Practice Question Set For A-Level
Subject : Chemistry
Paper-2 Topic: Alcohols

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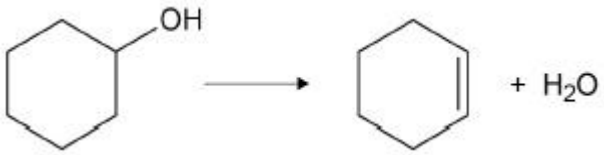
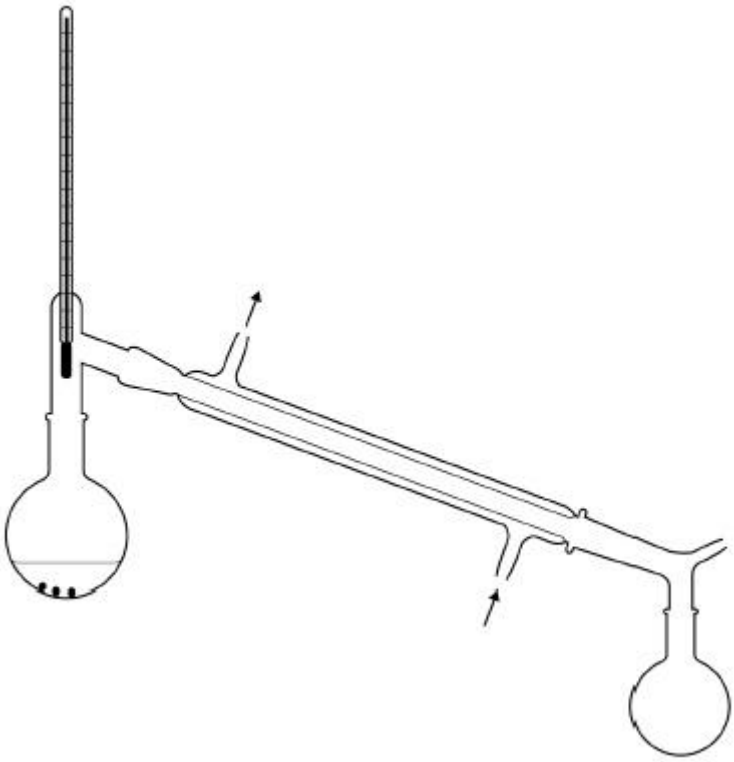
Name of the Student:_____
Max. Marks : 27 Marks **Time : 27 Minutes**

Q1.

Cyclohexene (boiling point = 83 °C) can be prepared by the dehydration of cyclohexanol (boiling point = 161 °C) using concentrated phosphoric acid.



A student prepared cyclohexene by placing 10 cm^3 of cyclohexanol (density = 0.96 g cm^{-3}) into a round-bottomed flask.
3 cm^3 of concentrated phosphoric acid were then carefully added to the flask.
The student added a few anti-bumping granules and set up the apparatus shown in the diagram.



- The student heated the mixture and collected the liquid that distilled at temperatures below 100 °C
- The distillate was poured into a separating funnel and washed by shaking with sodium carbonate solution.
- Periodically, the separating funnel was inverted and the tap opened.
- The aqueous layer was discarded and the final organic product was dried using anhydrous calcium chloride.
- After the product was dried, the drying agent was removed by filtration under reduced

pressure.

(a) The student collected 5.97 g of cyclohexene in the experiment.

Calculate the percentage yield of cyclohexene.

Percentage yield _____ %

(3)

(b) Describe a test-tube reaction, on the product, to show that the cyclohexanol had been dehydrated.

State what you would observe. _____

_____

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_____

(2)

(c) Suggest why sodium carbonate solution was used to wash the distillate.

_____

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(1)

(d) Explain why it is important to open the tap of the separating funnel periodically.

_____

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_____

(1)

(e) Give a property of anhydrous calcium chloride, other than its ability to absorb water, that makes it suitable as a drying agent in this preparation.

_____

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_____

(1)

(f) Describe the apparatus used to remove the drying agent by filtration under reduced pressure. Your description of the apparatus can be either a labelled diagram or a description in words.

(2)

(g) A sample of cyclohexene has been contaminated with cyclohexanol. The cyclohexene can be separated from the cyclohexanol by column chromatography.
Silica gel is used as the stationary phase and hexane as the mobile phase.

Explain why cyclohexene has a shorter retention time than cyclohexanol.

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(2)

(h) Explain how an infrared spectrum would confirm that the cyclohexene obtained from the chromatography column did not contain any cyclohexanol.

