Oxford Cambridge and RSA

A level Chemistry A

H432/01 Periodic table, elements and physical chemistry

Question Set 5

1. (a) This question is about equilibrium reactions.

Hydrogen gas is manufactured by the chemical industry using the reaction of methane andsteam. This is a reversible reaction, shown in **equilibrium 20.1** below.

equilibrium 20.1 $CH_4(g) + H_2O(g) \rightleftharpoons 3H_2(g) + CO(g) \quad \Delta H = +210\,kJ\,mol^{-1}$

Explain, in terms of le Chatelier's principle, the conditions of pressure and temperaturefor a maximum yield of hydrogen from **equilibrium 20.1**, and explain why the operational conditions used by the chemical industry may be different. **[4]**

(b) (i) A chemist investigates the equilibrium reaction between sulfur dioxide, oxygen, and sulfurtrioxide, shown below.

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

- The chemist mixes together SO_2 and O_2 with a catalyst.
- The chemist compresses the gas mixture to a volume of $400\,cm^3$.
- The mixture is heated to a constant temperature and is allowed to reach equilibriumwithout changing the total gas volume.

The equilibrium mixture contains $0.0540\,mol\ SO_2$ and $0.0270\,mol\ O_2$.

At the temperature used, the numerical value for K_c is $3.045 \times 10^4\,dm^3\,mol^{-1}$.

Write the expression for K_c and the units of K_c for this equilibrium. **[2]**

(ii) Determine the amount, in mol, of SO_3 in the equilibrium mixture at this temperature.Give your final answer to an **appropriate** number of significant figures.

Show all your working.

equilibrium amount of SO_3 = ……..mol **[4]**

Total Marks for Question Set 5: 10