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Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 2 Chemistry 2023

91165 Demonstrate understanding of the properties of selected organic compounds

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of the properties of selected organic compounds.	Demonstrate in-depth understanding of the properties of selected organic compounds.	Demonstrate comprehensive understanding of the properties of selected organic compounds.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

A periodic table and other reference material are provided in the Resource Booklet L2–CHEMR.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (DO NOT WRITE IN THIS AREA / DO NOT WRITE). This area will be cut off when the booklet is marked.

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QUESTION ONE

(a) An assortment of organic compounds is listed in the table below.

(i) Complete the table below by drawing the structure or giving the IUPAC (systematic) name.

Compound	Structure	IUPAC (systematic) name
A	$H_3C-CH_2-CH_2-CH_2-\overset{\overset{Cl}{\vert}}{C}H_2$	
B		methanoic acid
C	$H_3C-CH_2-\overset{\overset{NH_2}{\vert}}{C}H-CH_3$	
D		propan-1-ol

(ii) **Compounds A–D** are all liquids at room temperature.

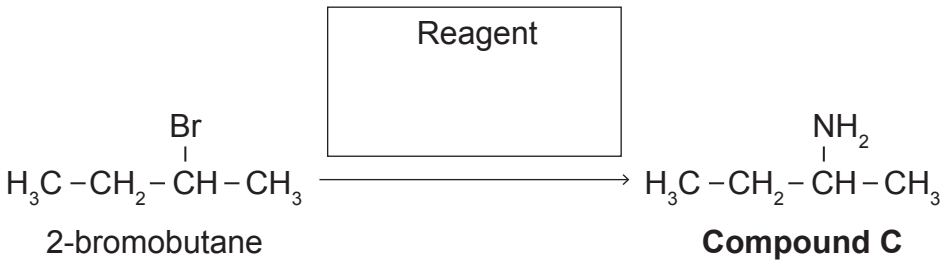
Devise a procedure to distinguish between **Compounds A–D** using only red litmus paper and aqueous acidified potassium permanganate, $KMnO_4/H^+$ (*aq*).

In your answer you should:

- state any observations
- link your observations to the chemical or physical properties of the organic molecule
- give the structural formula of the organic product of any chemical reaction(s) that occur.

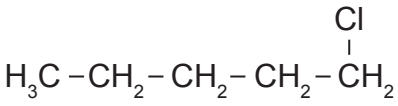
(b) **Compound C**, from the table opposite, can be formed by reacting 2-bromobutane with a reagent.

(i) Write the name or chemical formula of the reagent required for this conversion, in the box below.



(ii) Identify the type of reaction that is occurring in the conversion of 2-bromobutane to **Compound C**, and justify your choice.

(c) **Compound A** forms two different products when reacted with potassium hydroxide, KOH, depending on the conditions used.



Compound A

(i) Compare and contrast the reactions of **Compound A** with KOH.

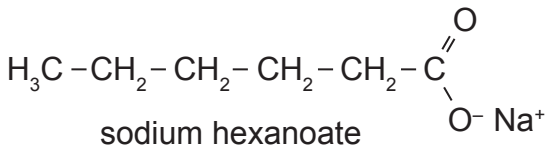
In your answer you should:

- give the conditions required for each reaction
- state the type of reaction occurring for each reaction
- give structural formulae for the organic products of each reaction.

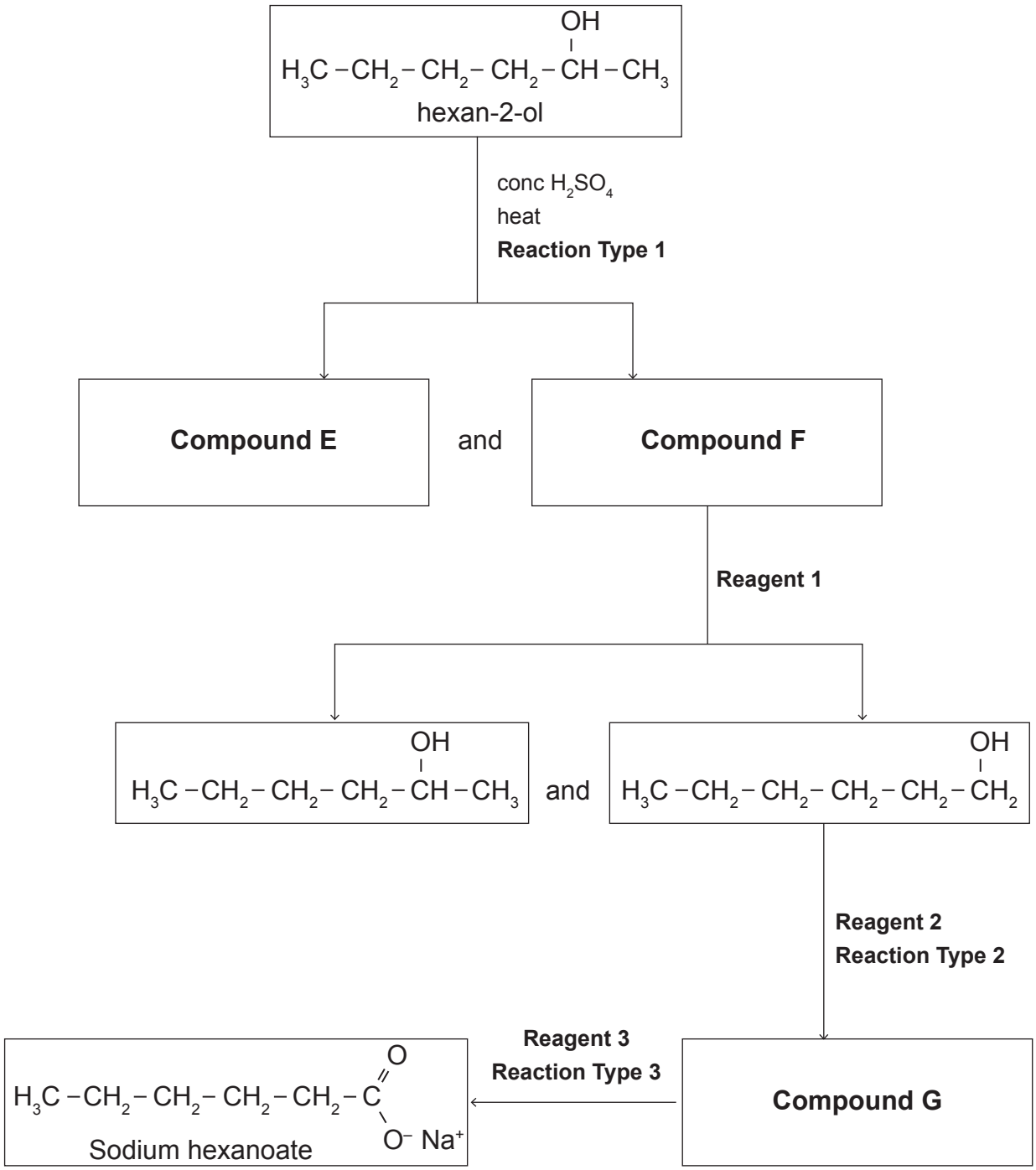
(ii) Explain how you could distinguish between the different products of these two reactions using bromine water, $Br_2(aq)$.

