

WRITTEN ASSIGNMENT

$$1. K_p = \frac{P_{NO}^2}{P_{N_2} \times P_{O_2}} = \frac{0.05^2}{0.15 \times 0.33}$$

$$= 0.000505$$

$$2. Q_p = \frac{P_{Cl_3} \times P_{Cl_2}}{P_{Cl_5}} = \frac{0.223 \times 0.111}{0.177}$$

$$= 0.1398$$

Q_p is less than K_p . The system will change in a way to increase Q_p to the point that it is equal to K_p . To achieve this, PCl_2 and Cl_2 have to increase and PCl_5 have to decrease

$$3. Br_2, M = \frac{1.05 \text{ moles}}{0.98 \text{ L}} = 1.0714 \text{ M}$$

Dissociation = 1.2%

	Br ₂	Br
Initial	1.071	0
Change	-x	2x
Equilibrium	1.071 - x	2x

$$\frac{[Br]_0 - [Br_2]_{\text{equal}}}{[Br_2]_0} = 0.012$$

$$\frac{1.071 - 1.071 + x}{1.071} = 0.012$$

$$\frac{x}{1.071} = 0.012$$

$$x = 0.0129$$

$$K_c = \frac{Br^2}{Br_2} = \frac{(2x)^2}{1.071 - x}$$

$$K_c = \frac{(2 \times 0.0129)^2}{1.071 - 0.0129} = 6.3 \times 10^{-4}$$

$$4. \quad K_c' = \frac{[HS^-][H^+]}{[H_2S]} \quad K_c'' = \frac{[S^{2-}][H^+]}{[HS^-]}$$

$$K_c' \times K_c'' = \frac{[H^+]^2 [S^{2-}]}{[H_2S]} = 9.5 \times 10^{-8} \times 1.0 \times 10^{-19} \\ = 9.5 \times 10^{-27}$$

$$K = 9.5 \times 10^{-27}$$

5

	H ₂	CO ₂	H ₂ O	CO
Initial	0	0	0.03	0.03
Change	x	x	-x	-x
Equilibrium	x	x	0.03 - x	0.03 - x

$$K_c = \frac{[CO][H_2O]}{[H_2][CO_2]}$$

$$0.534 = \frac{(0.03-x)(0.03-x)}{(x)(x)}$$

$$\left(\frac{0.03-x}{x}\right)^2 = 0.534$$

$$\frac{0.03-x}{x} = 0.731$$

$$0.03 - x = 0.731x$$

$$0.03 = 1.731x$$

$$x = \frac{0.03}{1.731} = 0.0173M$$

$$\text{Number of moles} = 0.0173 \times 10$$

$$= 0.173 \text{ moles}$$

6. Concentration of HBr, $M = \frac{3.2}{12} = 0.2667M$

$$K_c = \frac{[HBr]^2}{[H_2][Br_2]}$$

	H_2	Br_2	HBr
Initial	0	0	0.2667
change	+x	+x	-2x
Equilibrium	x	x	0.2667 - 2x

$$2.18 \times 10^6 = \frac{(0.2667 - 2x)^2}{(x)(x)}$$

$$\left(\frac{0.2667 - 2x}{x} \right)^2 = 2.18 \times 10^6$$

$$\frac{0.2667 - 2x}{x} = 1476.4823$$

$$0.2667 - 2x = 1476.4823x$$

$$0.2667 = 1478.4823x$$

$$x = 1.804 \times 10^{-4}$$

Concentration

$$[H_2] = 1.804 \times 10^{-4} M$$

$$[Br_2] = 1.804 \times 10^{-4} M$$

$$[HBr] = 0.2667 - 2(1.804 \times 10^{-4}) = 0.266 M$$

7.

