(#11-2)
ISE Table Mathematics

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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) ↔	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.

$$\frac{(.1)^2}{(.5)(.75)} = 0.026$$

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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) ↔	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

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

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

$N_2 + O_2 \leftrightarrow 2NO$ Kc 4.1 E-4

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])?

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

	N_2 +	O_2 ↔	2NO
I.	.5	.86	0
S	-x	-x	+2x
E	.5-x	.86-x	2x

~~e. Long hand m~~ethod:

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

x = 0.0066

f. Short-cut method:

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

a. Write the equilibrium expression for the reaction.

$$K = \frac{[NH_3]^2}{[N_2][H_2]^3} \quad Kp = \frac{p(NH_3)^2}{p(N_2)\,p(H_2)^3}$$

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

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

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

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

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°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°C Kc = 5.67 for this reaction.

	CH_4	$+ H_2O$	↔	CO	$+ 3H_2$
I.					
S.					
E	0.4	X		.3	0.8

a. Write the equilibrium expression.

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

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

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

$$\boxed{x = 0.67M}$$

6. A mixture of Hydrogen and nitrogen in a reaction vessel is allowed to attain equilibrium at 472°C. The equilibrium mixture of gases was analyzed and found to contain 0.1207M H_2, 0.0402M N_2, and 0.00272 MNH_3

a. Write the Kc expression.

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

b. Determine the Kc for this reaction.

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

$$0.104 \Rightarrow Kc = \frac{(.00272)^2}{(.0402)(.1207)^3}$$

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.

b. Complete an ISE table below the equation.

c. Determine K.

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

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

	$2A_{(g)}$	$+ B_{(g)}$	↔	$C_{(g)}$	$+ D_{(s)}$
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.

	A_g	$\rightleftharpoons$	$2B_g$	$+ C_{(s)}$
I	.55		0	–
S	-.4		+.8	–
E	.15		.8	–

$$Kp = \frac{p(B)^2}{p(A)} = \frac{(.8)^2}{.15} = 4.2$$

.8 1 ? .0024

1 1 , .500

c.) PV=nRT

mol B = 0.019 · $\frac{1}{2}$ · $\frac{12g}{1}$ = $\boxed{0.11gC}$