Friday Worksheet **Name: ……..**

Chemical equilibrium worksheet 4

1) Consider the equilibrium expression on the right. All species are in the gaseous state.

$$K = \frac{[A]^2[B]^3}{[C]^5\,[D]}$$

a) Write the chemical equation for the reverse reaction.

$2A(g) + 3B(g) \rightleftharpoons 5C(g) + D(g)$

b) Write the chemical equation whose equilibrium expression is given on the right

$2A(g) + 3B(g) \rightleftharpoons 5C(g) + D(g)$	$\frac{1}{K}$
$5/2\ C(g) + \frac{1}{2}\ D(g) \rightleftharpoons A(g) + 3/2B(g)$	$K^{1/2}$
$10C(g) + 2D(g) \rightleftharpoons 4A(g) + 6B(g)$	K^2

2) Hydrogen and fluorine react according to the equation below.

$$H_2(g) + F_2(g) \Leftrightarrow 2HF(g) \quad \Delta H = -542\ kJ\ mol^{-}$$

In an experiment 0.300 mol of hydrogen and 0.440 mol of fluorine were placed in a reaction vessel of volume V litres. Once equilibrium was established there was 0.320 mol of HF present in the reaction vessel. Calculate the K_e for this reaction.

Since the number of mol of particles on both sides of the equation are the same volume is not a factor in determining the K_e.

Step 1 Find the mol of each reactant and product at equilibrium.

$n_{hydrogen} = 0.140$, $n_{fluorine} = 0.280$, $n_{HF} = 0.320$

Step 2 calculate K_e

$$K_e = (0.320)^2 / (0.140 \times 0.280) = 2.61$$

3) Nitrogen and hydrogen react to produce ammonia according to the equation below.

$$N_{2(g)} + 3H_{2(g)} \rightleftarrows 2NH_{3(g)} \quad \Delta H = +92 \text{ kJ mol}^{-}$$

An amount of 2.00 mol of ammonia was placed in a sealed vessel at a constant temperature and allowed to reach equilibrium.

a) Explain why the rate of the reaction $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$ will never be greater than the rate of the reaction $2NH_{3(g)} \rightarrow N_{2(g)} + 3H_{2(g)}$

i. as the system approaches equilibrium.

Because the rate of the reverse reaction $2NH_{3(g)} \rightarrow N_{2(g)} + 3H_{2(g)}$ is favoured as the system moves towards equilibrium. In order to reach equilibrium the reverse reaction must be faster than the forward reaction $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$

ii. once equilibrium is established.

Rates of reverse and forward reactions are equal at equilibrium.

b) Sketch, on the axes provided below, a fully labelled energy profile diagram for the decomposition reaction of NH_3. Indicate on the diagram the effect of using a catalyst in this reaction