OCR
Oxford Cambridge and RSA

A Level Chemistry B (Salters)

H433/01 Fundamentals of chemistry

Question Set 11

1 (a) Ammonia is made by the reaction shown in **equation 31.1**.

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ $\Delta_r H = -92\,kJ\,mol^{-1}$ **Equation 31.1**

The reaction can be allowed to reach dynamic equilibrium.

Explain what is meant by **dynamic equilibrium**. **[2]**

(b) Ammonia is made by the reaction shown in **equation 31.1**.

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ $\Delta_r H = -92\,kJ\,mol^{-1}$ **Equation 31.1**

At a certain temperature, the equilibrium constant, K_c, for the reaction in **equation 31.1** is $3.0\,dm^6\,mol^{-2}$.

In an equilibrium mixture, the concentrations of nitrogen and hydrogen are as shown below.

Gas	Equilibrium concentration / mol dm^{-3}
Nitrogen	2.0
Hydrogen	1.6

Calculate the concentration of ammonia in the equilibrium mixture.

concentration of ammonia = ……..mol dm^{-3} **[3]**

(c) Ammonia is made by the reaction shown in **equation 31.1**.

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ $\Delta_r H = -92\,kJ\,mol^{-1}$ **Equation 31.1**

A chemist says the process would be more efficient if the ammonia produced is continuously liquefied and removed from the reaction vessel.

Comment on the Chemist's suggestion using ideas of equilibrium and the equilibrium constant.

[2]

(d) (i) Some of the ammonia is converted to nitric acid in the sequence of reactions shown below:

$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g)$ $\Delta_r H = -905\,kJ\,mol^{-1}$ **Equation 31.2**

$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$ $\Delta_r H = -114\,kJ\,mol^{-1}$ **Equation 31.3**

$NO_2(g) + H_2O(l) \rightarrow 2HNO_3(aq) + NO(g)$ $\Delta_r H = -117\,kJ\,mol^{-1}$ **Equation 31.**

A student considers the operating conditions for the reaction in **equation 31.2**.

The student recommends a **pressure** just greater than the pressure of the atmosphereand a **temperature** of 500 K in the presence of a platinum **catalyst**.

Comment on this choice of conditions. **[6]**

(ii) $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$ $\Delta_r H = -114\,kJ\,mol^{-1}$ **Equation 31.3**

Give the sign of ΔS_{sys} in **equation 31.3**, with a reason.

Use this to explain whether the reaction becomes more or less feasible at higher temperatures.

[3]

Total Marks for Question Set 11: 16