

Review Section 18.1-18.5 sheet 3

1. Given the reaction: $4J + K \rightarrow 3M + N + 5D$ is endothermic.

Predict the shift in equilibrium when the following changes are imposed

- a. Addition of N a) left
- b. Decrease the amount of K b) left
- c. Increase pressure c) left
- d. Inc temperature d) right
- e. Add a catalyst e) no shift in equilibrium
- f. Write the equilibrium law for the reaction f) $K_{eq} = \frac{[M]^3 [N] [D]^5}{[J]^4 [K]}$

2. Given the reaction: $4NH_3(g) + 5O_2(g) \leftrightarrow 4NO(g) + 6H_2O(g)$ is exothermic.

Predict the shift in equilibrium when the following changes are imposed

- a. Addition of oxygen a) right
- b. Decrease the amount of $NH_3(g)$ b) left
- c. Decrease pressure c) right
- d. Dec temperature d) right
- e. Add a catalyst e) no shift in equil.
- f. Write the equilibrium law for the reaction. (f) $K_{eq} = \frac{[NO]^4 [H_2O]^6}{[NH_3]^4 [O_2]^5}$
- g. Given the following concentrations are found in a 1L solution: $[NH_3] = 0.03 \text{ mol}$
 $[O_2] = 0.11 \text{ mol}$; $[NO] = 0.25 \text{ mol}$; $[H_2O] = 0.14 \text{ mol}$
 Determine the value of K_{eq} . Does the reaction favor the products or
g) $K_{eq} = \frac{(0.25)^4 (0.14)^6}{(0.03)^4 (0.11)^5}$

3. Given the reaction: $Al_2(CO_3)_3(s) \leftrightarrow 2Al^{3+}_{(aq)} + 3CO_3^{2-}_{(aq)}$.

Predict the shift in equilibrium when the following changes are imposed

a. Addition of $Al_2(SO_4)_3$

(a) left

b. Decrease the amount of CO_3^{2-}

(b) right

c. What does the addition of a catalyst do to the activation energy?

(c) lower the AE

d. Addition of $FeS(s)$

(d) no change

e. Write the equilibrium law for the reaction.

(e) $K_{eq} = \frac{[Al^{3+}]^2 [CO_3^{2-}]^3}{[Al_2(CO_3)_3]}$

f. Write the solubility product expression, how does it differ from K_{eq}

K_{sp} only includes products (ions)

$[Al_2(CO_3)_3]$

4. Which substance is more soluble in water at 25°C.

$K_{sp} = [Al^{3+}]^2 [CO_3^{2-}]^3$

a. Aluminum hydroxide

or

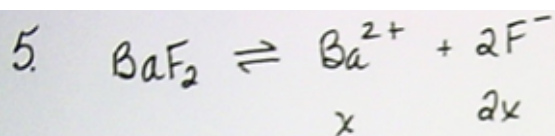
Calcium hydroxide? Why?

$K_{sp} = 3.0 \times 10^{-34}$

$K_{sp} = 6.5 \times 10^{-6}$

Because it has the larger K_{sp} .

"Larger K_{sp} favours ionization"



