20 (54b) $\underline{3Ce^{+4}} + Bi_{(s)} + H_2O_{(l)} \Rightarrow \underline{3Ce^{+3}} + BiO^+ + 2H^+$

E° rxn? p 1117

E°_{red}

$3(Ce^{+4} + e^- \Rightarrow Ce^{+3})$ $+1.61V$

E°_{ox}

$Bi_{(s)} + H_2O_{(l)} \rightarrow BiO^+ + 2H^+ + 3e^-$ -0.32

$\boxed{E^\circ_{cell} = +1.29V}$

$E^\circ = \frac{RT}{nF} \ln K$

$+1.29 = \left(\frac{(8.314)(298)}{3(96500)}\right) \ln K$

$\ln K = 150.734267258$

$\boxed{K = 2.9 \times 10^{65}}$

Apr 8-7:39 AM

20/62 $3Ce^{+4} + Cr_{(s)} \rightarrow 3Ce^{+3} + Cr^{+3}$

(a) p 1117 = std conditions.

$3Ce^{+4} + 3e^- \rightarrow 3Ce^{+3}$ $+1.61v$

$Cr_{(s)} \rightarrow Cr^{+3} + 3e^-$ $+0.74v$

$E^0 = +2.35_v$

(b) $[Ce^{+4}] = 3M$ $[Ce^{+3}] = 0.1M$ $[Cr^{+3}] = 0.01M$

$3Ce^{+4} + Cr_{(s)} \rightarrow 3Ce^{+3} + Cr^{+3}$

$$E = E^0 - \frac{RT}{nF} \ln Q$$

$$Q = \frac{[Ce^{+3}]^3 [Cr^{+3}]}{[Ce^{+4}]^3 (1)}$$

$$E = 2.35 - \frac{(8.314)(298)}{3(96500)} \ln \frac{(0.1)^3 (0.01)}{(3)^3}$$

$$\boxed{E = +2.4767349737\,v} \sim \boxed{2.48\,v}$$

Apr 8-7:59 AM

Find pH of cell.

$E = 0.45v$ when $[Zn^{+2}] = 1M$ and $P_{H_2} = 1\,atm$

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

p1117

$Zn^{+2} + 2e^- \rightarrow Zn^0_{(s)}$ $-0.763v$

$2H^+ + 2e^- \rightarrow H_{2(g)}$ $0.00v$

$Zn^0 \rightarrow Zn^{+2} + 2e^-$ $+0.763$

$2H^+ + 2e^- \rightarrow H_{2(g)}$ 0

$Zn^0_{(s)} + 2H^+ \rightarrow Zn^{+2} + H_2$ E^0 $+0.763$

$$E = E^0 - \frac{RT}{nF}\ln Q$$

$$Q = \frac{[Zn^{+2}][H_2]}{[H^+]^2}$$

$$0.45 = 0.763 - \frac{(8.314)(298)}{2(96500)}\ln\frac{(1)(1)}{(H^+)^2}$$

-0.763 -0.763

$$-0.313 = -\frac{8.314(298)}{2(96500)}\ln\frac{1}{(H^+)^2}$$

$$24.382 = \ln\frac{1}{(H^+)^2}$$

$$\frac{3.88\times10^{10}}{1} = \frac{1}{(H^+)^2}$$

$$\frac{1}{3.88\times10^{+10}} = \frac{(H^+)^2}{1}$$

$$\sqrt{\frac{1}{3.88\times10^{10}}} = (H^+)$$

$$(H^+) = 5.075\times10^{-6}$$

$pH = -\log(H^+)$

$\boxed{pH = 5.29}$ ✓

Apr 8-8:16 AM

Electrolysis → Non-Spontaneous

redox rxn. Use an outside source of energy (Battery) to force it to occur.

electrochemical cell (spontaneous)

