CHEM 1105 **ANSWERS TO PROBLEM SET 5**

1. $3O_2(g) + 2H_2S(g) \; K \; 2H_2O(g) + 2SO_2(g)$

	$3O_2(g)$	$2H_2S(g)$	$2H_2O(g)$	$2SO_2(g)$
moles start:	0.50	0.36	0.68	0.56
change:	-0.12	-0.08	+0.08	+0.08
equilibrium:	0.38	0.28	0.76	0.64
equilibrium conc(mole/L):	$\frac{0.38}{0.50}$	$\frac{0.28}{0.50}$	$\frac{0.76}{0.50}$	$\frac{0.64}{0.50}$
=	0.76	0.56	1.52	1.28

$$K_C = \frac{[H_2O]^2[SO_2]^2}{[H_2S]^2[O_2]^3} = \frac{1.52^2 \times 1.28^2}{0.56^2 \times 0.76^3} = 27$$

2. $Fe(s) + 5CO(g) \; K \; Fe(CO)_5(g)$

	$Fe(s)$	$5CO(g)$	$Fe(CO)_5(g)$
moles start:	$\frac{0.85}{55.85}$	$\frac{1.00}{28.00}$	0
=	0.0152	0.0357	
change:	-0.0037	-0.0185	+0.0037
equilibrium:	$\frac{0.64}{55.85}$		
=	0.0115	0.0172	0.0037
equilibrium conc(mole/L)		$\frac{0.0172}{3.0}$	$\frac{0.0037}{3.0}$
=		0.0057	0.0012

$$K_C = \frac{[Fe(CO)_5]}{[CO]^5} = \frac{0.0012}{0.0057^5} = 2.0 \times 10^8$$

3. $K_C = \frac{[CO][H_2O]}{[CO_2][H_2]}$ $K_C = 0.080$ at 400˚C and 0.41 at 600˚C

Since K_C increases as temperature increases, [CO] and $[H_2O]$ must increase and $[CO_2]$ and $[H_2]$ must decrease as the temperature increases. This means that the equilibrium shifts to the RIGHT (or, the FORWARD reaction is favoured) as the temperature increases. Therefore, the FORWARD reaction is ENDOTHERMIC.

4. Since ΔH for the forward reaction is negative, the forward reaction is EXOTHERMIC.

(a) (1) If the temperature is increased, the equilibrium will shift to the LEFT, i.e. in the direction of the ENDOTHERMIC reaction to use up the heat supplied. The concentrations of SO_2 and O_2 will increase while the concentration of SO_3 will decrease.

(2) K_c will get smaller since $K_c = \dfrac{[SO_3]^2}{[SO_2]^2[O_2]}$

(b) The equilibrium will shift to the LEFT to form more SO_2. This will result in a decrease in $[SO_3]$ and an increase in $[O_2]$.

(c) No. K_c only changes if the temperature is changed.

(d) If SO_3 is added, the equilibrium will shift to the LEFT to use up part of the added SO_3 and hence the SO_2 concentration will increase.

5. Addition of CaO will remove some of the CO_2 by equilibrium (a) and hence the equilibrium (b) will shift to the LEFT to form more CO_2. This will result in a decrease in the concentration of CO.