

Unit 7 Review for Midterms

$$\textcircled{1} \text{ a) } K_p = \frac{(P_{CO_2})(P_{SO_2})}{(P_{SO_2}C_2)}$$

$$\text{b) } K_p = \frac{(P_{CO_2})(P_{H_2})}{(P_{CO})(P_{H_2O})}$$

$$\text{c) } K_p = \frac{(P_{CO_2})^b(P_{H_2O})^b}{(P_{O_2})^b} = \left(\frac{(P_{CO_2})(P_{H_2O})}{(P_{O_2})} \right)^b$$

\textcircled{2} least product favored

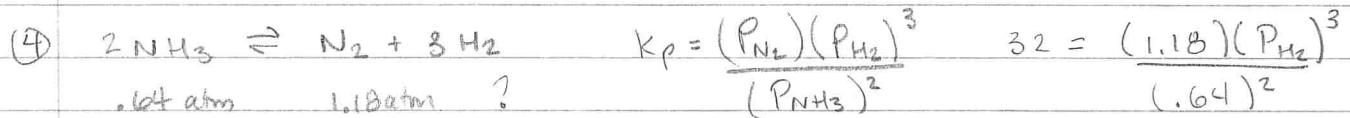
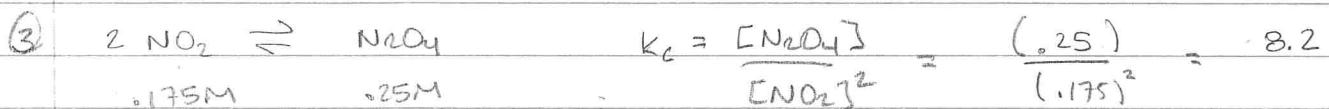
b

c

a

most product favored

d



$$P_{H_2} = 2.23 \text{ atm}$$



$$Q > K_c$$

$$\Rightarrow 1.25 = 1$$

Rxn will shift left to make more reactants



$$= (.29 \text{ atm})^3 = .024$$

$$\textcircled{8} \text{ a) } K_c = \frac{[\text{COCl}_2]}{[\text{CO}][\text{Cl}_2]}$$

large K_c indicates products are strongly favored; only very small amounts of reactants at equilb



$$\begin{array}{ccc} \text{i} & .55\text{M} & .38\text{M} \\ \text{c} & -x & -x \\ \text{e} & .55-x & .38-x \end{array}$$

$$\begin{array}{ccc} & +x & \\ & & x = .17\text{M} \\ .55-x & & .38-x \approx 0, x = .38 \\ & & .17\text{M} \end{array}$$

at equilib:

$$[\text{CO}] = .17\text{M}$$

$$[\text{Cl}_2] \approx 0$$

$$[\text{COCl}_2] = .17\text{M}$$



$$\begin{array}{ccc} \text{i} & .467\text{M} & .953\text{M} & .953\text{M} \end{array}$$

$$\begin{array}{ccc} \text{c} & +x & -x & -x \end{array}$$

$$\begin{array}{ccc} \text{e} & .467+x & .953-x & .953-x \end{array}$$

$$\frac{1.40\text{ mol}}{3.00\text{L}} = .467\text{M}$$

$$\frac{2.86\text{ mol}}{3.00\text{L}} = .953\text{M}$$

$$Q = \frac{[\text{N}_2][\text{O}_2]}{[\text{NO}]^2} = \frac{(.953)(.953)}{(.467)^2}$$

$$K_c = \frac{(.953-x)(.953-x)}{(467+x)} = 2.60 \cdot 10^{-7}$$

$$= 4.17$$

* sorry, this is a quadratic *

$Q > K_c$, rxn shift towards reactants

\textcircled{10} a) left

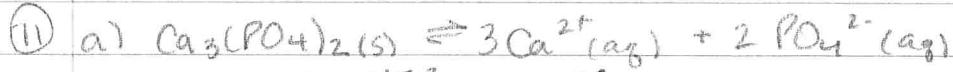
b) Right

c) left

d) left

e) left

f) no change



b) $K_{\text{sp}} = [\text{Ca}^{2+}]^3 [\text{PO}_4^{3-}]^2$



$$0 \quad 0 \quad 2.0 \cdot 10^{-29} = 108x^5$$

$$+3x \quad +2x \quad 1.9 \cdot 10^{-31} = x^5$$

$$x = 7.1 \cdot 10^{-7} \text{ mol/L}$$



$$0.0010 \text{ M} \quad 0 \quad 2.0 \cdot 10^{-29} = (0.0010)^3 (2x)^2$$

$$+3x \quad +2x \quad 2 \cdot 10^{-20} = 4x^2$$

$$0.0010 + 3x \quad 2x \quad x = 7.1 \cdot 10^{-11} \text{ M/L}$$

negligible, K_{sp} very small



a) $\xrightarrow{\quad} \frac{0.016 \text{ g}}{\text{L}} \left| \begin{array}{c} 1 \text{ mol} \\ 78.08 \text{ g} \end{array} \right. = 2.0 \cdot 10^{-4} \frac{\text{mol}}{\text{L}}$

c) $K_{\text{sp}} = [\text{Ca}^{2+}][\text{F}^-]^2$



$$x \quad 2x$$

$$2.0 \cdot 10^{-4} \text{ M} \quad 4.0 \cdot 10^{-4} \text{ M}$$

$$K_{\text{sp}} = (2.0 \cdot 10^{-4})(4.0 \cdot 10^{-4} \text{ M})^2 = 3.2 \cdot 10^{-11}$$



