

53.

a. 0

$$b. E = 0 - \frac{0.0591}{1} \log\left(\frac{1}{2}\right) \quad 0.018 \text{ V}$$

$$c. E = 0 - \frac{0.0591}{1} \log\left(\frac{0.10}{1}\right) \quad 0.059 \text{ V}$$

$$d. E = 0 - \frac{0.0591}{1} \log\left(\frac{4.0 \times 10^{-5}}{1}\right) \quad 0.26 \text{ V}$$

e. 0

54. a. 0

no e<sup>-</sup> flow

$$b. E = 0 - \frac{0.0591}{2} \log\left(\frac{1}{2}\right) \quad \begin{array}{l} \text{Left - anode} \\ \text{Right - cathode} \end{array}$$

0.00889

$$c. E = 0 - \frac{0.0591}{2} \log\left(\frac{0.10}{1}\right) \quad \begin{array}{l} \text{right - anode} \\ \text{left cathode} \end{array}$$

0.02955

$$d. E = 0 - \frac{0.0591}{2} \log\left(\frac{4.0 \times 10^{-5}}{1}\right) \quad \begin{array}{l} \text{right anode} \\ \text{left cathode} \end{array}$$

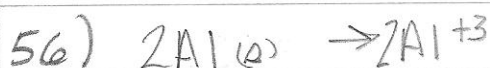
0.1299

e. 0

Electrons Always Flow from A to C

$$55. E = 2.04 - \frac{0.0591}{2} \log\left(\frac{1}{(4.5)^2 (4.5)^2}\right) = 2.1172$$

2.12 V



+1.66



1.33V

6 electrons

$$3.01 = 2.99 - \frac{0.0591}{6} \log \frac{(.30)^2 (.15)^2}{(.55) (\text{H}^+)^{14}}$$

$$3.01 = 2.99 - (.00985 \log \frac{(.09)(.0225)}{.55 \times 14})$$

$$\begin{array}{rcl} 3.01 & = & 2.99 - .00985 \log \frac{.00368}{\times 14} \\ -2.99 & & -2.99 \end{array}$$

$$\frac{.02}{-.00985} = \frac{-.00985}{-.00985} \log \frac{.00368}{\times 14}$$

$$-2.030 = \log \frac{.00368}{\times 14}$$

$$10^{2.030} = \frac{.00368}{\times 14}$$

$$.00933 = \frac{.00368}{\times 14}$$

$$\times 14 = \frac{.00368}{.00933}$$

$$\times 14 = .394$$

14<sup>th</sup>√

$$.394^{1/14} = .9356 = [\text{H}^+]$$

$$-\log [\text{H}^+] = \text{pH}$$

$$-\log [.9356] =$$

$$\text{pH} = .028$$

p. 832 #56, 57, 58 continued



making more  $\text{Zn}^{+2}$

$$[\text{Zn}^{+2}] = 1.20 \text{ M}$$



using up (less)  $\text{Cu}^{+2}$

$$[\text{Cu}^{+2}] = 0.80 \text{ M}$$

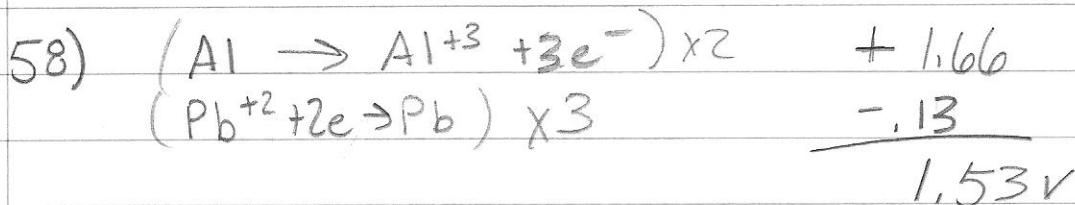


$$E_{\text{cell}} = 1.10 - \frac{0.0591}{2} \log \frac{1.20}{.80}$$

.17609

$$1.10 - .00520$$

$$E_{\text{cell}} = 1.09 \text{ V}$$



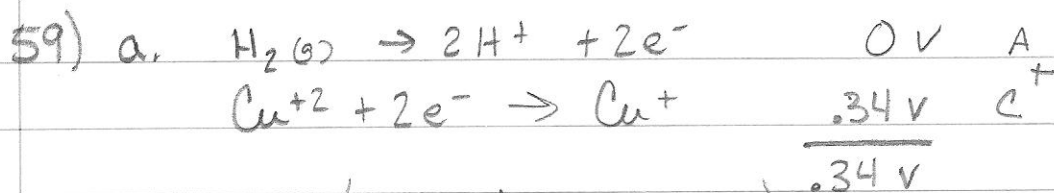
$$E_{\text{cell}} = 1.53 - \frac{0.0591}{6} \log \frac{(1.60)^2}{(.40)^3}$$

