2002

XVIII

1583

**Time allowed
23 Minutes**

Score

/19

Percentage

%

CHEMISTRY

**Edexcel
AS & A LEVEL**

Topic Questions

Paper 1: Advanced Inorganic and Physical Chemistry

1 (a) In the catalytic converter of a car engine's exhaust system, the following reaction occurs.

$$2NO(g) + 2CO(g) \rightleftharpoons N_2(g) + 2CO_2(g) \qquad \Delta H = -745 \text{ kJ mol}^{-1}$$
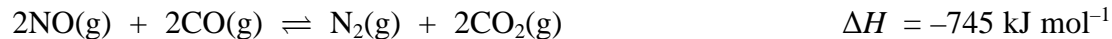
The temperature in a catalytic converter is high.

(i)   State the effect, if any, on the position of equilibrium if the temperature is lowered. Give a reason for your answer.

(2)

Effect

Reason

(ii) The gases from the engine are **not** cooled before entering the converter. Explain why this is so.

(2)

(iii) State the effect, if any, on the position of equilibrium if the pressure on the reacting gases is increased. Give a reason for your answer.

(2)

Effect

Reason

(b) Nitrogen monoxide, NO, is formed when nitrate ions, NO_3^-, in acidic solution are reduced by silver metal.

(i) Calculate the oxidation number of nitrogen in NO and in NO_3^-.

(2)

In NO

In NO_3^-

(ii) Balance the half-equation for the reduction of nitrate ions, NO_3^-, in acidic solution.

(1)

$$NO_3^- + \quad H^+ + \quad e^- \rightarrow NO + \quad H_2O$$
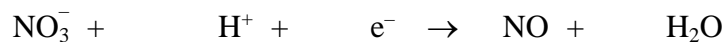
(iii) Write the half-equation for the oxidation of silver metal, Ag, to silver ions, Ag^+.

(1)

(iv) Hence deduce the full ionic equation for the reaction between silver metal and nitrate ions in acidic solution. State symbols are **not** required.

(2)

(Total for Question = 12 marks)

2 The exothermic reaction between carbon monoxide and hydrogen can be used industrially to make methanol. The process is carried out at 250 °C and between 50 and 100 atm.

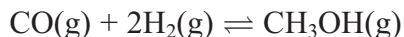$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

(a) Explain why increasing the pressure increases the yield of methanol. Give **one** disadvantage of increasing the pressure.

(2)

....

....

....

....

(b) The reaction gives a greater equilibrium yield at 100 °C than at 250 °C.

    (i)   Explain, in terms of the entropy change of the surroundings and the total entropy change of the reaction, why this is so.

        A calculation is **not** required.

(2)

....

....

....

....

    (ii) Explain why the reaction is, nevertheless, carried out at 250 °C.

(1)

....

....

(c) Given that the reaction is an equilibrium, suggest **two** ways in which the atom economy of this process could be maximised without changing the temperature or pressure.

(2)

....

....

(Total for Question   7 marks)