$$\text{new volume} = 0.10 \text{ L} + 0.40 \text{ L} = 0.50 \text{ L}$$

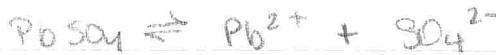
$$M_1 V_1 = M_2 V_2$$

$$(8.0 \cdot 10^{-3})(0.10) = (M_2)(0.50)$$

$$M_2 = 1.6 \cdot 10^{-3} \text{ M } \text{Pb}(\text{NO}_3)_2$$

$$(5.0 \cdot 10^{-3})(0.40) = (M_2)(0.5)$$

$$M_2 = 4.0 \cdot 10^{-3} \text{ M } \text{Na}_2\text{SO}_4$$



$$x \quad x$$

$$= 6.4 \cdot 10^{-6}$$

$Q > K_{\text{sp}}$, no precipitate forms

$$Q = [\text{Pb}^{2+}][\text{SO}_4^{2-}]$$

$$= (1.6 \cdot 10^{-3})(4.0 \cdot 10^{-3})$$



?s $K_{\text{sp}} = [\text{Ag}^+][\text{Br}^-]$

b) $\text{AgBr} \rightleftharpoons \text{Ag}^+ + \text{Br}^-$ $K_{\text{sp}} = x \cdot x = 5.0 \cdot 10^{-3} = x^2$
 $x \quad x$ $x = 7.1 \cdot 10^{-7} \text{ M}$

c) $[\text{Ag}^+]$ would be the same in a saturated soln of AgBr . The new soln is saturated because some solid AgBr in bottom that remains undissolved.

d) $\frac{5.0 \text{ g AgBr}}{188 \text{ g}} \left| \begin{array}{c} 1 \text{ mol} \\ 1 \text{ mol} \end{array} \right. = 0.027 \text{ mol AgBr} = 0.027 \text{ mol Ag}^+$

in a saturated soln, $[\text{Ag}^+] = 7.1 \cdot 10^{-7} \text{ M}$

$$\frac{0.027 \text{ mol Ag}^+}{7.1 \cdot 10^{-7} \text{ mol}} \left| \begin{array}{c} 1 \text{ L} \\ 1 \text{ L} \end{array} \right. = 3.7 \cdot 10^4 \text{ L}$$

e) $[\text{AgNO}_3] = 1.5 \cdot 10^{-4} \text{ M} = [\text{Ag}^+] \quad [\text{NaBr}] = [\text{Br}^-] = 5.0 \cdot 10^{-4} \text{ M}$
after mixing the new volume = $10.0 \text{ mL} + 2.0 \text{ mL} = 12.0 \text{ mL}$

$$M_1 V_1 = M_2 V_2$$

$$(1.5 \cdot 10^{-4})(10.0 \text{ mL}) = (M_2)(12.0 \text{ mL})$$

$$(5.0 \cdot 10^{-4})(2 \text{ mL}) = (M_2)(12.0 \text{ mL})$$

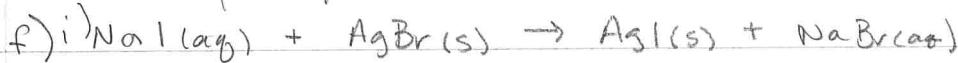
$$M_2 = 1.25 \cdot 10^{-4} \text{ M} = 1.3 \cdot 10^{-4} \text{ M Ag}^+$$

$$M_2 = 8.3 \cdot 10^{-5} \text{ M Br}^-$$

$$Q = [\text{Ag}^+][\text{Br}^-] = (1.3 \cdot 10^{-4})(8.3 \cdot 10^{-5}) = 1.0 \cdot 10^{-8}$$

$$K_{\text{sp}} < Q$$

a precipitate will form

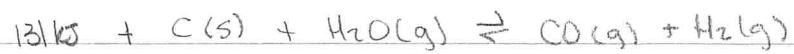


either one is acceptable

ii) AgBr has a greater value of K_{sp}

Ag^+ from dissolved AgBr reacts w/ I^- from NaI soln to form solid.

The precipitate that forms is AgI (yellow), not AgBr .



- a) adding H₂ will cause decrease in # moles CO.
more CO will react w/ added H₂ to reestablish equilibrium
- b) # moles will increase as T is increased.
Rxn will shift to produce more CO + H₂ to relieve stress of heat
- c) # moles CO will decrease when P is decreased.
Rxn will shift left to side w/ fewest gaseous moles
- d) # moles CO is unchanged. Equilibrium position is unaffected by changing the solid carbon.

* Updated #9 *

$$\frac{1.40 \text{ mol N}_2}{3.00 \text{ L}} = .467 \text{ M N}_2$$



$$1.467 \text{ M} \quad .953 \text{ M} \quad 0$$

$$C \quad -x \quad -x \quad +2x$$

$$E \quad .467-x \quad .953-x \quad 2x$$

$$K_c = \frac{[\text{NO}]^2}{[\text{N}_2][\text{O}_2]} = \frac{2.60 \cdot 10^{-7}}{(.467)(.953)} = \frac{(2x)^2}{(2x)^2}$$

$$x = 1.16 \cdot 10^{-7} \text{ M}$$

at equilibrium

$$[\text{NO}] = 2x = 2.31 \cdot 10^{-7} \text{ M}$$

$$[\text{N}_2] = .467 \text{ M}$$

$$[\text{O}_2] = .953 \text{ M}$$