

Name of the Student: _____

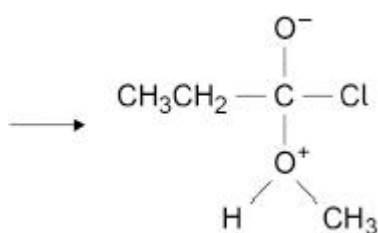
Max. Marks : 29 Marks

Time : 29 Minutes

Q1.

This question is about intermediates in reaction mechanisms.

- (a) **Figure 1** shows an intermediate formed in the first step of a nucleophilic addition–elimination mechanism.

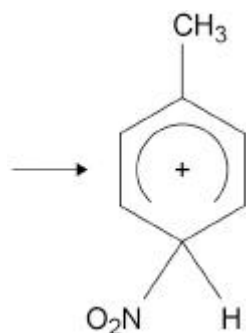
Figure 1

Complete **Figure 1** to show the structures of the two reactant species with curly arrows and relevant lone pairs of electrons involved in the formation of the intermediate.

Draw curly arrows and relevant lone pairs of electrons on the intermediate to show how the final products are formed.

(4)

- (b) **Figure 2** shows an intermediate formed in the first step of a reaction mechanism of methylbenzene.

Figure 2

Complete **Figure 2** to show the reactant species and any curly arrows involved in the formation of the intermediate.

Draw a curly arrow on the intermediate to show how the product is formed.

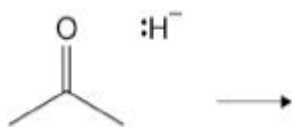
Give the name of the reaction mechanism.

Name of mechanism _____

(4)

- (c) **Figure 3** shows the reactant species involved in the first step of a mechanism.

Figure 3



Complete **Figure 3** to show the structure of the intermediate formed with curly arrows involved in its formation.

Give the name of the reaction mechanism.

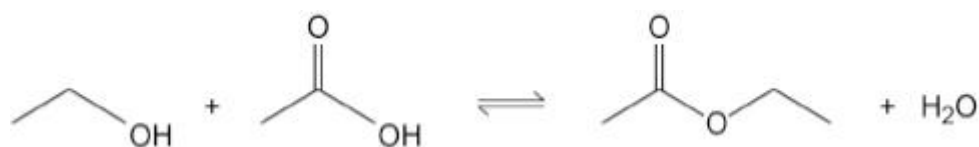
Name of mechanism _____

(4)

(Total 12 marks)

Q2.

Ethyl ethanoate can be made by reacting ethanol with ethanoic acid in the presence of concentrated sulfuric acid.



Method

1. A mixture of ethanol, ethanoic acid, and concentrated sulfuric acid, with anti-bumping granules, is heated under reflux for 10 minutes.
2. The apparatus is rearranged for distillation.
3. The mixture is heated to collect the liquid that distils between 70 and 85 °C
4. The distillate is placed in a separating funnel. Aqueous sodium carbonate is added, and a stopper is placed in the funnel. The mixture is shaken, releasing pressure as necessary.
5. The lower aqueous layer is removed and the upper organic layer is placed in a small conical flask.
6. Anhydrous calcium chloride is added to the sample in the conical flask. The flask is shaken well and left for a few minutes.
7. The liquid from the flask is redistilled and the distillate is collected between 74 and 79 °C

(a) State the role of concentrated sulfuric acid in this reaction.

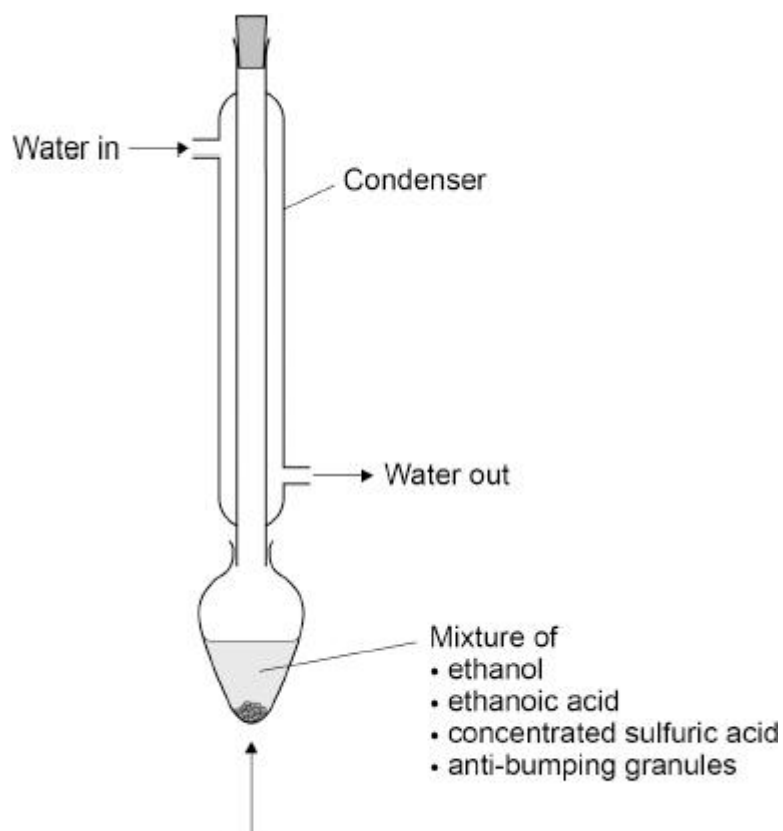
(1)

(b) The reaction mixture is flammable.

Suggest how the reaction mixture should be heated in step 1.

(1)

(c) The figure below shows how a student set up the apparatus for reflux in step 1. You should assume that the apparatus is clamped correctly.



Identify **two** mistakes the student made in setting up the apparatus.

State the problem caused by each mistake.

Mistake 1 _____

Problem caused _____

Mistake 2 _____

Problem caused _____

(4)

(d) State why sodium carbonate is added to the distillate in step 4.

Explain why there is a build-up of pressure in the separating funnel.

(2)

- (e) Give a reason why two layers form in the separating funnel.

Suggest why ethyl ethanoate forms the upper layer.

Reason _____

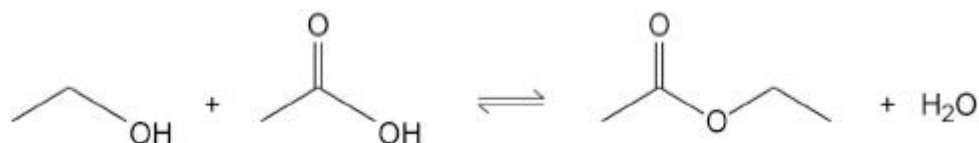
Suggestion _____

(2)

- (f) State why anhydrous calcium chloride is added in step 6.

(1)

- (g) A student uses the method to prepare some ethyl ethanoate.



The student adds 10.0 cm³ of ethanol ($M_r = 46.0$) to 5.25 g of ethanoic acid ($M_r = 60.0$) and obtains 5.47 g of ethyl ethanoate ($M_r = 88.0$).

For ethanol, density = 0.790 g cm⁻³

Determine the limiting reagent.

Calculate the percentage yield of ethyl ethanoate.

Limiting reagent _____

Percentage yield _____

(5)

(h) Suggest a reason why the percentage yield is **not** 100%.

(1)

(Total 17 marks)