

(#11-2)
ISE Table Mathematics

1. The following reaction is taking place and goes to equilibrium. At equilibrium the following concentrations were measured. $[A] = 0.5M$ $[B] = 0.75M$ $[C] = 0.1M$

	$A(aq) + B(aq) \leftrightarrow 2C(aq)$		
I			
S			
E	.5	.75	0.1

- a. Write out the equilibrium Expression.

$$K = \frac{[C]^2}{[A][B]}$$

- b. Complete an ISE table in the box to the right and fill in the known data.
c. Solve for Kc.

$$\frac{(0.1)^2}{(.5)(.75)} = 0.026$$

2. The following reaction in the box provided contains 0.5M of each substance. After a period of time, the concentration of A is measured to be 0.65M.

	$A(aq) + B(aq) \leftrightarrow 2C(aq)$		
I	.5	.5	.5
S	+.15	+.15	-.3
E	.65	.65	.2

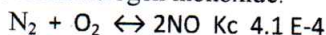
- a. In the box provided fill out the ISE table.

- b. $[B]$ at equilibrium = .65 $[C]$ at equilibrium = .2

- c. Calculate Kc for this reaction

$$\frac{(.2)^2}{.65 \cdot .65} = 0.094$$

3. Nitrogen gas is mixed with oxygen gas to form nitrogen monoxide.



In a 1L rigid tank, 0.5mol of N_2 is mixed with 0.86 mol of O_2 gas at 2000.K. The two gases react forming an equilibrium.

- a. Write out the equilibrium expression.

$$K = \frac{[NO]^2}{[N_2][O_2]}$$

- b. If this reaction were to go to completion, what is the value of "x"?

very large

- c. Based upon the size of K the value of "x" is (big, small, very small)?

	$N_2 + O_2 \leftrightarrow 2NO$		
I	.5	.86	0
S	-x	-x	+2x
E	.5-x	.86-x	2x

- d. Fill out the ISE table to the right, including "x".

$$\frac{2x^2}{.5 \cdot .86} = 4.1 \times 10^{-4}$$

$$x = 0.0066$$

- e. Long hand method:

- f. Short-cut method:

4. For the Haber process, $N_{2(g)} + 3H_{2(g)} \leftrightarrow 2NH_{3(g)}$, $K_p = 1.45E-5$ @ $500^\circ C$. In an equilibrium mixture of the three gases, the partial pressure of H_2 is 0.928 atm and that of N_2 is 0.432 atm.

a. Write the equilibrium expression for the reaction.

$$K = \frac{[NH_3]^2}{[N_2][H_2]^3} \quad K_p = \frac{P(NH_3)^2}{P(N_2)P(H_2)^3}$$

b. What is the partial pressure of NH_3 in this equilibrium mixture?

$$1.45E-5 = \frac{(x)^2}{(.432)(.928)}$$

$$x = 0.0024 \text{ atm}$$

	$N_{2(g)} + 3H_{2(g)} \leftrightarrow 2NH_{3(g)}$		
I.			
S.			
E.	0.432	0.928	x

5. The reversible reaction $CH_{4(g)} + H_2O_{(g)} \leftrightarrow CO_{(g)} + 3H_{2(g)}$ has been used as a commercial source of hydrogen. At $1500^\circ C$, an equilibrium mixture of these gases was found to have the following concentrations: $[CO] = 0.300M$, $[H_2] = 0.800M$, $[CH_4] = 0.400M$. At $1500^\circ C$ $K_c = 5.67$ for this reaction.

a. Write the equilibrium expression.

$$K_c = \frac{[H_2]^3 [CO]}{[CH_4][H_2O]}$$

b. Fill in equilibrium expression and solve for the concentration of water.

$$5.67 = \frac{(.3)(.8)^3}{(.04)x}$$

$$x = 0.67M$$

	$CH_4 + H_2O \leftrightarrow CO + 3H_2$			
I.				
S.				
E.	0.4	x	.3	0.8

6. A mixture of Hydrogen and nitrogen in a reaction vessel is allowed to attain equilibrium at $472^\circ C$. The equilibrium mixture of gases was analyzed and found to contain 0.1207M H_2 , 0.0402M N_2 , and 0.00272M NH_3 .

a. Write the K_c expression.

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

b. Determine the K_c for this reaction.

$$0.104 \Rightarrow K_c = \frac{(0.00272)^2}{(0.0402)(.1207)^3}$$

	$N_{2(g)} + 3H_{2(g)} \leftrightarrow 2NH_{3(g)}$		
I			
S			
E	.0402	.1207	.00272

7. A reaction mixture of three gases, A, B, and C are all 1.0 M at 200K. The reaction below runs for a period of time and forms an equilibrium balance where a little solid formed on the bottom. The concentration of A at equilibrium is .5M.

a. Write the equilibrium expression.

$$K_c = \frac{[C]}{[A]^2[B]}$$

b. Complete an ISE table below the equation.

c. Determine K.

$$\frac{1.25}{(.5)^2 \cdot .75} = 6.67$$

	$2A_{(g)} + B_{(g)} \leftrightarrow C_{(g)} + D_{(s)}$		
I	1	1	1
S	-.5	-.25	+.25
E	.5	.75	1.25

8. The following reaction goes to equilibrium at 500K.

Original pressure of A is .55atm and reduces to .15atm at equilibrium.

$$K_p = \frac{P(B)^2}{P(A)} = \frac{(0.8)^2}{.15} = 4.2$$

	$A_{(g)} \rightleftharpoons 2B_{(g)} + C_{(g)}$		
I	.55	0	-
S	-.4	+.8	-
E	.15	.8	-

c.) $PV = nRT$
 $m \times 0.8 = 0.019 \cdot \frac{1.25}{1} = 0.119C$