

Final Exam Review #2 AK

$$\Delta T_f = K_f \times m \times i$$

$$\frac{\Delta T_f}{K_f \times i} = \frac{\text{moles } KX}{0.100 \text{ kg}}$$

$$\frac{-0.998}{-1.86 \times 2} = \frac{\text{moles } KX}{0.100}$$

$$0.0268 = \text{moles } KX$$

know:

$$K_f = -1.86 \text{ } ^\circ\text{C/m}$$

$$\Delta T = -0.998 \text{ } ^\circ\text{C}$$

$$i = 2$$

$$\text{molar mass } KX = \frac{2.00 \text{ g}}{0.0268 \text{ moles}} = 74.5 \text{ g/mol}$$

$$\text{mass } X = KX - K = 74.5 - 39.1 = 35.4 \text{ g/mol}$$

Therefore $X = \underline{\underline{\text{chlorine}}}$



I	1.00 atm	0
C	-x	+2x
E	1.00 - x	2x

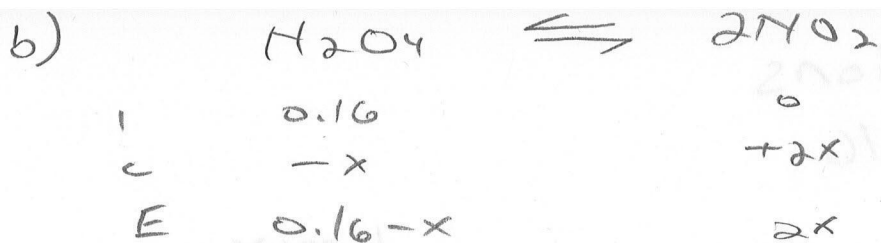
↳ if 20% converted to NO_2 , then
equilibrium $P_{\text{H}_2\text{O}_4} = 0.800 \text{ atm}$

new ICE chart:

$$\text{H}_2\text{O}_4 \rightleftharpoons 2\text{NO}_2$$

I	1.00 atm	0 atm
C	-0.200 atm	+2(0.200)
E	0.800 atm	0.400 atm

$$K_p = \frac{(\text{NO}_2)^2}{\text{H}_2\text{O}_4} = \frac{0.400^2}{0.800} = \underline{\underline{0.200}}$$



$$K_p = 0.200 = \frac{(2x)^2}{0.16 - x}$$

$$0.032 - 0.200x = 4x^2$$

$$4x^2 + 0.200x - 0.032 = 0$$

$$x = 0.0679, -0.118$$

$$\text{new } P_{\text{H}_2\text{O}_4} = 0.16 - 0.0679 = 0.0921 \text{ atm}$$

$$\text{new } P_{\text{NO}_2} = 2(0.0679) = 0.136 \text{ atm}$$

* In this case $\frac{0.0679}{0.16} \times 100\%$, or 42%.

of the original H_2O_4 has been converted to NO_2 . This makes sense, since we started with less pressure and the reaction shifts to the side with more gas moles.

3. Figure out how many moles of each species there are

- before addition of NaOH :

$$0.0873 \text{ L soln} \left(\frac{0.135 \text{ mol NH}_3}{1 \text{ L soln}} \right) = 0.0118 \text{ mol NH}_3$$

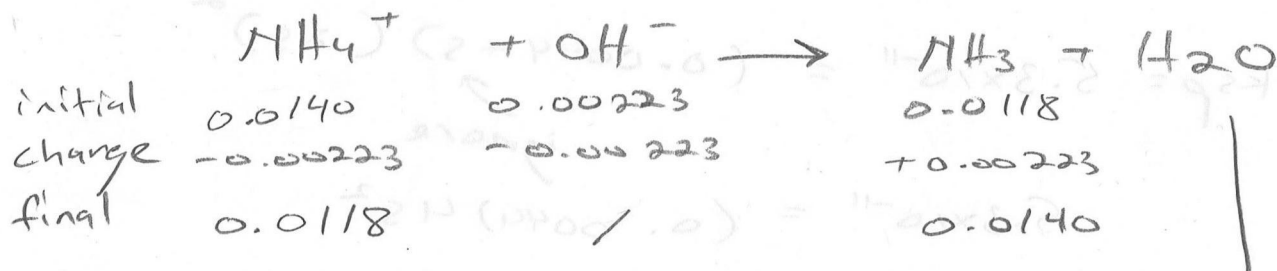
$$0.0873 \text{ L soln} \left(\frac{0.160 \text{ mol NH}_4^+}{1 \text{ L soln}} \right) = 0.0140 \text{ mol NH}_4^+$$

$$\text{pH} = \text{pK}_a + \log \frac{B}{A} = 9.25 + \log \left(\frac{0.0118}{0.0140} \right) = 9.18$$