$$K_{sp} = [\text{Ba}^{2+}][\text{F}^-]^2$$

$$1.3 \times 10^{-6} = (x)(2x)^2$$

$$1.3 \times 10^{-6} = x(4x^2)$$

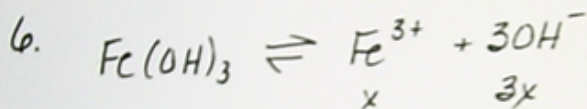
$$1.3 \times 10^{-6} = 4x^3$$

↓

$$0.0069 = x$$

$$[\text{Ba}^{2+}] = x = 0.0069 \text{ M}$$

$$[\text{F}^-] = 2x = 2(0.0069) \\ = 0.0138 \text{ M}$$



$$K_{sp} = [\text{Fe}^{3+}][\text{OH}^-]^3$$

$$4 \times 10^{-38} = (x)(3x)^3$$

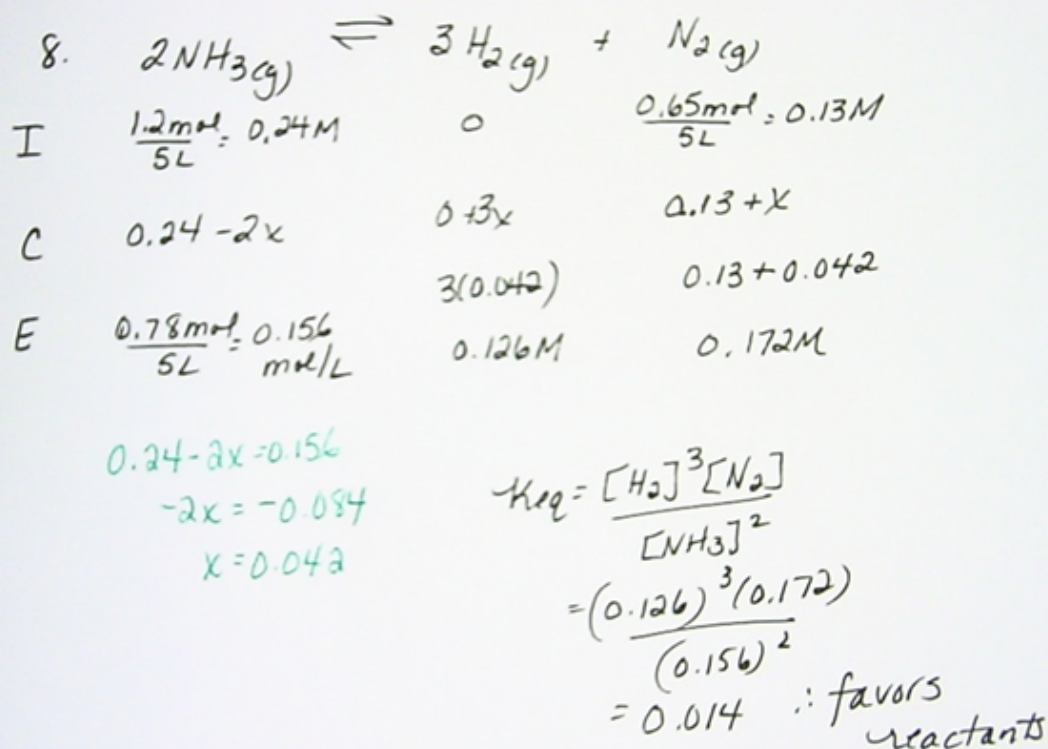
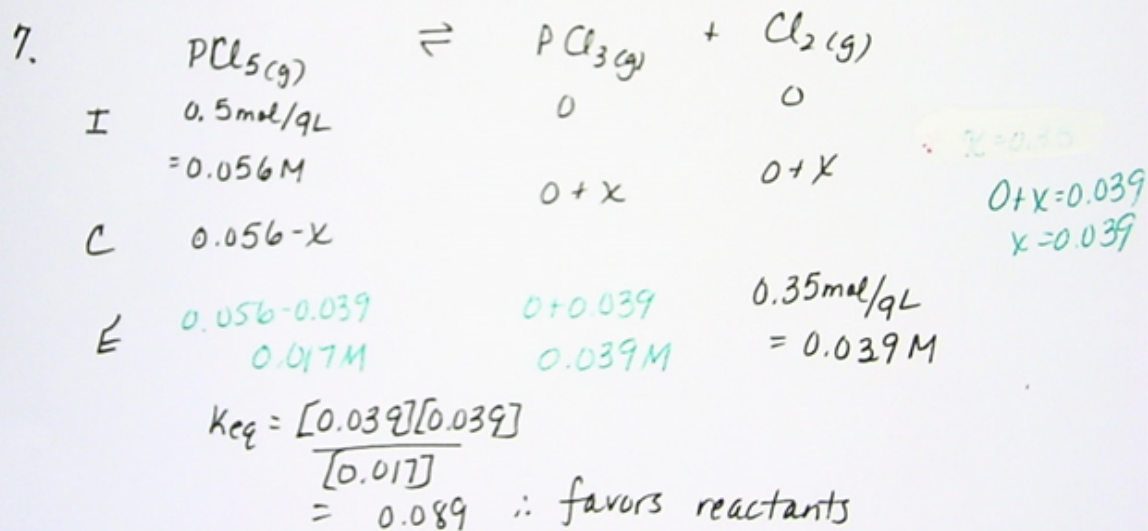
$$4 \times 10^{-38} = 27x^4$$

