode potential is intensive property while Gibbs energy is extensive property.
- (2) intensive properties are non-additive in nature, while extensive properties are additive.



$$E_{\text{cell}} = E^{\circ}_{\text{cell}} - \frac{0.06}{6} \log \frac{[\text{Cr}^{3+}]^2}{[\text{Fe}^{2+}]^3}$$

$$E_{\text{cell}} = 1.20 - 0.01 \log \frac{10^{-2} \times 10^{-2}}{10^{-1} \times 10^{-1} \times 10^{-1}}$$

$$= 1.20 - 0.01 \log(10^{-1})$$

$$= 1.20 + 0.01 \times 1$$

$$E_{\text{cell}} = 1.21 \text{ V}$$