Name of the Student:_____
Max. Marks : 18 Marks **Time : 18 Minutes**

Q1.

A and **B** react together to form an equilibrium mixture.

$$A(aq) + 2\ B(aq) \rightleftharpoons C(aq)$$

An aqueous solution containing 0.25 mol of **A** is added to an aqueous solution containing 0.25 mol of **B**.

When equilibrium is reached, the mixture contains 0.015 mol of **C**.

(a) Calculate the amount of **A** and the amount of **B**, in moles, in the equilibrium mixture.

Amount of **A** _____ mol
Amount of **B** _____ mol

(2)

(b) At a different temperature, another equilibrium mixture contains 0.30 mol of **A**, 0.25 mol of **B** and 0.020 mol of **C** in 350 cm^3 of solution.

Calculate the value of the equilibrium constant K_c

Deduce the units of K_c

K_c _____
Units _____

(4)

When an excess of water is added to chloroethanal, an equilibrium mixture is formed.

$$ClCH_2CHO(aq) + H_2O(l) \rightleftharpoons ClCH_2CH(OH)_2(aq)$$

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An expression for an equilibrium constant (K) for the reaction under these conditions is

$$K = \frac{[ClCH_2CH(OH)_2]}{[ClCH_2CHO]}$$

(c) Suggest why an expression for K can be written without the concentration of water.

_____

_____

_____

(1)

(d) Distilled water is added to 4.71 g of chloroethanal (M_r = 78.5) to make 50.0 cm^3 of solution. The mixture is allowed to reach equilibrium.

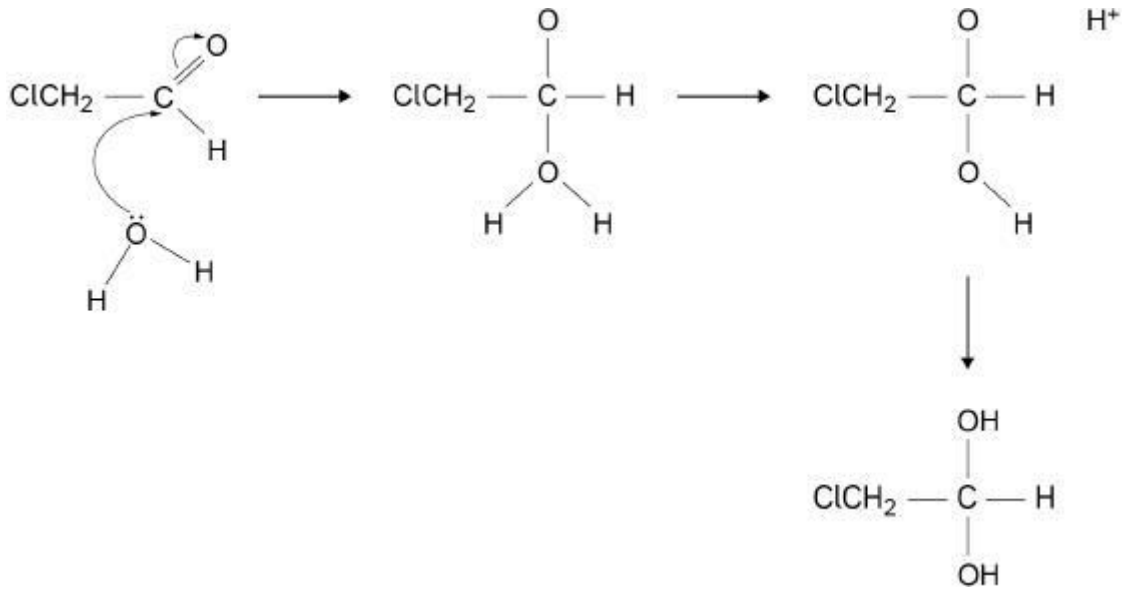
The value of the equilibrium constant (K) is 37.0

Calculate the equilibrium concentration, in mol dm^{-3}, of $ClCH_2CH(OH)_2$

Concentration _____ mol dm^{-3}

(5)

(e) The figure below shows an incomplete nucleophilic addition mechanism for the reaction of water with chloroethanal.



Complete the mechanism in the figure by adding **two** curly arrows, all relevant charges and any lone pairs of electrons involved.

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(3)

(f) When an excess of water is added to ethanal a similar nucleophilic addition reaction occurs.

$$CH_3CHO(aq) + H_2O(l) \rightleftharpoons CH_3CH(OH)_2(aq)$$

Suggest why this reaction is slower than the reaction in part (e).

_____

_____

_____

_____

_____

_____

(3)

(Total 18 marks)

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