Answer all the questions below as fully as you can then check your answers below.

1. Write the mechanism and an equation to show the reaction of 1-bromobutane with a warm aqueous solution of sodium hydroxide.

2. Write the mechanism and an equation to show the reaction of 1-iodopropane With an excess of ammonia.

a. This reaction requires 2 moles of ammonia for every mole of the iodopropane, explain why.

b. Why is an excess of ammonia used in this reaction? How would the products of the reaction differ if the ammonia and the iodopropane had been used in the molar ratio of 2:1?

3. Write the mechanism and an equation to show the reaction of 1-bromobutane with an aqueous/ethanolic solution of sodium cyanide.

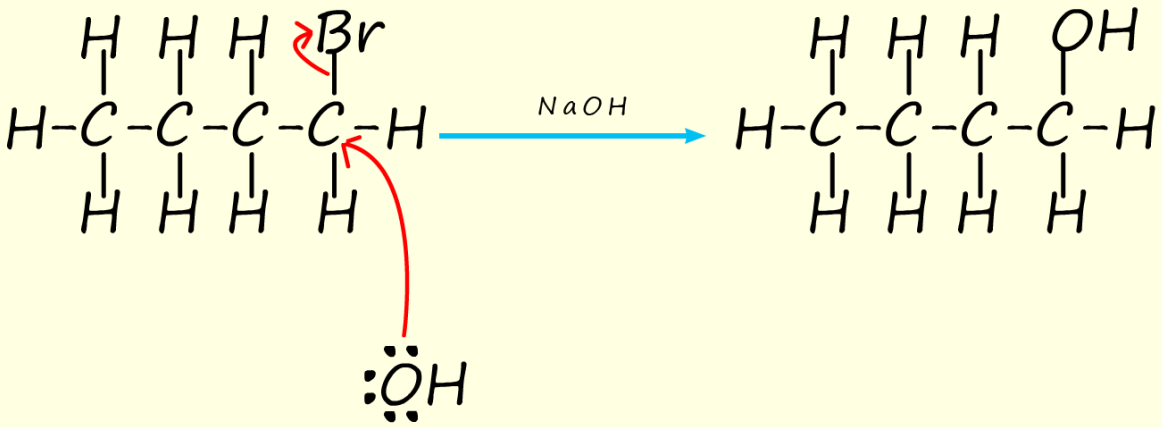
4. Write the mechanism and an equation to show the reaction of 1,3-dibromobutane with a warm aqueous solution of sodium hydroxide.

5. Explain how each of the following compounds can be made from halogenalkanes, name the starting reagents for each.

a. propan-2-ol
b. butanenitrile
c. ethylamine
d. 4-methylpentan-2-ol

Answers

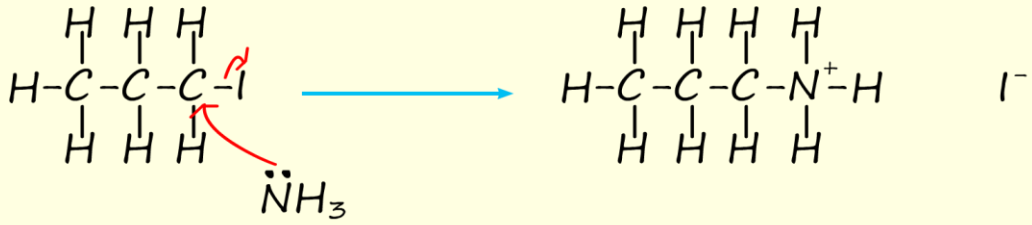
1. Write the mechanism and an equation to show the reaction of 1-bromobutane with a warm aqueous solution of sodium hydroxide.

