5

$\overset{+3}{Fe_2}\overset{-2}{S_3} + 12\overset{+1}{H}NO_3 \rightarrow 2\overset{+3}{Fe}(NO_3)_3 + 3\overset{0}{S} + 6NO_2 + 6\overset{+1}{H_2}O$

$\boxed{\text{reducing agent}} \Rightarrow$ LEO ox

more e^- → fewer e^-
more ⊕

S^{-2} is undergoing ox

Always pick a reactant.

7

Pb_3O_4

$\overset{0}{Pb} + \overset{+4\ (+2)}{Pb}\overset{-2\ (-1)}{O_2} + 2\overset{+1}{H_2}\overset{+6}{S}\overset{-2}{O_4} \rightarrow 2\overset{+2}{Pb}\overset{+6}{S}\overset{-2}{O_4} + 2\overset{+1}{H_2}\overset{-2}{O}$

LEO GER

GER
ox agent

$\overset{-2}{SO_4}\ ^{-2}$

$+6 - 8 = -2$

$Pb^0 \rightarrow Pb^{+2} + 2e^-$

$Pb^{+4} + 2e^- \rightarrow Pb^{+2}$

(8) Basic Soln → Alkaline

$BrO^- + Fe(OH)_2 \rightarrow Br^- + Fe(OH)_3$

$\cancel{2e^-} + \boxed{\cancel{2H^+}} + BrO^- \rightarrow Br^- \cancel{+ H_2O}$

$1 \quad \cancel{2}\ H_2O + 2Fe(OH)_2 \rightarrow 2Fe(OH)_3 \boxed{\cancel{+2H^+}} \cancel{+2e^-}$

$BrO^- + H_2O + 2Fe(OH)_2 \rightarrow Br^- + 2Fe(OH)_3$ ✓

(10) Basic

$ClO^- + S_2O_3^{-2} \rightarrow Cl^- + SO_4^{-2}$

$\times 4 \quad \cancel{2e^-}\ 8 + \cancel{2H^+}\ 8 + 4ClO^- \rightarrow 4Cl^- \cancel{+4H_2O}$

$1 \quad \cancel{5}\ H_2O + S_2O_3^{-2} \rightarrow 2SO_4^{-2} + \cancel{10}\ 2H^+ \cancel{+8e^-}$

$2OH^- + 4ClO^- + \cancel{H_2O} + S_2O_3^{-2} \rightarrow 4Cl^- + 2SO_4^{-2} + \boxed{2H^+ + 2OH^-}$

$\cancel{2}\ H_2O$

$2OH^- + 4ClO^- + S_2O_3^{-2} \rightarrow 4Cl^- + 2SO_4^{-2} + H_2O$ ✓

$-8 \qquad -8$

(12) $\overset{+7\ -2}{3MnO_4^-} + 24H^+ + 5Fe \xrightarrow{+5e^-} 3Mn^{+2} + 5Fe^{+3} + 12H_2O$

$+7\ -8 = -1$

$\boxed{\text{Cathode}} \Rightarrow$ FAT RED CAT

GER

(13) $Cr^{+3} \xrightarrow{\text{LEO}} \overset{+6\ \ -2}{Cr_2O_7^{-2}}$

An Ox

$+12 \quad -14 \quad = -2$

$\overset{+1}{H}As\overset{-2}{O_2} \rightarrow \overset{0}{As}$

$+1 \quad +3 \quad -4 = 0$

FAT RED CAT

GER

$H_2^0 + O_2^0 \rightarrow \overset{+1}{H_2}\overset{-2}{O}$

$O_2^0 \rightarrow O^{-2}$

(15) Spont R $\longrightarrow$ P

$\Delta G < 0$ (−) ΔG

$E^\circ > 0$ (+) E°

$K = \frac{[P]}{[R]}$ $K > 1$ large

(16) $Pb^{+2} + Zn_{(s)} \rightarrow Zn^{+2} + Pb_{(s)}$

1M 2x10⁻⁴M

Short hand $Pb^{+2}/Pb \,//\, Zn/Zn^{+2}$

1M 2x10⁻⁴M

Find E

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

$= 0.637 - \frac{(8.314)(298)}{(2)(96500)} \ln \frac{2\times10^{-4}}{1}$

$\boxed{E = 0.746_V}$

E°

$Pb^{+2} \rightarrow Pb^\circ$ -0.126_V

$Zn \rightarrow Zn^{+2}$ $+0.763_V$

E° $+0.637_V$

$K = \frac{[Zn^{+2}]}{[Pb^{+2}]}$

Electrolysis

- Need a Battery

Energy NRG

$\boxed{\text{Factor label}}$

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

$$\frac{1\ \text{Faraday}}{1} = \frac{96500\ \text{coul}}{1\ \text{Mole of } e^-}$$

↑ value

$$\frac{\text{Ampere}}{1} = \frac{\text{coulomb}}{\text{sec}}$$

Ex) ___?___ g Al is produced in 1 hour by electrolysis of molten $AlCl_3$. 10 amp current.

___ g Al^0

$Al^{+3}Cl_3$

$Al^0 \downarrow Al^{+3}$

For every 1 mole Al ⇒ 3 mole e−

$Al \rightarrow Al^{+3} + 3e^-$

10 amps = * $\frac{10\ \text{coul}}{\text{sec}}$

1 hour = * 3600 sec

* $\frac{1\ \text{Mole Al}}{3\ \text{Mole } e^-}$

1 ~~mole Al~~	27 g Al	1 ~~mole e−~~	10 ~~coul~~	3600 ~~sec~~
3 ~~mole e−~~	1 ~~mole Al~~	96500 ~~coul~~	~~sec~~	

3.36 g Al

Calc mass of Mg^0 formed from molten $Mg^{+2}Cl_2^{-1}$

60 amps over 4×10^3 sec

$\frac{60\ \cancel{coul}}{\cancel{sec}}$, $\frac{96500\ \cancel{coul}}{1\ \cancel{mole\ e^-}}$, $\frac{1\ \cancel{mole\ Mg}}{\cancel{24\ g\ Mg}}$, $\frac{1\ \cancel{mole\ Mg}}{2\ \cancel{mole\ e^-}}$

24 g Mg	1 ~~mole Mg~~	1 ~~mole e-~~	60 ~~coul~~	4×10³ ~~sec~~
1 ~~mole Mg~~	2 ~~mole e-~~	96500 ~~coul~~	~~sec~~	

= $\boxed{30.2\ g\ Mg}$

HW PS 20-1

\# 18, 19, 21, 23, 24, 26

Exam 3 Soon