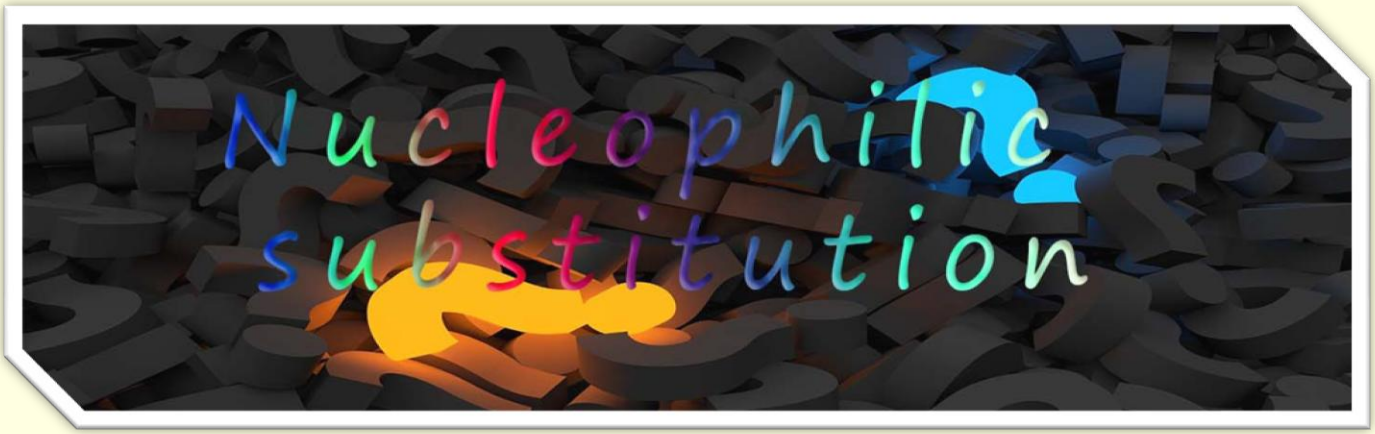


Answer all the questions below as fully as you can then check your answers

1. What is a Nucleophile? What feature will all nucleophiles have?

b. Gives some examples of nucleophiles.

2. Draw the displayed formula for the following compounds and label them as primary, secondary or tertiary halogenalkanes:

a. 2-bromopropane b. 1-chlorobutane c. 2-bromo-2-methylbutane

3. What is meant by the term nucleophilic substitution?

4. 1-chlorobutane was warmed with a aqueous solution of sodium hydroxide. The products of this reaction were an alcohol and sodium bromide.

a. Draw the displayed formula of 1-chlorobutane.

b. Is 1-chlorobutane a primary, secondary or tertiary halogenalkanes? Explain your choice.

c. What type of nucleophilic substitution react ion will 1-chlorobutane undergo? Give a reason for your answer.

d. Draw the mechanism to show how this nucleophilic substitution reaction takes place.

5. What is the difference between a S_N1 and S_N2 nucleophilic substitution reaction?

a. Explain why primary halogenalkanes undergo S_N2 reactions whereas tertiary halogenalkanes undergo S_N1 reactions

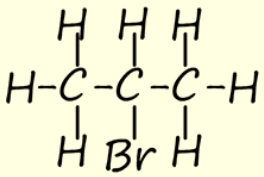
Answers

1. What is a Nucleophile? What feature will all nucleophiles have?
   Nucleophiles are electron rich species, they all contain lone pairs of electrons which they can use to form bonds with. They will form bonds with electron poor species, or electrophiles.

b. Gives some examples of nucleophiles.
   Ammonia NH_3, hydroxide OH^-, cyanide CN^-, chloride Cl^-

