

- A. Find E_{CELL} for $\text{Ag} | f[\text{Ag}^+] = 0.010 || f[\text{Fe}^{+3}] = 0.0050, f[\text{Fe}^{+2}] = 0.0030 | \text{Pt}$
 $\text{Ag}^+ + e^- \rightleftharpoons \text{Ag} \quad E^\circ = +.7993 \text{ V} \quad \text{Fe}^{+3} + e^- \rightleftharpoons \text{Fe}^{+2} \quad E^\circ = +.771 \text{ V}$
 $E_{LEFT} = .7993 - 0.05916 \log \frac{1}{.01} = .6810 \quad E_{RIGHT} = .771 - 0.05916 \log \frac{.003}{.005} = .7841$

$$E_{CELL} = E_{RIGHT} - E_{LEFT} = 0.7841 - 0.6810 = 0.1031$$

- B. Find E° for $\text{Pb}(\text{OH})_2(\text{s}) + 2e^- \rightleftharpoons \text{Pb}(\text{s}) + 2\text{OH}^-$.

$$1. \text{Pb}^{+2} + 2e^- \rightleftharpoons \text{Pb} \quad E^\circ = -.126; E = -.126 - \frac{0.05916}{2} \log \frac{1}{[\text{Pb}^{+2}]}$$

$$2. [\text{Pb}^{+2}] \text{ is found from } K_s = [\text{Pb}^{+2}][\text{OH}^-]^2 = 8 \times 10^{-16}$$

$$[\text{Pb}^{+2}] = \frac{8 \times 10^{-16}}{[\text{OH}^-]^2}; E = -.126 - \frac{0.05916}{2} \log \frac{[\text{OH}^-]^2}{8 \times 10^{-16}}$$

3. E° for $\text{Pb}(\text{OH})_2(\text{s}) + 2e^- \rightleftharpoons \text{Pb}(\text{s}) + 2\text{OH}^-$ means the potential when $[\text{OH}^-] = 1.00$. $[\text{Pb}^{+2}] \neq 1.00$ since it is not a species in the E° equation.

$$E^\circ_{\text{Pb}(\text{OH})_2} = -.126 - \frac{0.05916}{2} \log \frac{1}{8 \times 10^{-16}} = -.57 \text{ V}$$

- C. Find K_s for $\text{Hg}_2(\text{CH}_3\text{COO})_2$ given $E_{CELL} = 0.596 \text{ V}$ for

SHE || $0.0100 = [\text{CH}_3\text{COO}^-]$, saturated $\text{Hg}_2(\text{CH}_3\text{COO})_2 | \text{Hg}$

$$1. \text{Hg}_2^{+2} + 2e^- \rightleftharpoons 2\text{Hg}(l) \quad E^\circ = 0.796; E = 0.796 - \frac{0.05916}{2} \log \frac{1}{[\text{Hg}_2^{+2}]}$$

$$2. [\text{Hg}_2^{+2}] \text{ is found from } K_s = [\text{Hg}_2^{+2}][\text{CH}_3\text{COO}^-]^2$$

$$[\text{Hg}_2^{+2}] = \frac{K_s}{[\text{CH}_3\text{COO}^-]^2}; E = 0.796 - \frac{0.05916}{2} \log \frac{[\text{CH}_3\text{COO}^-]^2}{K_s}$$

3. When $[\text{CH}_3\text{COO}^-] = 0.0100 \text{ M}$, we know $E_{CELL} = E_{RIGHT} - E_{LEFT} = E_{RIGHT} - 0 \text{ V}$

$$0.596 = 0.796 - \frac{0.05916}{2} \log \frac{(.0100)^2}{K_s}; 10 \frac{2(.596 - .788)}{-0.05916} = \frac{.01^2}{K_s}; K_s = 1.73 \times 10^{-11}$$

- D. Find E° for $\text{Ag}(\text{NH}_3)_2^+ + e^- \rightleftharpoons \text{Ag}(\text{s}) + 2\text{NH}_3$

$$1. \text{Ag}^+ + e^- \rightleftharpoons \text{Ag} \quad E^\circ = .7993; E = .7993 - 0.05916 \log \frac{1}{[\text{Ag}^+]}$$

$$2. [\text{Ag}^+] \text{ is found from } K_{f1}K_{f2} = \frac{[\text{Ag}(\text{NH}_3)_2^+]}{[\text{Ag}^+][\text{NH}_3]^2} = 10^{3.31+3.92}$$

$$[\text{Ag}^+] = \frac{[\text{Ag}(\text{NH}_3)_2^+]}{10^{7.23}[\text{NH}_3]^2}; E = .7993 - 0.05916 \log \frac{10^{7.23}[\text{NH}_3]^2}{[\text{Ag}(\text{NH}_3)_2^+]}$$

3. E° for $\text{Ag}(\text{NH}_3)_2^+ + e^- \rightleftharpoons \text{Ag}(\text{s}) + 2\text{NH}_3$ means the potential when

$[\text{NH}_3] = [\text{Ag}(\text{NH}_3)_2^+] = 1.00$. $[\text{Ag}^+] \neq 1.00$ since it is not in the E° equation.

$$E = .7993 - 0.05916 \log 10^{7.23} = 0.372$$

- E. Find K_a for CH_3COOH given $E_{CELL} = 0.445 \text{ V}$ for

$\text{Pt} | 1.00 \text{ atm } \text{H}_2, 0.0100 \text{ M } \text{CH}_3\text{COOH} || \text{SCE}$

$$1. 2\text{H}^+ + 2e^- \rightleftharpoons \text{H}_2 \quad E^\circ = 0; E = 0 - \frac{0.05916}{2} \log \frac{[\text{H}_2(\text{g})]}{[\text{H}^+]^2}$$

$$2. [\text{H}^+] \text{ is found from } K_a = [\text{H}^+][\text{CH}_3\text{COO}^-]/[\text{CH}_3\text{COOH}]$$

3. When $C_a = 0.0100 \text{ M}$, we know $0.445 = E_{RIGHT} - E_{LEFT} = 0.241 - E_{LEFT}$

$$E_{LEFT} = -.204 = 0.05916 \log [\text{H}^+]; [\text{H}^+] = 3.56 \times 10^{-4}$$

From charge balance $[\text{H}^+] = [\text{CH}_3\text{COO}^-] + [\text{OH}^-]$, $[\text{CH}_3\text{COO}^-] = 3.56 \times 10^{-4}$

From mass balance $C_a = [\text{CH}_3\text{COOH}] + [\text{CH}_3\text{COO}^-]$, $[\text{CH}_3\text{COOH}] = 0.00964$

$$K_a = [\text{H}^+][\text{CH}_3\text{COO}^-]/[\text{CH}_3\text{COOH}] = 1.31 \times 10^{-5}$$