- after adding base

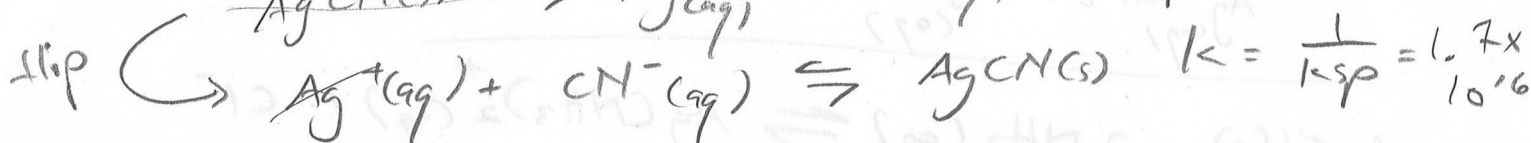
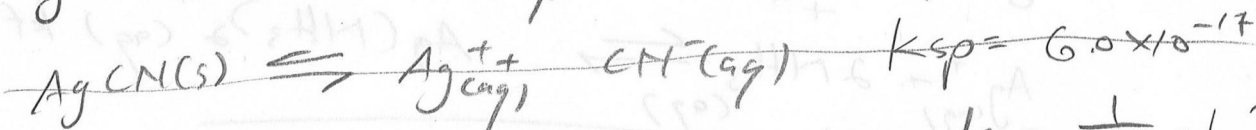
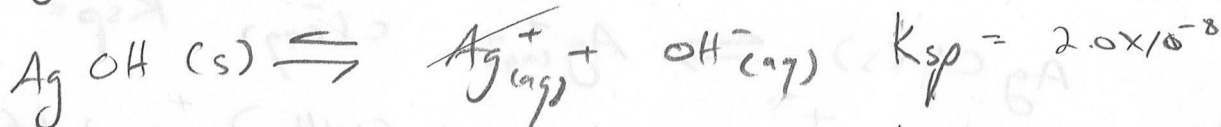
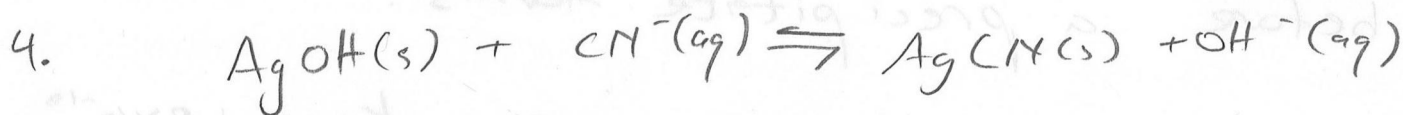
$$0.0177 \text{ L soln} \left(\frac{0.126 \text{ mol NaOH}}{1 \text{ L soln}} \right) = 0.00223 \text{ mol OH}^-$$

mole chart:

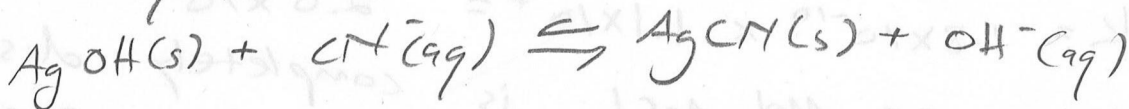


$$\text{pH} = 9.25 + \log \left(\frac{0.0140}{0.0118} \right) = 9.32$$

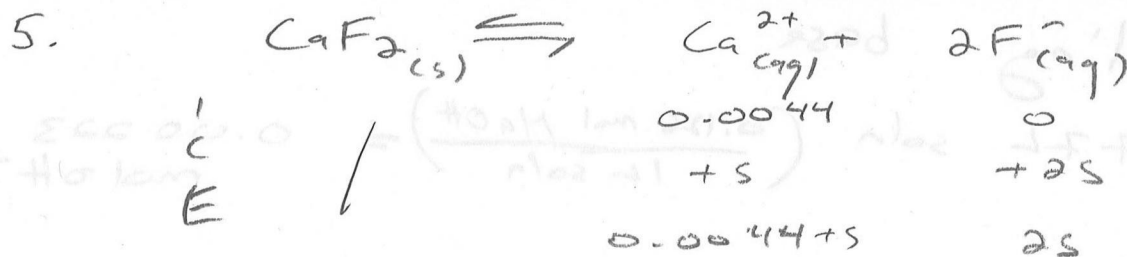
$$\ast \text{ pH change} = 9.32 - 9.18 = \underline{\underline{0.14}}$$