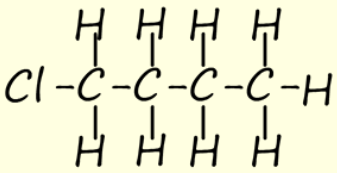
2. Draw the displayed formula for the following compounds and label them as primary, secondary or tertiary halogenalkanes:

a. 2-bromopropane



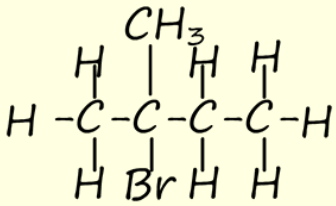
2-bromopropane
secondary halogenalkane

b. 1-chlorobutane



1-chlorobutane
primary halogenalkane

c. 2-bromo-2-methylbutane

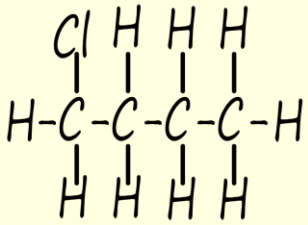


2-bromo-2methylbutane
tertiary halogenalkane

3. What is meant by the term nucleophilic substitution?
   Nucleophilic substitution reactions are where an electron rich nucleophile attacks a positively charged electrophile or electron poor site to replace a leaving group

4. 1-chlorobutane was warmed with a aqueous solution of sodium hydroxide. The products of this reaction were an alcohol and sodium bromide.

a. Draw the displayed formula of 1-chlorobutane.



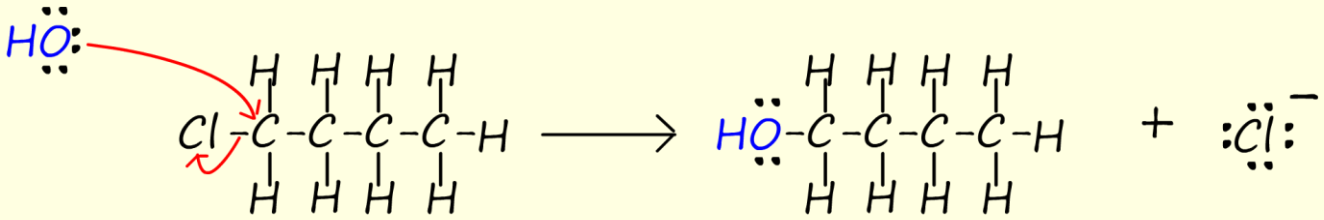
b. Is 1-chlorobutane a primary, secondary or tertiary halogenalkanes? Explain your choice.

Primary halogenalkanes, the carbon atom bonded to the chlorine atom is also bonded to two hydrogen atoms and one alkyl group, in this case a propyl group C_3H_7.

c. What type of nucleophilic substitution reaction will 1-chlorobutane undergo? Give a reason for your answer.

S_N2, primary halogenalkanes readily undergo S_N2 nucleophilic substitution because the incoming nucleophile has free access to the δ+ carbon atom in the C-Cl bond, it is not hindered or blocked.

d. Draw the mechanism to show how this nucleophilic substitution reaction takes place.



1-chlorobutane butanol chloride ion

5. What is the difference between a S_N1 and S_N2 nucleophilic substitution reaction?

The rate of SN2 reactions depend on the concentration of both the halogenalkanes and the nucleophile. They occur in a single step via a transition state.

SN1 reaction rates depend only on the concentration of the halogenalkanes and not the nucleophile. They occur by two steps, one slow step which is the dissociation of the tertiary halogenalkanes to form a tertiary carbocation and a fast step which is the attack of the nucleophile on the carbocation.

a. Explain why primary halogenalkanes undergo S_N2 reactions whereas tertiary halogenalkanes undergo S_N1 reactions

In a primary halogenalkanes the δ+ carbon atom in the C-X bond is mostly unhindered and is available for the nucleophile to attack at an angle of 180° attack.

In a tertiary halogenalkanes the three alkyl groups around the δ+ carbon atom block the 180°approach of the nucleophile, which is necessary for a SN2 reaction