1. $[A]_I = [A] \times \frac{V_A}{V_T}$

$= 5.0 \frac{mol}{L} \times \frac{20.0mL}{60.0mL}$

$= 1.67 mol/L$

$[B]_I = [B] \times \frac{V_B}{V_T}$

$= 6 \frac{mol}{L} \times \frac{40mL}{60mL}$

$= 4.0 mol/L$

	$A_{(aq)}$ +	$B_{(aq)}$	$\rightleftharpoons$ $C_{(aq)}$
I	1.67	4	0
C	$-x$	$-x$	$+x$
E	$1.67-x$	$4-x$	x

$K_c = 4.7$

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

$4.7 = \frac{x}{(1.67-x)(4-x)}$

$4.7 = \frac{x}{6.68 - 5.67x + x^2}$

$x = 31.396 - 26.65x + 4.7x^2$

$0 = 4.7x^2 - 27.65x + 31.396$

$x = 1.5$

$[A]_{eq'm} = 0.17 mol/L$

$[B]_{eq'm} = 2.5 mol/L$

$[C]_{eq'm} = 1.5 mol/L$

2.

$$NO_{(g)} + CO_{2(g)} \rightleftharpoons NO_{2(g)} + CO_{(g)}$$

	$NO_{(g)}$	$CO_{2(g)}$	$NO_{2(g)}$	$CO_{(g)}$
I	0.5	0.2	0	0
C	$-x$	$-x$	$+x$	$+x$
E	$0.5-x$	$0.2-x$	x	x

$K_c = 40$

$$K_c = \frac{[NO_2][CO]}{[NO][CO_2]}$$

$$40 = \frac{(x)(x)}{(0.5-x)(0.2-x)}$$

$$40 = \frac{x^2}{0.1 - 0.7x + x^2}$$

$$40x^2 - 28x + 4 = x^2$$

$$0 = 39x^2 - 28x + 4$$

~~$x = 0.52$~~

$x = 0.1968$

$[NO]_{eq'm} = 0.5 - 0.2$
$= 0.3 \text{ mol/L}$

$[CO_2]_{eq'm} = 0.2 - 0.1968$
$= 0.004 \text{ mol/L}$

$[CO]_{eq'm} = [NO_2]_{eq'm} = 0.2 \text{ mol/L}$

3.

$$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$$

	$H_{2(g)}$	$I_{2(g)}$	$2HI_{(g)}$
I	0.3	0.5	0
C	$-x$	$-x$	$+2x$
E	$0.3-x$	$0.5-x$	$2x$

$K_c = 90.0$

$$K_c = \frac{[HI]^2}{[H_2][I_2]}$$

$$90 = \frac{(2x)^2}{(0.3-x)(0.5-x)}$$

$$90 = \frac{4x^2}{0.15 - 0.8x + x^2}$$

$$0 = 86x^2 - 72x + 13.5$$

$x = 0.28$

$[H_2]_{eq'm} = 0.02 \text{ mol/L}$

$[I_2]_{eq'm} = 0.22 \text{ mol/L}$

$[HI]_{eq'm} = 0.56 \text{ mol/L}$

4.

$$Cl_{2(g)} + H_{2(g)} \rightleftharpoons 2HCl_{(g)}$$

	Cl_2	H_2	HCl
I	0.5	0.6	
C	$-x$	$-x$	$+2x$
E	$0.5-x$	$0.6-x$	$2x$

$$K_c = \frac{[HCl]^2}{[Cl_2][H_2]}$$

$$0.5 = \frac{(2x)^2}{(0.5-x)(0.6-x)}$$

$$0.15 - 0.55x + 0.5x^2 = 4x^2$$

$$0 = 3.5x^2 + 0.55x - 0.15$$

$$x = 0.14$$

$[Cl_2]_{eq'm} = 0.36$ mol/L

$[H_2]_{eq'm} = 0.46$ mol/L

$[HCl]_{eq'm} = 0.28$ mol/L

5.