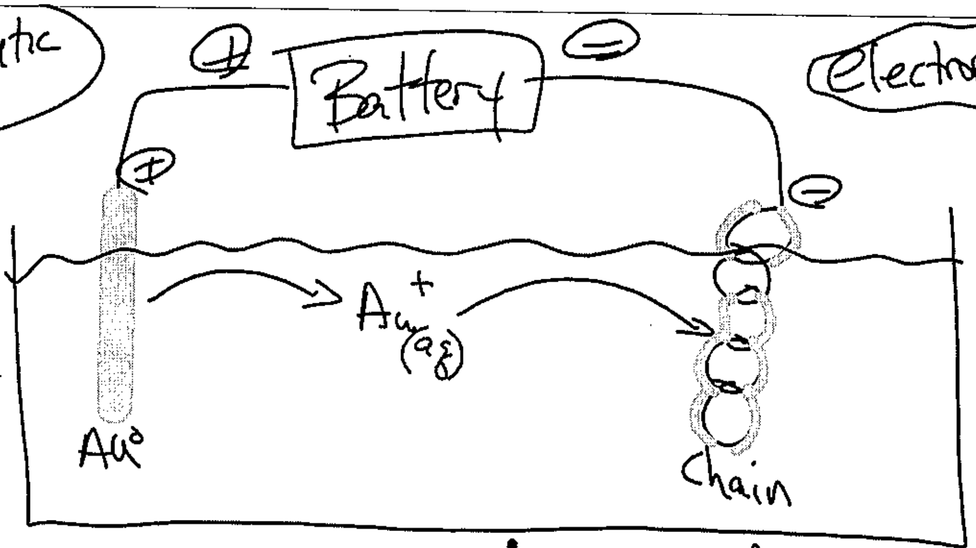
* Electroplating

⊕ Au ions

⊖ metal

Electrolytic cell

Electroplating



NOT SPONT

E $-$

ΔG $+$

$Au^0 \rightarrow Au^+ + e^-$

LEO ANODE $+$

Oxidation

$Au^+ + e^- \rightarrow Au^0$

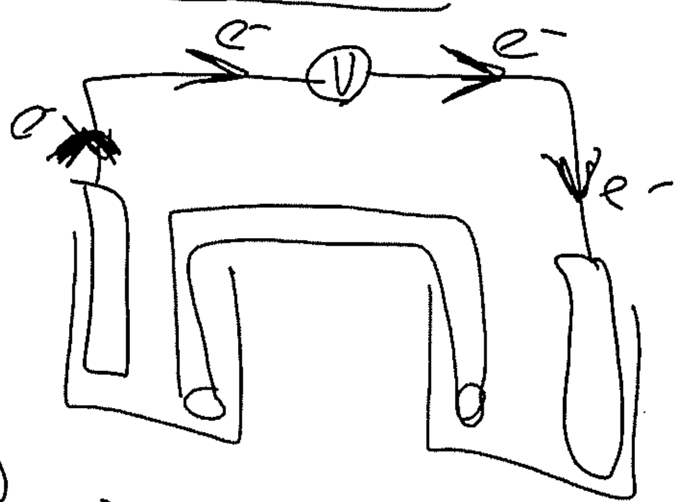
GER CATHODE $-$

reduction

Apr 8-8:52 AM

electrolytic, quantitative electrolytic, finish 20 review e-chem

repel e^-
(−) pole



(+) pole
attract e^-

LEO
Anode
(−)

$\rightarrow + e^-$

$+e^- \rightarrow$

GER
cathode
(+)

Quantitative aspects of electrochemistry

$\boxed{\frac{1 \text{ volt}}{1} = \frac{1 \text{ Joule}}{\text{coulomb}}}$

$\boxed{1 \text{ Faraday} = \frac{96{,}500 \text{ coulombs}}{\text{Mole of } e^-}}$

coulomb = amp * sec

$\text{Amp} = \frac{\text{coulomb}}{\text{sec}}$

$\frac{1 \text{ mole } Na^+}{1 \text{ mole } e^-}$; $\frac{1 \text{ mole } Ca}{2 \text{ mole } e^-}$

P.T. charge

Find g Al produced in 1 hour by electrolysis of Molten $Al^{+3}Cl_3$ if Current is ~~10 amps~~.

$\boxed{\frac{1 \text{ mole Al}}{3 \text{ mole } e^-}}$ $\boxed{\frac{1 \text{ mole Al}}{27 \text{ g Al}}}$ PT $\frac{10 \text{ coul}}{\text{sec}}$

(1 hr)

$$\frac{27 \boxed{\text{g Al}}}{1 \cancel{\text{mole Al}}} \cdot \frac{1 \cancel{\text{mole Al}}}{3 \cancel{\text{mole } e^-}} \cdot \frac{1 \cancel{\text{mole } e^-}}{96{,}500 \cancel{\text{coul}}} \cdot \frac{10 \cancel{\text{coul}}}{\cancel{\text{sec}}} \cdot \frac{3600 \cancel{\text{sec}}}{} =$$

3.36 g Al

Apr 8-9:08 AM

$Zn / Zn^{+2} \,||\, Cu^{+2} / Cu$

$(Zn \rightarrow Zn^{+2} + 2e^-)$ e-Chem cell $((Cu^{+2} + 2e^- \rightarrow Cu))$

Apr 8-9:16 AM