Practice Question Set For A-Level
Subject : Chemistry
Paper-2 Topic: Chemical equilibria, Le Chatelier's principle and Kc

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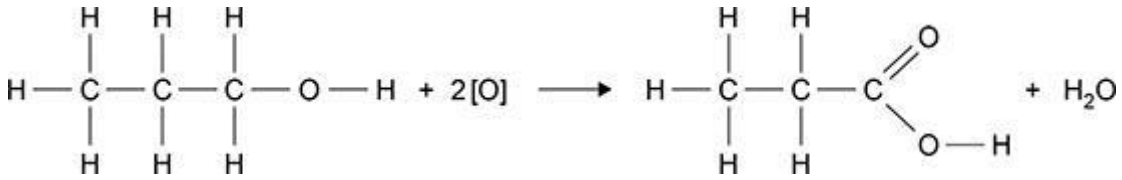
Name of the Student:_____
Max. Marks : 17 Marks **Time : 17 Minutes**

Q1.

This question is about propanoic acid (CH_3CH_2COOH).

The equation for the oxidation of propan-1-ol under reflux to form propanoic acid is shown.



(a) Acidified potassium dichromate(VI) is used as the oxidising agent.

State the colour change in this reaction.

_____

(1)

(b) A second organic product, **X**, is formed in small quantities.
The boiling point of **X** is 49 °C

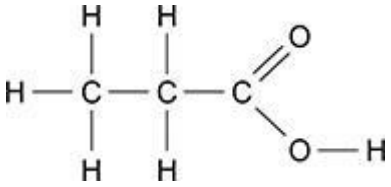
Identify **X**.

_____

(1)

(c) Propanoic acid molecules cannot be separated from the reaction mixture by simple distillation because propanoic acid forms hydrogen bonds with water molecules.

Complete the diagram to show how the propanoic acid molecule interacts with **one** water molecule through hydrogen bonding.
Include in the diagram all the partial charges and lone pairs of electrons involved in this hydrogen bond.



(3)

An alternative method of preparing propanoic acid is shown.

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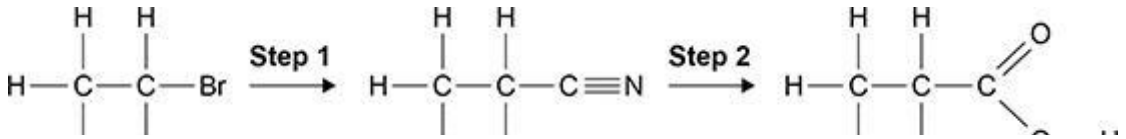

Step 1 involves the reaction of bromoethane with sodium cyanide under reflux in a suitable solvent.

(d) Name and outline the mechanism for **Step 1**.

Name of mechanism _____

Outline of mechanism

(3)

(e) Suggest one reason why water is **not** a suitable solvent for **Step 1**.

_____

_____

(1)

A third way of making propanoic acid uses the reaction between ethene, steam and carbon monoxide in the presence of a catalyst.

$$C_2H_4(g) + H_2O(g) + CO(g) \rightleftharpoons CH_3CH_2COOH(g) \qquad \Delta H = -59 \text{ kJ mol}^{-1}$$

(f) Give an expression for the equilibrium constant (K_c) for this reaction.

K_c =

(1)

(g) The table below shows the amount of each substance in an equilibrium mixture in a container of volume 1.20 dm^3 at a constant temperature.

Substance	$C_2H_4(g)$	$H_2O(g)$	$CO(g)$	$CH_3CH_2COOH(g)$
Amount of substance / mol	0.062	0.078	0.062	0.420

Calculate K_c

State the units.

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K_c _____

Units _____

(4)

(h) Predict the effect of increasing the temperature on the yield of propanoic acid.

Explain your answer.

Effect on yield _____

Explanation _____

_____

_____

_____

_____

(3)

(Total 17 marks)

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