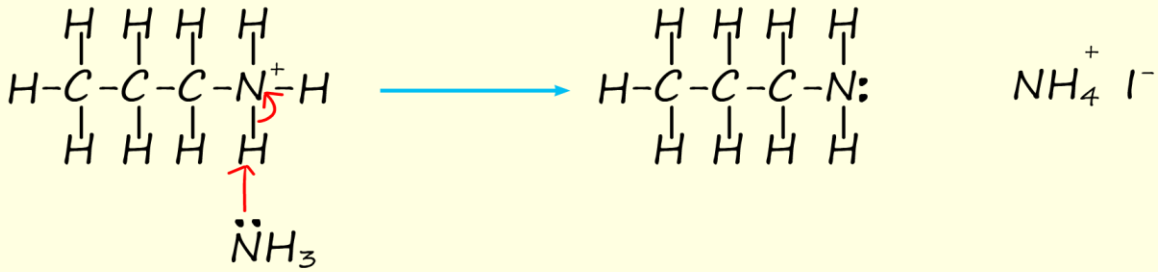


$CH_3CH_2CH_2CH_2Br + NaOH \longrightarrow CH_3CH_2CH_2CH_2OH + NaBr$

1-bromobutane + sodium hydroxide ⟶ butan-1-ol + sodium bromide

2. Write the mechanism and an equation to show the reaction of 1-iodopropane With an excess of ammonia.





$CH_3CH_2CH_2I + 2HN3 \longrightarrow CH_3CH_2CH_2NH_2 + NH4I$

1-iodopropane + ammonia ⟶ propylamine + ammonium iodide

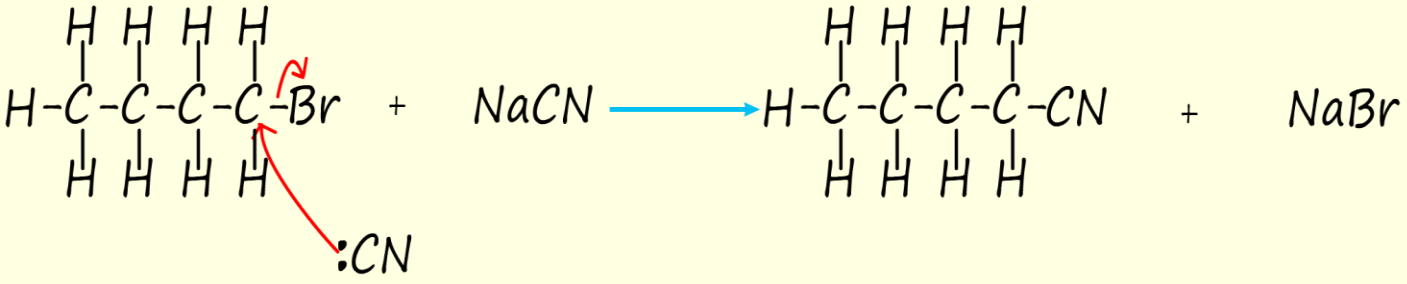
a. This reaction requires 2 moles of ammonia for every mole of the iodopropane, explain why.

1 mole of the ammonia acts as a nucleophile and replaces the iodine atom in the iodopropane, while the other mole of ammonia acts as a base and removes a proton (H^+ ion) from the intermediate ammonium ion formed.

b. Why is an excess of ammonia used in this reaction? How would the products of the reaction differ if the ammonia and the iodopropane had been used in the molar ratio of 2:1?

An excess of ammonia is used because the product of the reaction, the propylamine is a better nucleophile than ammonia, so it would replace it and take over from it in the reaction to form dipropylamine, which would then replace the propylamine and ultimately we would end up with the all the hydrogen atom on the ammonium being replaced by a propyl group. The final product would be the quaternary ammonium salt. To prevent this from happening an excess of ammonia is used, if we use say a tenfold molar excess of ammonia it is hoped that it will block other nucleophiles by sheer weight of numbers.

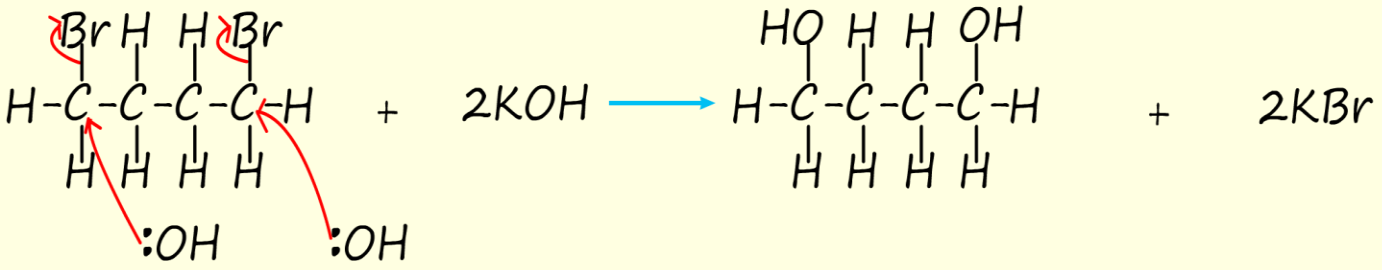
3. Write the mechanism and an equation to show the reaction of 1-bromobutane with an aqueous/ethanolic solution of sodium cyanide.



$CH_3CH_2CH_2CH_2Br$ + NaCN ⟶ $CH_3CH_2CH_2CH_2CN$ + NaBr

1-bromobutane + sodium cyanide ⟶ pentanenitrile + sodium bromide

4. Write the mechanism and an equation to show the reaction of 1,3-dibromobutane with a warm aqueous solution of sodium hydroxide.



$CH_2BrCH_2CH_2CH_2Br$ + 2KOH ⟶ $CH_2(OH)CH_2CH_2CH_2OH$ + 2KBr

1,4-dibromobutane + potassium hydroxide ⟶ butane-1,4-diol + potassium bromide

5. Explain how each of the following compounds can be made from halogenalkanes, name the starting reagents for each.

a. propan-2-ol

2-bromopropane or 2-iodopropane and warm aqueous sodium hydroxide solution

b. butanenitrile

1-bromopropane or 1-iodopropane and warm aqueous/alcoholic solution of potassium or sodium cyanide.

c. ethylamine

bromoethane or iodoethane and an excess of ammonia in a sealed container.

d. 4-methylpentan-2-ol

2-bromo-4-methylpentane and warm aqueous sodium hydroxide solution