$$\log \frac{2.56}{.1064}$$

1.602

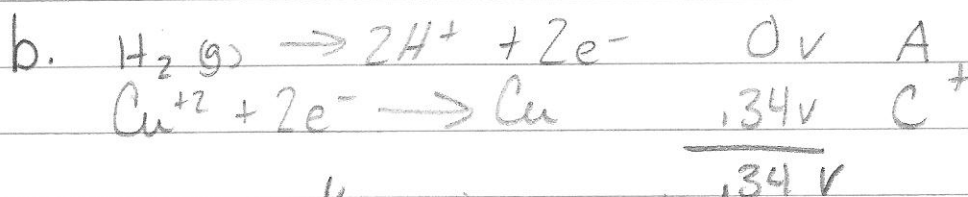
$$1.53 - .0157$$

$$E_{\text{cell}} = 1.5142 \text{ V}$$



$$E_{\text{cell}} = .34 - \left( \left( \frac{0.0591}{2} \right) \log \frac{1}{2.5 \times 10^{-4}} \right)$$

$$E_{\text{cell}} = .2335 \text{ V}$$



$$\begin{array}{rcl} .195 & = & .34 - \left( \left( \frac{0.0591}{2} \right) \log \frac{1}{[\text{Cu}^{+2}]} \right) \\ -.34 & & -.34 \end{array}$$

$$\begin{array}{rcl} -0.145 & = & -.02955 \log \frac{1}{[\text{Cu}^{+2}]} \\ -.02955 & & -.02955 \end{array}$$

$$4.9069 = \log \frac{1}{[\text{Cu}^{+2}]}$$

$$4.9069 = \log 1 - \log [\text{Cu}^{+2}]$$

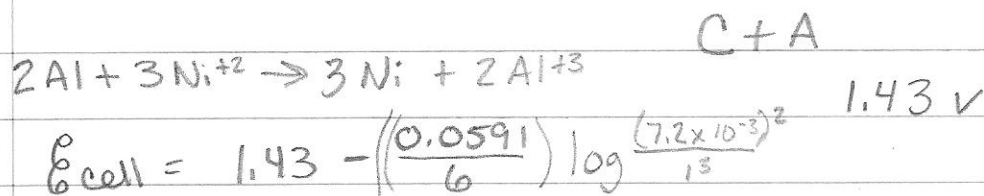
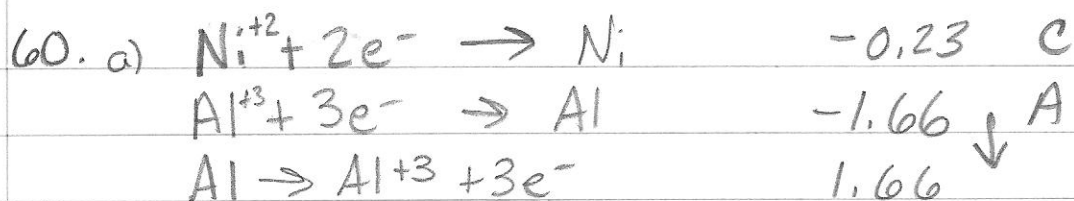
$$\downarrow$$

$$0$$

$$10^{-4.9069} = [\text{Cu}^{+2}]$$

$$1.239 \times 10^{-5} \text{ M}$$

p. 833 #60



$$E_{\text{cell}} = 1.4722 \text{ V}$$



$$1.62 = 1.43 - \left( \frac{0.0591}{6} \right) \log \frac{[\text{Al}^{+3}]^2}{1}$$

