

Name of the Student: _____

Max. Marks : 20 Marks

Time : 20 Minutes

Q1.

A student added 627 mg of hydrated sodium carbonate ($\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$) to 200 cm^3 of $0.250 \text{ mol dm}^{-3}$ hydrochloric acid in a beaker and stirred the mixture.

After the reaction was complete, the resulting solution was transferred to a volumetric flask, made up to 250 cm^3 with deionised water and mixed thoroughly.

Several 25.0 cm^3 portions of the resulting solution were titrated with $0.150 \text{ mol dm}^{-3}$ aqueous sodium hydroxide. The mean titre was 26.60 cm^3 of aqueous sodium hydroxide.

Calculate the value of x in $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$

Show your working.

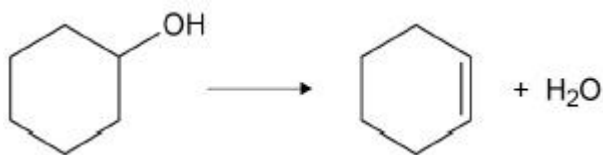
Give your answer as an integer.

Value of x _____

(Total 7 marks)

Q2.

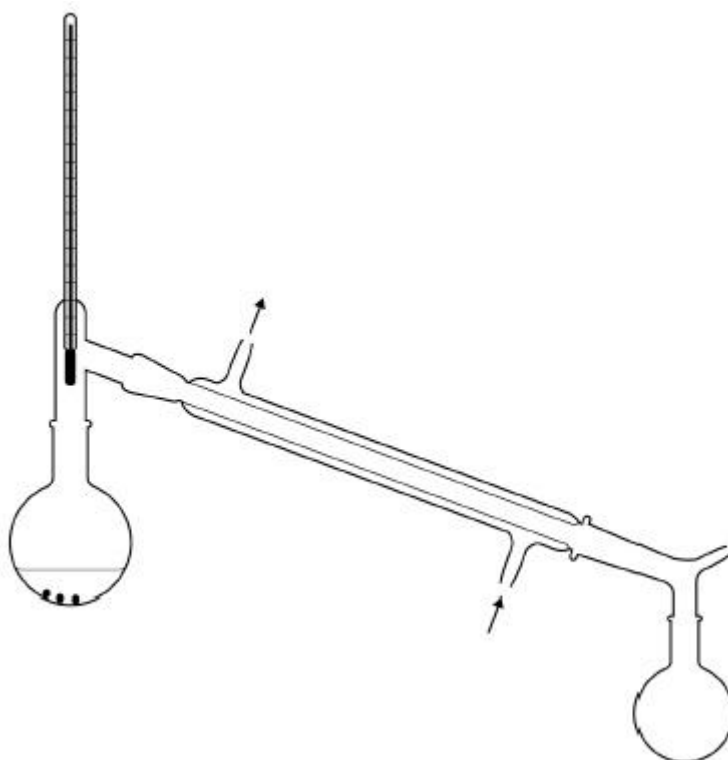
Cyclohexene (boiling point = 83 °C) can be prepared by the dehydration of cyclohexanol (boiling point = 161 °C) using concentrated phosphoric acid.



A student prepared cyclohexene by placing 10 cm³ of cyclohexanol (density = 0.96 g cm⁻³) into a round-bottomed flask.

3 cm³ 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.

(3)

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

State what you would observe. _____

(2)

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

(1)

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

(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.

(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.

(2)

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

(1)

(Total 13 marks)