add two equations



$$K = (1.7 \times 10^{16})(2.0 \times 10^{-8}) = \underline{\underline{3.3 \times 10^8}}$$



$$K_{sp} = 5.3 \times 10^{-11} = (0.0044 + s)(2s)^2$$

↑
ignore

$$5.3 \times 10^{-11} = (0.0044) 4s^2$$

$$3.0 \times 10^{-9} = s^2$$

$$5.5 \times 10^{-5} = s$$

Therefore F^{-} can be $2s = \underline{\underline{1.1 \times 10^{-4} \text{ M}}}$
before a precipitate forms.

6.

$$\Delta G^\circ_{\text{rxn}} = \Delta G^\circ_{\text{products}} - \Delta G^\circ_{\text{reactants}}$$

$$= [2(\Delta G^\circ_{\text{CO}}) + \Delta G^\circ_{\text{TiCl}_3}] - \Delta G^\circ_{\text{TiO}_2}$$

$$= [2(-200.48) + (-162.53)] - (-757.23)$$

$$\Delta G^\circ = 193.74 \text{ kJ}$$

$$\Delta G^\circ = -RT \ln(K)$$

$$\frac{\Delta G^\circ}{-RT} = \ln(K)$$

$$\frac{193.74}{(0.008314)(1003\text{K})} = \ln K$$

$$e^{-23.2} = K$$

$$\underline{8.16 \times 10^{-11} = K}$$

7.

$$a) \Delta H^\circ = \Delta H^\circ_{\text{products}} - \Delta H^\circ_{\text{reactants}}$$

$$\Delta H^\circ = 0 - (2(-31.1)) = 62.2 \text{ kJ}$$

$$\Delta S^\circ = \Delta S^\circ_{\text{products}} - \Delta S^\circ_{\text{reactants}}$$

$$= (4(42.55) + 205.07) - 2(121.3) = 132.77 \text{ J/K}$$

$$\Delta G^\circ_{\text{at } 298\text{K}} = 62.2 - 298(0.1327) = 22.6 \text{ kJ}$$

b) because $\Delta G > 0$ at 298 K, then reaction is not spontaneous at these conditions. To find out above which temp the rxn becomes spontaneous:

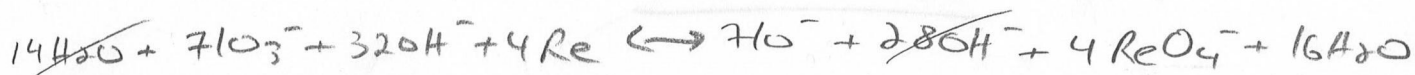
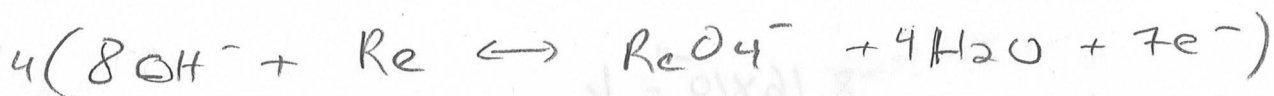
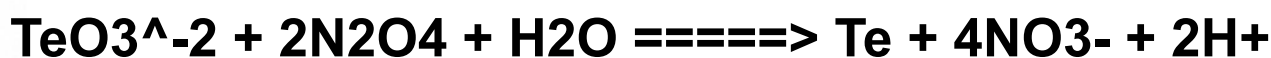
$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$

$$0 = 62.2 - T(0.1327)$$

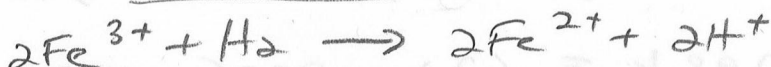
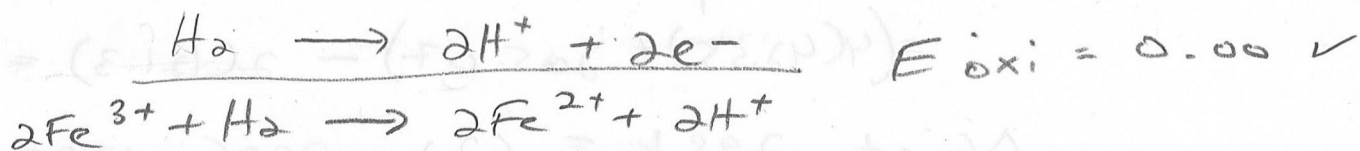
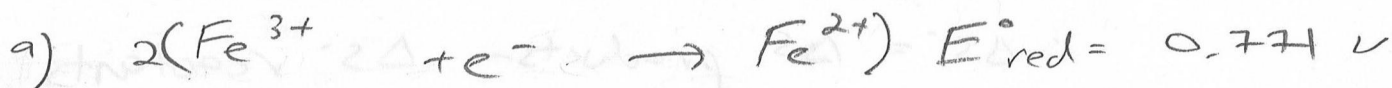
$$\frac{62.2}{0.1327} = T$$

$$\underline{469 \text{ K} = T}$$

8.