$$.19 = - \frac{0.0591}{6}$$

$$-19.2893401 = \log [\text{Al}^{+3}]^2$$

$$10^{-19.2893401}$$

$$5.1364 \times 10^{-20} = [\text{Al}^{+3}]^2$$

$$2.266 \times 10^{-10} = [\text{Al}^{+3}]$$

(65)

$$25a. \Delta G^\circ = (-6)(96485)(.03) = -17367.3 \text{ J}$$

$$K = 0 = .03 - \frac{0.0591}{6} \log K$$

$$\frac{6 \times -.03}{-0.0591} = \log K$$

$$K = 10^{3.045} = 1110.9$$

$$25b. \Delta G^\circ = (-2)(96485)(2.71) = -522948.7 \text{ J}$$

$$K = 0 = 2.71 - \frac{0.0591}{2} \log K$$

$$\frac{-2.71 \times 2}{-0.0591} = \log K$$

$$K = 10^{91.708} = 5.116 \times 10^{91}$$

$$29a. \Delta G^\circ = (-2)(96485)(.27) = -52101.9 \text{ J}$$

$$K = 0 = .27 - \frac{0.0591}{2} \log K$$

$$\frac{-.27 \times 2}{-.0591} = \log K$$

$$K = 10^{9.1370} = 1.3710 \times 10^9$$

$$29b. \Delta G^\circ = (-10)(96485)(.09) = -86836.5 \text{ J}$$

$$K = 0 = .09 - \frac{0.0591}{10} \log K$$

$$\frac{-.09 \times 10}{-.0591} = \log K$$

$$K = 10^{15.228} = 1.69210 \times 10^{15}$$

p. 833 #66, #68

$$66) 26a. \Delta G^\circ = (-10)(96485)(.43) = -414885.5 \text{ J}$$

$$K = 0 = .43 - \frac{0.0591}{10} \log K$$

$$K = 10^{72.758} = 5.72845 \times 10^{72}$$

$$26b. \Delta G^\circ = (-2)(96485)(1.56) = -301033.2 \text{ J}$$

$$K = 0 = 1.56 - \frac{0.0591}{2} \log K$$

$$K = 10^{52.7918} = 6.1926 \times 10^{52}$$

$$30a. \Delta G = (-2)(96485)(1.10) = -212267.0 \text{ J}$$

$$K = 0 = 1.10 - \frac{0.0591}{2} \log K$$

$$K = 10^{37.225} = 1.6789 \times 10^{37}$$

$$30b. \Delta G = (-6)(96485)(1.14) = -659957.4 \text{ J}$$

$$K = 0 = 1.14 - \frac{0.0591}{6} \log K$$

$$K = 10^{115.73} = 5.45 \times 10^{115}$$

$$68. -1.23 + .14 = -0.09 \text{ V}$$

$$0 = -0.09 - \frac{0.0591}{2} \log K$$

$$K = 10^{-3.045}$$

$$K = .00090015$$

$$\frac{[\text{Sn}^{+2}]}{[\text{Ni}^{+2}]} < .00090015$$



71)



$$E^{\circ} = 1.50 + .34 = 1.84 \text{ V}$$

$$b. \Delta G^{\circ} = (-3)(96485)(1.84) = -532597.2 \text{ J}$$

$$K = 0 = 1.84 - \frac{0.0591}{3} \log K$$

$$K = 10^{93.40} = 2.51776 \times 10^{93}$$

c.

$$E_{\text{cell}}^{\circ} = 1.84 - \frac{0.0591}{3} \log \frac{(1 \times 10^{-4})^3}{1 \times 10^{-2} \text{ M}}$$

$$E_{\text{cell}}^{\circ} = 2.037 \text{ volts}$$

$$72) \log 2.97 \times 10^7 = \frac{2(x)}{0.0591} \quad x = 0.2208$$

$$E_{\text{cell}}^{\circ} = 0.2208 \text{ volts}$$

$$\Delta G = -2(96485)(0.2208) = -42607.776 \text{ J}$$

$$E_{\text{cell}} = 0.2208 - \frac{0.0591}{2} \log \frac{(2.0)^2}{(0.3)^2(0.2)}$$

$$E_{\text{cell}} = 0.151 \text{ volts}$$

$$\Delta G \text{ at cond.} = (-2)(96485)(0.151) = -29138.475$$