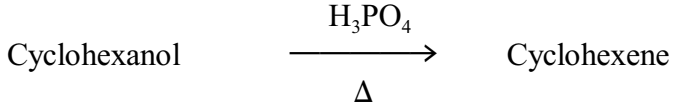
Preparation of Cyclohexene via E1: Dehydration of Cyclohexanol

Introduction

The dehydration of alcohols to give alkenes is an important transformation. The reaction is catalyzed by strong mineral acids such as sulphuric acid and phosphoric acid. The dehydration reaction will be illustrated by the conversion of cyclohexanol to cyclohexene. The choice of cyclohexanol as starting material is based on the following considerations ...

1. Because of its structure, cyclohexanol can give only one alkene upon dehydration, namely cyclohexene.
2. The rate of dehydration of cyclohexanol using phosphoric acid is conveniently fast.
3. The product is easily purified by distillation at a readily accessible temperature, 83 ^{O}C.

The reaction is :



molar mass (g mol^{-1})	100.16	82.15
Density (g cm^{-3})	0.963	0.811
b.p (^{O}C)	160	83

Once the cyclohexene has been prepared, it will be used to illustrate the chemical behaviour of an alkene towards several common reagents such as bromine and oxidizing agents.

Part A: Preparation of Cyclohexene

1.Fit a small (100 cm^3 round bottomed flask with a fractionating column and a water-cooled condenser. Arrange for the distillate to be collected in a receiver cooled in ice.

2.Mix thoroughly 12.0 g, (12.5 cm^3) cyclohexanol with 8.0 cm^3 of phosphoric acid in a 100 cm^3 round bottomed flask.

3.Add two or three boiling chips. Connect a condenser fitted with a thermometer and heat the mixture by means of an electric mantle to about 75 ^{O}C for ~ 45 minutes. This reaction produces a product which is volatile at the reaction temperature. The use of the condenser allows one to trap the product as a liquid.

4. Raise the temperature by a further 15 ^{O}C for 10 minutes and collect the distillate which comes over between 70 ^{O}C and 90 ^{O}C.

5. Collect about 15 cm^3 of the distillate and discard the residue in the waste container provided.

Part B: Test Reactions

1. Place 3 cm^3 of Br_2 in TTE into a test tube and add 1cm^3 of the distillate . Record your observation.

2. Place 2 cm^3 of the distillate in a test tube and add 1-2 cm^3 of acidified $KMnO_{4(aq)}$

3. Mix carefully 1 cm^3 of the distillate with 2 cm^3 of conc. H_2SO_4. Record any changes

Conclusion

Prepare a suitable data table summarizing your results, and write equations for all the reactions occurring.

Questions

1. Write an equation, describing the mechanism, for the conversion of cyclohexanol to cyclohexene.

2. What are the possible dehydration products from each of the following alcohols ...

3. Complete the following equations ...

4. Alcohols as a group are important in synthetic organic chemistry. Ethanol, in particular, has the additional significance of being widely consumed in alcoholic drinks. What are your views on the statement that "There is no real difference in the use of cannabis and alcoholic drinks or tobacco. The former (cannabis) is simply socially unacceptable at the present time"?