$$C_{(s)} + O_{2\,(g)} \rightleftharpoons CO_{2\,(g)}$$

	$C_{(s)}$	O_2	CO_2
I	/	5	0
C		$-x$	x
E		$5-x$	x

$K_c = 500$

$$K_c = \frac{[CO_2]}{[O_2]}$$

$$500 = \frac{x}{5-x}$$

$$2500 - 500x = x$$

$$2500 = 501x$$

$$x = 4.99$$

$[O_2]_{eq'm} = 0.01$ mol/L

$[CO_2]_{eq'm} = 4.99$ mol/L

6.

$$[X] = [X] \times \frac{V_X}{V_T}$$

$$= 0.30 \frac{mol}{L} \times \frac{150 mL}{400 mL}$$

$$= 0.1125 \frac{mol}{L}$$

$$[Y] = [Y] \times \frac{V_Y}{V_T}$$

$$= 0.7 \frac{mol}{L} \times \frac{250 mL}{400 mL}$$

$$= 0.438 \text{ mol/L}$$

$$[X]_{eq'm} = 0.003 \text{ mol/L}$$
$$[Y]_{eq'm} = 0.328 \text{ mol/L}$$
$$[Z]_{eq'm} = [W]_{eq'm} = 0.11 \frac{mol}{L}$$

$$x + y \rightleftharpoons Z + W$$

	x	+ y ⇌	Z	+ W
I	0.113	0.438		
			+x	+x
C	−x	−x		
E	0.113 − x	0.438 − x	x	x

$$K_c = \frac{[Z][W]}{[X][Y]}$$

$$15.2 = \frac{(x)(x)}{(0.113-x)(0.438-x)}$$

$$15.2 = \frac{x^2}{0.0495 - 0.551x + x^2}$$

$$15.2x^2 - 8.38x + 0.752 = x^2$$

$$14.2x^2 - 8.38x + 0.752 = 0$$

$$x = 0.11$$

7.

$$2H_{2(g)} + O_{2(g)} \rightleftharpoons 2H_2O_{(s)}$$

	$2H_2$	+ O_2 ⇌	$2H_2O$
I	0.3	0.2	/
C	−2x	−x	+2x
E	0.3 − 2x	0.2 − x	+2x

$$K_c = \frac{[H_2O]^2}{[H_2]^2[O_2]}$$

$$1 \times 10^{-5} = \frac{(2x)^2}{(0.3)^2(0.2)}$$

$$x = 2.12 \times 10^{-4}$$

check

$$\frac{[\ ]_I}{K_c}$$

$$\frac{0.2}{1 \times 10^{-5}} > 500$$

$\therefore 0.2 - x \approx 0.2$

$0.3 - 2x \approx 0.3$

proof

$$\frac{2x}{[H_2O]} \times 100\%$$

$$\frac{2(2.12 \times 10^{-4})}{0.3} \times 100\%$$

$0.14\% < 5\%$

$\therefore$ assump valid

$$[H_2O]_{eq'm} = 4.24 \times 10^{-4} \text{ mol/L}$$
$$[H_2] = 0.3 \text{ mol/L}$$
$$[O_2] = 0.2 \text{ mol/L}$$

8.

	$PCl_5(g)$	$\rightleftharpoons$	$PCl_3(g)$	$+ Cl_2(g)$
I	1		0	0
C	$-x$		$+x$	$+x$
E	$1-x$		$+x$	x.

$[PCl_5]_{eq'm} = 0.861 [PCl_5]_I = 1 - x$

$0.861 = 1 - x$

$x = 0.139$

$\therefore [PCl_3]_{eq'm} = [Cl_2]_{eq'm} = 0.139 \text{ mol/L}$

$K_c = \dfrac{[PCl_3][Cl_2]}{[PCl_5]}$

$= \dfrac{(0.139)(0.139)}{(0.861)}$

$\boxed{K_c = 0.022}$

9.

	$2HI(g)$	$\rightleftharpoons$	$H_2(g)$	$+ I_2(g)$
I	y		0	0
C	$-2x$		$+x$	$+x$
E	$y-2x$		x	x
	$= 2.00$.			

$K_c = \dfrac{[H_2][I_2]}{[HI]^2}$

$5 \times 10^{-4} = \dfrac{(x)(x)}{(2)^2}$

$x = 0.045$

$y - 2x = 2.00$

$y = 2 + 2x$

$= 2.00 + 2(0.045)$

$y = 2.09$

$\therefore [HI]_{Initial} = 2.09 \text{ mol}$