↓

$$1.96 \times 10^{-10} = x$$

$$[\text{Fe}^{3+}] = x = 1.96 \times 10^{-10}$$

$$[\text{OH}^-] = 3x = 5.88 \times 10^{-9}$$



9.

$\text{Cd(OH)}_2 \rightleftharpoons \text{Cd}^{2+} + 2\text{OH}^-$ $0.6\cancel{\text{L}} \times \frac{0.05\text{mol}}{\cancel{\text{L}}} = 0.03\text{mol}$	$0.03\text{mol} \quad 0.06\text{mol}$	$\text{Al}_2(\text{CO}_3)_3 \rightleftharpoons 2\text{Al}^{3+} + 3\text{CO}_3^{2-}$ $0.4\cancel{\text{L}} \times \frac{0.02\text{mol}}{\cancel{\text{L}}} = 0.008\text{mol}$	$0.016\text{mol} \quad 0.024\text{mol}$
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TOTAL Vol = 1000 mL = 1L

$$\text{CdCO}_3 \rightleftharpoons \text{Cd}^{2+} + \text{CO}_3^{2-}$$

$$K_{sp} = [\text{Cd}^{2+}][\text{CO}_3^{2-}]$$

$$5.2 \times 10^{-12} = \left(\frac{0.03\text{mol}}{1\text{L}}\right) \left(\frac{0.024\text{mol}}{1\text{L}}\right)$$

$$5.2 \times 10^{-12} < 7.2 \times 10^{-4}$$

∴ Yes

10.

$\text{BaCl}_2 \rightarrow \text{Ba}^{2+} + 2\text{Cl}^-$ $\frac{0.23\text{mol}}{\cancel{\text{L}}} \times 0.75\cancel{\text{L}} = 0.1725\text{mol}$	$0.1725\text{mol} \quad 0.345\text{mol}$	$\text{K}_2\text{SO}_4 \rightleftharpoons 2\text{K}^+ + \text{SO}_4^{2-}$ $\frac{0.25\text{mol}}{\cancel{\text{L}}} \times 0.25\cancel{\text{L}} = 0.0375\text{mol}$	$0.075\text{mol} \quad 0.0375\text{mol}$
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$$\text{Ba}_2\text{SO}_4 \rightleftharpoons 2\text{Ba}^{2+} + \text{SO}_4^{2-}$$

$$K_{sp} = [\text{Ba}^{2+}]^2 [\text{SO}_4^{2-}]$$

$$1.1 \times 10^{-10} = \left(\frac{0.1725\text{mol}}{1\text{L}}\right)^2 \left(\frac{0.0375\text{mol}}{1\text{L}}\right)$$

$$1.1 \times 10^{-10} < 0.0011 \quad \therefore \text{Yes precipitate will form}$$

11. Entropy will increase

$$12. \text{ rate} = k [K]^2 [B]^3 [C]$$

$$13. \text{ rate} = k [A]^2 [B]^4$$

Solve for k $0.03 = k (0.25)^2 (0.70)^4$

TRIAL 1 $1.999 = k$

TRIAL 2 $18.75 = k (0.25)^2 (3.5)^4$

$1.999 = k$

TRIAL 3 $0.27 = k (0.75)^2 (0.70)^4$

$1.999 = k$

only
need to
solve
1