QUESTION TWO

Sodium hexanoate (shown below) is used as a preservative in foods, cosmetics, and medicines.



(a) An incomplete reaction scheme for the production of sodium hexanoate from hexan-2-ol is shown below.



(i) Complete the reaction scheme by giving the structures of **Compounds E–G**, **Reagents 1–3**, and **Reaction Types 1–3** in the tables below.

Give conditions where necessary.

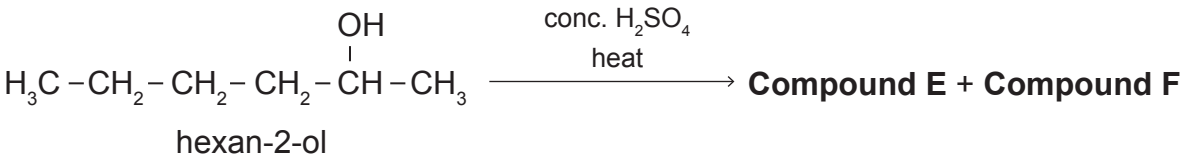
Compound E	**Compound F**
Compound G	

Reagent 1	
Reagent 2	
Reagent 3	

Reaction Type 1	
Reaction Type 2	
Reaction Type 3	

(ii) Explain whether the starting material, hexan-2-ol, in the scheme opposite, is a primary, secondary, or tertiary alcohol.

(iii) In the first step of the reaction scheme, where hexan-2-ol reacts with concentrated sulfuric acid, conc. H_2SO_4, two products, **Compounds E** and **F**, are formed in unequal amounts.



Elaborate on the reaction of hexan-2-ol with concentrated sulfuric acid.

In your answer you should:

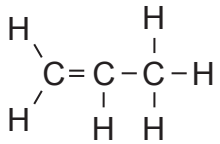
- explain why two different products are formed
- identify the major and minor products of the reaction
- justify your choice of major and minor products.

(iv) Give the structural (constitutional) isomer of hexan-2-ol that would form only ONE product when reacted with concentrated sulfuric acid, conc. H_2SO_4.

QUESTION THREE

Polypropene is the polymer used to make the web-like filters in most N95 and loose-fitting surgical face masks. While filtering out most microbes, air can still pass through.

Polypropene is made through the addition polymerisation of the prop-1-ene monomer, shown below.



prop-1-ene

(a) (i) In the box below, **draw three repeating units** of the polypropene polymer.

(ii) Explain why this is classified as addition polymerisation.

(iii) Polypropene is a relatively chemically inert (unreactive) substance.

Compare the reactivity of polypropene with its monomer.

In your answer you should:

- link the structure of the monomer to its reactivity
- outline why polypropene's lower reactivity makes it appropriate for use in face masks.

There is more space for your answer on the next page.

(b) Propose a structure of a compound with the molecular formula C_4H_8 that forms geometric isomers.

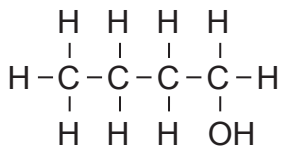
Justify your choice by:

- drawing the structure of your proposed compound in the box below
- stating the requirements for geometric isomerism
- linking your structure to these criteria.

Proposed structure:

You do not need to draw the cis / trans isomers of your proposed structure.

(c) (i) Draw and name four structural (constitutional) isomers of $C_4H_{10}O$.
The first one is done for you.

	
Name: butan-1-ol	Name:
Name:	Name:

(ii) By referring to your compounds drawn in the table above, explain why they are structural isomers.

Extra space if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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