9.



$$E^\circ_{\text{cell}} = E^\circ_{\text{red}} + E^\circ_{\text{oxi}} = 0.771 + 0 = \underline{\underline{0.771 \text{ V}}}$$

b) Since H^+ is on the product side, increasing H^+ concentration (by lowering pH) will shift the reaction to the right, making it less favorable.

c) $pH = 6.50 = -\log [H^+]$

$$[H^+] = 3.2 \times 10^{-7}$$

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

$$E_{cell} = 0.771 - \frac{(8.314)(298)}{2(96485)} \ln(1.0 \times 10^{-13})$$

$$\underline{E_{cell} = 1.2V}$$

$$E^{\circ} = 0.771V$$

$$R = 8.314$$

$$T = 298K$$

$$n = 2$$

$$F = 96485$$

$$Q = \frac{[H^+]^2 [Fe^{2+}]^2}{PH_2 [Fe^{3+}]^2}$$

$$Q = \frac{(3.2 \times 10^{-7})^2 (1)^2}{(1) (1)^2}$$

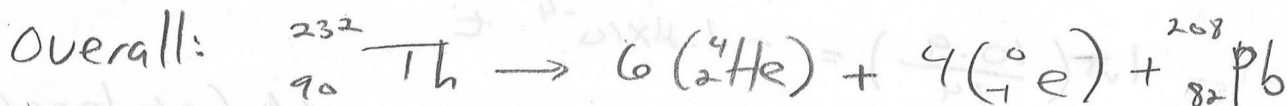
10.



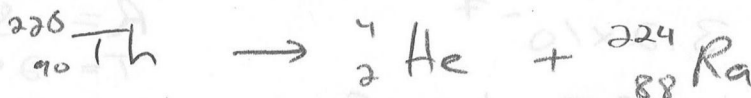
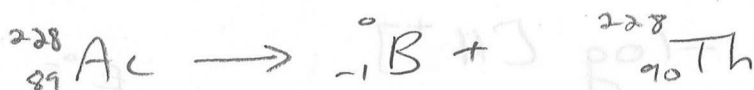
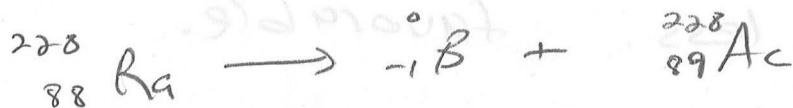
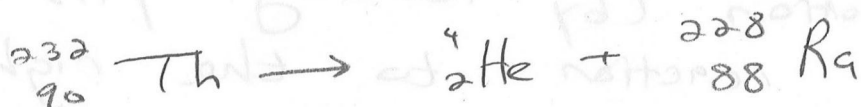
1) find how many α decays:

$$\frac{232 - 208}{4} = 6 \text{ alpha decays}$$

2) If had 6 alpha decays, in theory would have also reduced proton # by 12, so new atomic number should be 78. Since the atomic # only decreased by 8, must have also released 4 β^- particles



3) first 4 steps:



b) $t_{1/2} = \frac{0.693}{k} \quad t_{1/2} = 8.04 \text{ days}$

$$k = \frac{0.693}{8.04 \text{ days}} = 0.0862 \text{ days}^{-1}$$

$$\ln \frac{N_t}{N_0} = -kt$$

$$\ln \frac{0.57}{1} = -0.0862 t$$

$$\underline{\underline{6.52 \text{ days} = t}}$$

12. $t_{1/2} = \frac{0.693}{k} \quad t_{1/2} = 5730 \text{ years}$

$$k = \frac{0.693}{5730} = 1.21 \times 10^{-4} \text{ years}^{-1}$$

$$\ln \frac{N_t}{N_0} = -kt$$

$$\ln \left(\frac{10.9}{14} \right) = -1.21 \times 10^{-4} t$$

$t = 2070 \text{ years}$ old (at least that's the age of the wood).