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(1)

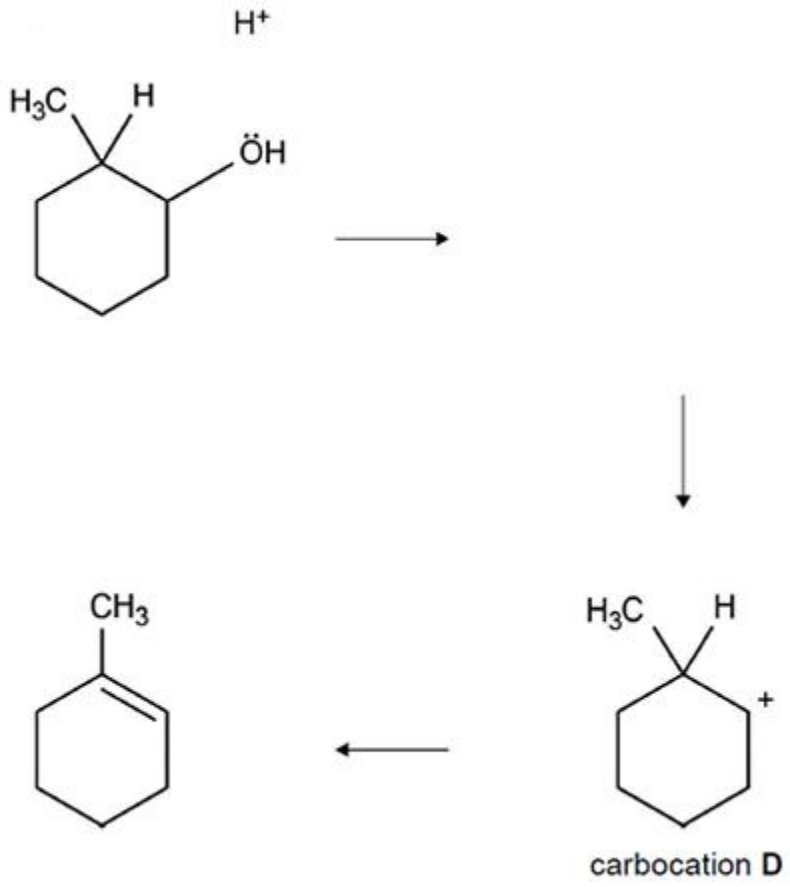
(Total 13 marks)

Q2.

Alcohols undergo dehydration in the presence of concentrated phosphoric acid, via a carbocation intermediate, to form alkenes.

(a) Complete the mechanism for the conversion of 2-methylcyclohexanol into 1-methylcyclohexene via carbocation **D** by drawing

- the structure of the missing intermediate
- all necessary curly arrows.

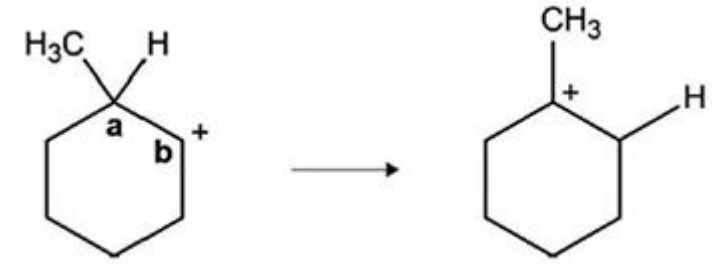


(4)

(b) Draw the structure of a different cyclic alkene formed from carbocation **D**.

(1)

(c) Carbocation **D** can undergo a type of reaction called a rearrangement to form carbocation **E**. In this reaction, a hydrogen atom and its bonding pair of electrons move from carbon **a** to carbon **b** as shown in the diagram below.



carbocation **D** carbocation **E**

Use your knowledge of carbocations to explain why this rearrangement takes place.

_____

_____

_____

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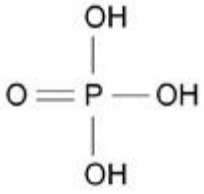
(2)

(d) As a result of the rearrangement in part (c), a third alkene is formed in this reaction.

Draw the structure of this third alkene.

(1)

(e) Cyclohexene is prepared by the dehydration of cyclohexanol using concentrated phosphoric acid as a catalyst. The structure of concentrated phosphoric acid is shown.



Identify the factors that influence the boiling points of each of the compounds in this reaction mixture. State how and explain why cyclohexene can be separated from the reaction mixture.

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(6)

(Total 14 marks)