$$\text{Concentration, } [I_2] = \frac{0.0456}{2.3} = 0.01983 M$$

	I_2	I
Initial	0.01983	0
Change	-x	+2x
Equilibrium	0.01983 - x	2x

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

$$3.8 \times 10^{-5} = \frac{(2x)^2}{0.01983 - x}$$

$$(2x)^2 = 3.8 \times 10^{-5} (0.01983 - x)$$

$$4x^2 = 7.5354 \times 10^{-7} - 3.8 \times 10^{-5} x$$

$$4x^2 + 3.8 \times 10^{-5} x - 7.5354 \times 10^{-7} = 0$$

$$x = 4.293 \times 10^{-4}$$

Concentration.

$$[I_2] = 0.01983 - 4.293 \times 10^{-4} = 0.0194 M$$

$$[I] = 2(4.293 \times 10^{-4}) = 8.586 \times 10^{-4} M$$

8 (a) More products will be formed. The equilibrium position will shift to favour the forward reaction

(b) The equilibrium position will shift to favour the forward reaction

(c) The equilibrium position will shift to favour the reverse reaction.

9. (a) The equilibrium will shift to the right, where the number of molecules is less

(b) The equilibrium will shift to the left so that the increased I_2 can be replaced

(c) The equilibrium will shift to the right, to increase the temperature again.

10 (a) The equilibrium will shift backwards. SO_3 concentration will decrease while SO_2 and O_2 concentration will increase.

(b) The equilibrium will shift to the right when pressure is increased. SO_3 concentration will increase while SO_2 and O_2 concentration will decrease.

(c) The equilibrium will shift to the right (to decrease the concentration of SO_2). SO_3 concentration increases while SO_2 and O_2 concentration decreases.

(d) It has no effect on the position of the equilibrium and concentrations of SO_2 , O_2 , and SO_3 .

(e)

(e) It has no effect. The concentrations of SO_2 , O_2 , and SO_3 does not change.

11.

$$K_c = \frac{[\text{H}_2]^2 [\text{S}_2]}{[\text{H}_2\text{S}]^2} = 2.25 \times 10^{-4}$$

$$\frac{(1.5 \times 10^{-3})^2 [\text{S}_2]}{(4.84 \times 10^{-3})^2} = 2.25 \times 10^{-4}$$

$$[\text{S}_2] = \frac{(2.25 \times 10^{-4}) (4.84 \times 10^{-3})^2}{(1.5 \times 10^{-3})^2} = 2.34 \times 10^{-3} \quad \text{M}$$

12		NO	CO ₂	NO ₂	CO
	Initial	3.9	0.88	0	0
	change	-x	-x	+x	+x
	Equilibrium	3.9-x	0.88-x	x	x

No. of moles of CO₂

$$0.11 = 0.88 - x$$

$$x = 0.77 \text{ mol}$$

$$K_c = \frac{[\text{NO}_2][\text{CO}]}{[\text{NO}][\text{CO}_2]} = \frac{(x)(x)}{(3.9-x)(0.88-x)}$$

$$= \frac{(0.77)(0.77)}{(3.9-0.77)(0.88-0.77)} = 1.722$$

13		H ₂	I ₂	HI
	Initial	0.9	0.9	0.9
	Change	+x	+x	-2x
	Equilibrium	0.9+x	0.9+x	0.9-2x

$$K_c = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]}$$

$$54.3 = \frac{(0.9-2x)^2}{(0.9+x)(0.9+x)} = \left(\frac{0.9-2x}{0.9+x} \right)^2$$

$$7.36885 = \frac{0.9-2x}{0.9+x}$$

$$7.36885(0.9+x) = 0.9 - 2x$$

$$7.36885x + 2x = 0.9 - 6.632$$

$$9.36885x = -5.73197$$

$$x = -0.612$$

$$[H_2] = 0.9 + (-0.612) = 0.288 M$$

$$[I_2] = 0.9 + (-0.612) = 0.288 M$$

$$[HI] = 0.9 - 2(-0.612) = 2.124 M$$