

Name:	Teacher:
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Level 3 Chemistry

91391 Demonstrate understanding of the properties of organic compounds

Credits: Five

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

You should attempt ALL the questions in this booklet.

A periodic table is provided in the Resource Sheet.

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

Check that this booklet has pages 2–13 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

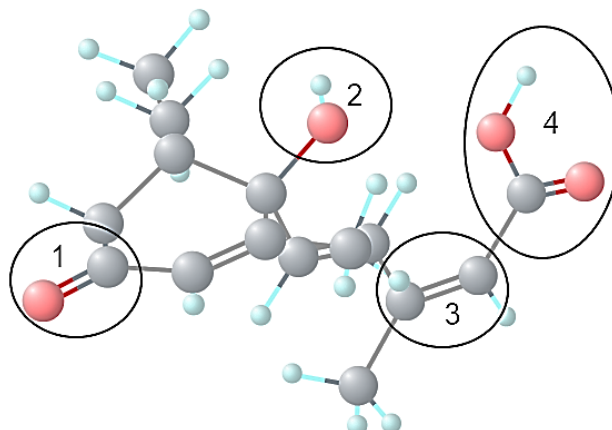
TOTAL

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ASSESSOR'S USE ONLY

QUESTION ONE

(a) The structure of a plant hormone, ABA, is given below.



Identify the FOUR different functional groups within the molecule that are circled and numbered above:

1	2
3	4

(b) Complete the table below by drawing the structural formula for the named compounds or naming the drawn compound using its IUPAC systematic name.

IUPAC systematic name.	Structural formula
Propanoyl chloride	
	$ \begin{array}{ccccccc} & \text{CH}_3 & \text{H} & \text{H} & \text{CH}_3 & & \\ & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & \\ & & & & & & // \\ & \text{H} & \text{H} & \text{H} & \text{H} & & \text{O} \\ & & & & & & \backslash \\ & & & & & & \text{OH} \end{array} $
3-bromopentan-2-ol	

- (c) (i) C_4H_9OH has four isomers that are all alcohols. They are butan-1-ol, butan-2-ol and two others, A and B. Draw them in the box below.

Butan-1-ol	Butan-2-ol
Alcohol A	Alcohol B

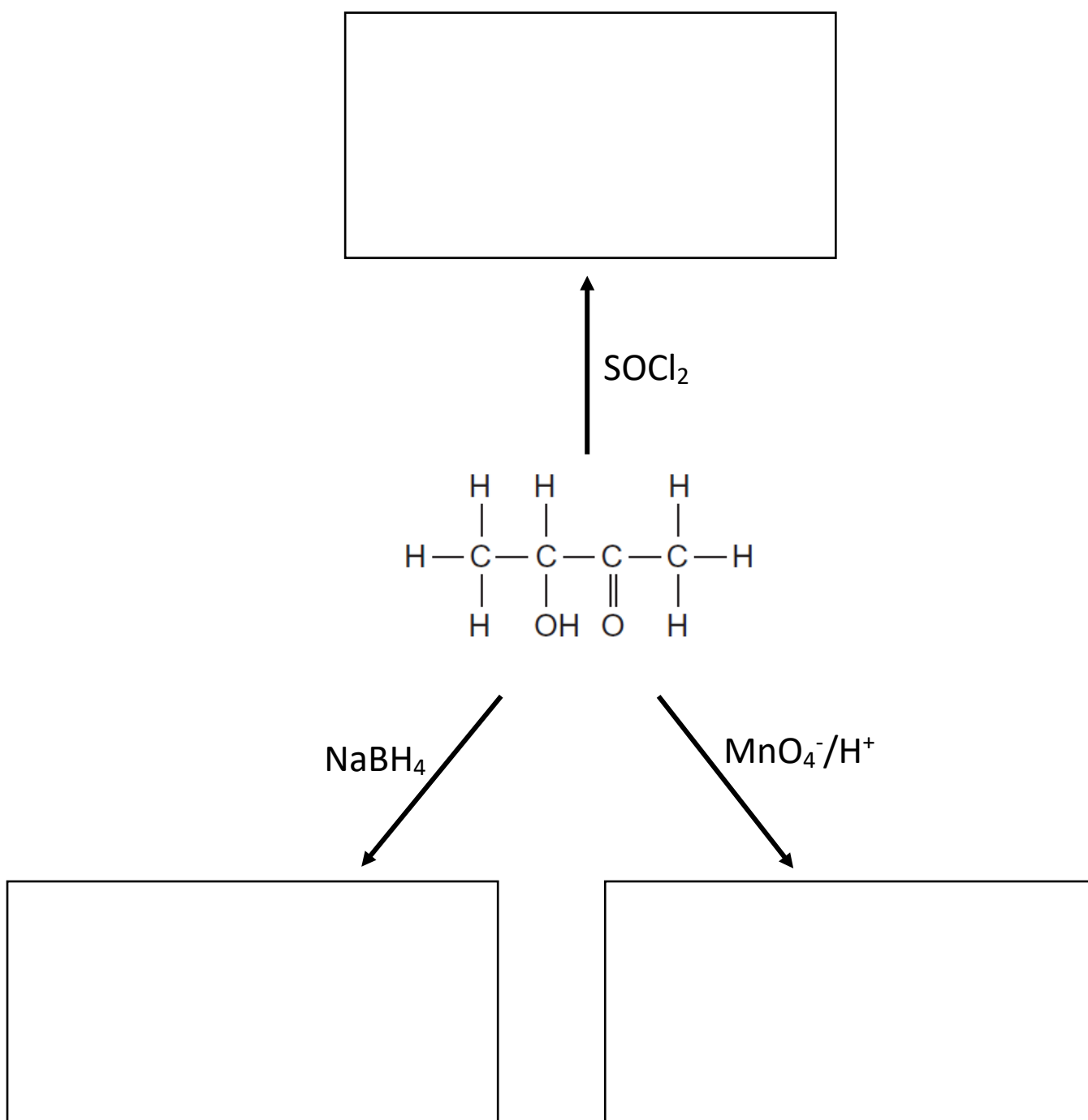
- (ii) Describe a chemical test you could do to distinguish between butan-1-ol and butan-2-ol. Include the name of the reagent, any conditions and the expected observations.

