Halogenoalkanes

Question Paper 4

Level	International A Level
Subject	Chemistry
Exam Board	CIE
Topic	Halogen Derivatives
Sub-Topic	Halogenoalkanes
Paper Type	Theory
Booklet	Question Paper 4

Time Allowed: **34 minutes**

Score: **/28**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	777.5%	70%	62.5%	57.5%	45%	<45%

1 Commercial paint and varnish removers contain a mixture of dichloromethane, CH_2Cl_2, and methanol, CH_3OH.

(a) What would be observed when the following reactions are carried out?
In each case, give the name or formula of the reaction product which is responsible for the observation you have made.

(i) CH_2Cl_2 is reacted with NaOH(aq) and $AgNO_3$(aq) and the mixture left to stand.

observation .....

product responsible .....

(ii) CH_3OH is mixed with PCl_5.

observation .....

product responsible .....

(iii) CH_3OH is reacted with sodium.

observation .....

product responsible .....

[6]

(b) When CH_2Cl_2 is heated under reflux with an excess of NaOH(aq), a compound **W** is formed.

W has the following composition by mass: C, 40.0%; H, 6.7%; O, 53.3%.

Use this information and the *Data Booklet* to show that the empirical formula of **W** is CH_2O.

[2]

(c) Compounds with the empirical formula CH_2O can have the molecular formula $C_2H_4O_2$.

Two possible structural formulae for compounds with molecular formula $C_2H_4O_2$ are HCO_2CH_3 and $H_2C{=}C(OH)_2$.

In the boxes below, draw displayed formulae for **three further** structural isomers with the molecular formula $C_2H_4O_2$.

Do **not** attempt to draw any structures containing rings or O–O bonds.

X	**Y**	**Z**

[3]

(d) Identify which of your compounds, **X**, **Y**, or **Z**, will react with the following reagents.

In **each** case, state what you would observe.

(i) solid $NaHCO_3$

compound .....

observation .....

(ii) Tollens' reagent

compound .....

observation .....

[4]

(e) **One** of the three compounds, **X**, **Y**, or **Z**, shows stereoisomerism.

Draw displayed, labelled structures of the stereoisomers of this compound.

[2]

[Total: 17]

2 Many organic reactions are substitution reactions in which the number of carbon atoms in the organic compound is unchanged.

(a) What is meant by the term *substitution reaction*?

.....

.....[1]

(b) One example of a substitution reaction is the formation of an alcohol from a halogenoalkane.

(i) Write a balanced equation for the formation of ethanol from bromoethane.

.....

(ii) State the conditions for this reaction.

.....[2]

(c) In a few organic reactions, the product contains **one** more carbon atom than the starting material.

(i) Write the equation for a reaction in which the organic compound bromoethane, which contains **two** carbon atoms, is converted into an organic compound which contains **three** carbon atoms.

.....

(ii) State the conditions for this reaction.

.....[2]

(d) Ethanol may be converted into propanoic acid in a three-stage process which uses ethanol as the only organic compound.

$$C_2H_5OH \xrightarrow{\text{step I}} \mathbf{K} \xrightarrow{\text{step II}} \mathbf{L} \xrightarrow{\text{step III}} C_2H_5CO_2H$$

(i) Give the structural formulae of the intermediate compounds **K** and **L**.

K .....

L .....

(ii) State the reagent(s) used and give the essential condition(s) for step I and for step III.

step I

reagent(s) .....

condition(s) .....

step III

reagent(s) .....

condition(s).....

[6]

[Total: 11]