Year 12 Chemistry
HSC ER Questions 9.5.B – Quantitative Equilibrium

Module	9.5 – Industrial Chemistry
Topic	9.5.B – Quantitative Equilibrium
Name	**Date**

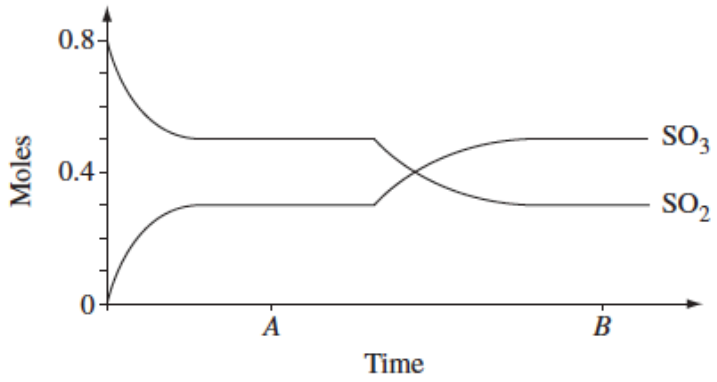
2011

(d) (i) Models are often used to help explain complex concepts. Outline a first-hand investigation that can model an equilibrium reaction. **2**

(ii) Assess the validity of the information that could be collected in this investigation. **3**

2010

(c) At room temperature 0.80 moles of SO_2 and 0.40 moles of O_2 were introduced into a sealed 10 L vessel and allowed to come to equilibrium.



(i) Write the equilibrium constant expression and calculate the value for the equilibrium constant at time *A*. **3**

(ii) Explain why a new equilibrium position was established at time *B*. **2**

2009

(b) At a particular temperature, iodine trichloride dissociates into iodine gas and chlorine gas according to the following equation:

$$2ICl_3(g) \quad I_2(g) + 3Cl_2(g) \quad \Delta H = 240 \text{ kJ}$$

Initially 0.35 mol of $ICl_3(g)$ was introduced into a 1.0 L container and allowed to come to equilibrium. At equilibrium there was 0.45 mol L^{-1} of $Cl_2(g)$.

(i) Write the equilibrium constant expression for this reaction. **1**

(ii) Calculate the value of K at this temperature. **3**

(iii) What are TWO consequences of increasing the temperature of the mixture at equilibrium? **2**

2008

(c) Consider the following mixture of gases in a closed 5.0 L vessel at 730°C.

Gas	*Quantity* (mol)
CH_4	2.00
H_2O	1.25
CO	0.75
H_2	0.75

The following reaction occurs:

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g) \qquad \Delta H = +206 \text{ kJ}$$

The equilibrium constant, K, is 0.26 at 730°C.

(i) Determine whether the system is at equilibrium. **3**

(ii) Explain how conditions in this reaction could be adjusted to increase the quantity of products. **3**

2007

(c) Hydrogen sulfide can be removed from natural gas via the following process.

$$2H_2S(g) + SO_2(g) \rightleftharpoons 3S(s) + 2H_2O(g) \qquad \Delta H = -145 \text{ kJ mol}^{-1}$$

(i) Write the equilibrium constant expression for this reaction. **1**

(ii) Calculate the equilibrium constant, when 1.00 mol of H_2S and 1.00 mol of SO_2 react in a 1.00 L vessel at 373 K to give 0.50 mol of water vapour under equilibrium conditions. **2**

(iii) Identify FOUR factors that would maximise the removal of $H_2S(g)$ in this reaction. **2**

2006

(b) Nitrogen dioxide forms an equilibrium mixture with dinitrogen tetraoxide as shown.

$$2NO_2(g) \rightleftharpoons N_2O_4(g)$$

At 100°C, K for this reaction is 2.08.

At 25°C, a 1.00 L vessel initially contained 0.132 mol of $NO_2(g)$. Once equilibrium had been established, there was 0.0400 mol of $N_2O_4(g)$ in the vessel.

(i) Explain the effects of the addition of a catalyst and an increase in pressure on the yield of N_2O_4 in this reaction when carried out at 25°C. **2**

(ii) Calculate the equilibrium constant for this reaction at 25°C, and account for any difference from the K value at 100°C. **4**