

HALOALKANES

SECTION A

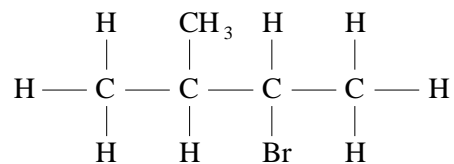
1. The table below gives some of the names and structures of isomers having the molecular formula C_4H_9Br

Structure	Name
$CH_3CH_2CH_2CH_2Br$	
$\begin{array}{c} CH_3 \\ \\ H_3C - C - CH_3 \\ \\ Br \end{array}$	2-bromo-2-methylpropane
	1-bromo-2-methylpropane
$\begin{array}{c} CH_3CH_2 - CH - CH_3 \\ \\ Br \end{array}$	2-bromobutane

Complete the table.

(Total 2 marks)

2. There are eight structural isomers with the molecular formula $C_5H_{11}Br$. Four of these are classed as primary, three as secondary and one as tertiary. The graphical formula of one of the secondary compounds, isomer A, is shown below.



isomer A

- (i) Give the name of isomer A.

.....

(2)

- (ii) Explain what is meant by the term *structural isomers*.

.....

- (iii) Draw the graphical formula of the tertiary compound with molecular formula $C_5H_{11}Br$, isomer **B**.

isomer **B**

(1)
(Total 5 marks)

3. (a) Bromomethane, CH_3Br , can be formed by a reaction between bromine and methane.

The mechanism for this reaction is similar to the mechanism for the chlorination of methane.

- (i) Name the mechanism for this reaction.

.....

- (ii) Give the name of, and state an essential condition for, the first step in the mechanism for this reaction.

Name

Essential condition

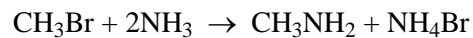
- (iii) Write an equation for a termination step in the mechanism for this reaction which gives ethane as a product.

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- (iv) Bromomethane can undergo further substitution. Write an overall equation for the reaction between bromomethane and bromine in which dibromomethane is formed.

.....
(5)

(b) Bromomethane reacts with the nucleophile ammonia according to the following equation.



(i) Explain what is meant by the term *nucleophile*.

.....
.....

(ii) Name the organic product of this reaction.

.....

(iii) Outline a mechanism for this reaction.

(6)
(Total 11 marks)

4. (a) Compound **A** ($M_r = 215.8$) contains 22.24% carbon, 3.71% hydrogen and 74.05% bromine by mass. Show that the molecular formula of **A** is $\text{C}_4\text{H}_8\text{Br}_2$.

(3)

- (b) There are nine structural isomers of molecular formula $C_4H_8Br_2$, three of which have branched carbon chains. Give the names and draw the graphical formulae for **any two** of the branched chain isomers of $C_4H_8Br_2$.

Name of isomer 1

Graphical formula of isomer 1

Name of isomer 2

Graphical formula of isomer 2

(4)

- (c) 2-bromopropane, $CH_3CH(Br)CH_3$, will react with KOH to form two different products. One product is formed by an elimination reaction, while the other is formed by a substitution reaction. For each type of reaction, suggest the condition(s) most likely to lead to that type of reaction and draw the structure of the organic product.

- (i) Elimination reaction

Condition(s)

Structure of the product

(2)

- (ii) Substitution reaction

Condition(s)

Structure of the product

(2)

(d) For the reaction between 2-bromopropane and potassium cyanide:

(i) give the name or formula of the attacking species involved;

.....

(1)

(ii) give the name of the mechanism involved;

.....

(1)

(iii) write an equation for the reaction;

.....

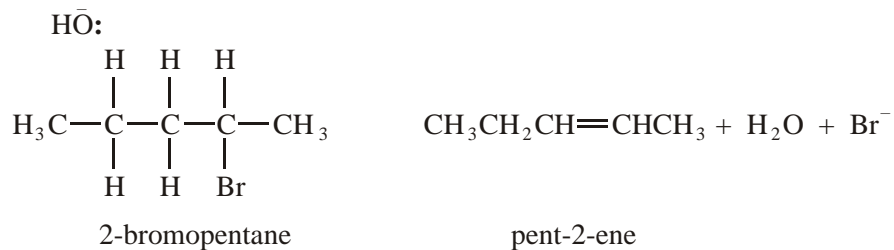
(1)

(iv) draw the graphical structure of the organic product.

(1)

(Total 15 marks)

5. Complete the mechanism below by drawing appropriate curly arrows.



(3)

(Total 3 marks)

SECTION B

6. (a) Give the systematic chemical name of CCl_2F_2 . (1)
- (b) Draw the shape of the CCl_2F_2 molecule. Explain this shape in terms of the electron pair repulsion theory and suggest why the shape of the CCl_2F_2 molecule is non-regular. (3)
- (c) Suggest why, in the reaction represented by equation (5), a chlorine atom is lost rather than a fluorine atom. (1)
- (Total 5 marks)**

7. Bromination of 2-methylbutane gives a mixture of four monosubstituted isomers, one of which is 2-bromo-2-methylbutane.
- (a) Give the structures and names of the other three isomers. (6)
- (b) Suggest why the mass spectrum of 2-bromo-2-methylbutane has two almost equally intense molecular ion peaks at $m/z = 150$ and $m/z = 152$. (3)
- (Total 9 marks)**
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