- (iii) Using a different reagent, describe how you could distinguish between the isomers A and B you have drawn. Include the observations that would occur.

Question Two

Acetoin (3-hydroxybutanone) is a colourless or pale yellow to green yellow liquid with a pleasant buttery odour. It is used as a food flavoring and a fragrance.

(a) Complete the scheme that shows some of the reactions of acetoin.



(b) Acetoin is optically active.

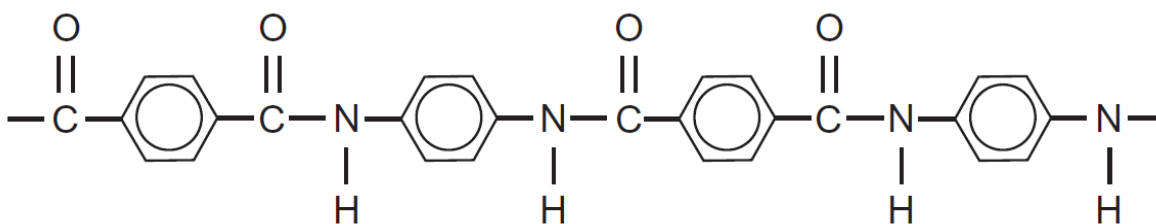
(i) Explain what is meant by the term optically active.

(ii) Describe the structural feature necessary for acetoin to be optically active.

(iii) Draw the two optical isomers of acetoin below, as 3-D structures.

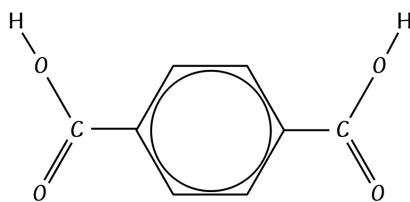


- (c) Kevlar is a polyamide. It is used in bulletproof jackets. A section of the polymer chain is drawn below.



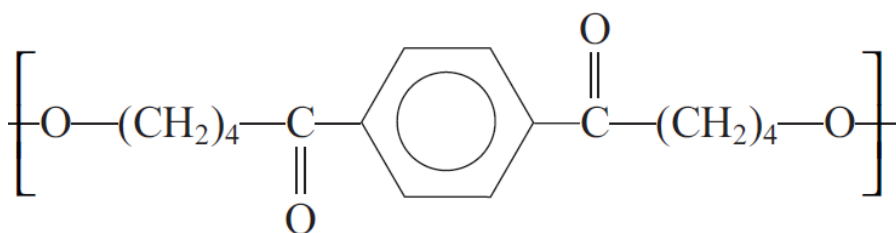
- circle an amide link in the diagram above
- explain the term condensation polymer
- draw the structures of the two monomers which can be used to produce Kevlar.

- (d) (i) Butane-1,4-diol and benzene-1,4-dicarboxylic acid react to form a polyester.



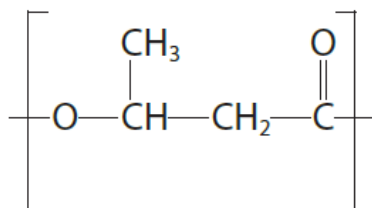
benzene-1,4-dicarboxylic acid

A student was asked to draw the repeat unit of the polyester but made error(s).



Draw a correct version in the space provided.

- (ii) PHB is a biodegradable polymer. The repeat unit is shown below.



It can be hydrolysed by either hydrochloric acid or sodium hydroxide to form different organic products. State the formula of the organic product in each case.

Hydrolysis with HCl	Hydrolysis with NaOH

Question Three

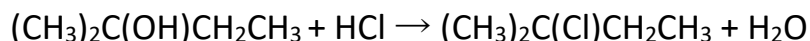
(a) Identify the reagents, conditions required, and observations linked to species, to enable the following pairs of chemicals to be distinguished from each other.

(i) 1-chlorobutane and butanoyl chloride

(ii) propanal and propanone

(iii) aqueous solutions of propanamide and propan-1-amine

2-chloro-2-methylbutane may be prepared by reacting 2-methylbutan-2-ol with concentrated hydrochloric acid:



The method is as follows.

1. Carefully place 5.00 mL of 2-methylbutan-2-ol and about 25 mL of concentrated hydrochloric acid into a separating funnel.
2. Gently shake the mixture for 10 minutes.
3. Discard the lower aqueous layer.
4. Slowly add about 10 mL of dilute sodium hydrogen carbonate solution to the separating funnel, shaking the mixture gently, inverting the separating funnel and opening the tap at regular intervals.
5. Remove the aqueous layer and discard it as before.
6. Transfer the organic layer to a conical flask.
7. Add a few pieces of anhydrous calcium chloride to the conical flask and shake the mixture.
8. Decant the liquid into a distillation flask and distil it to collect the pure 2-chloro-2-methylbutane.

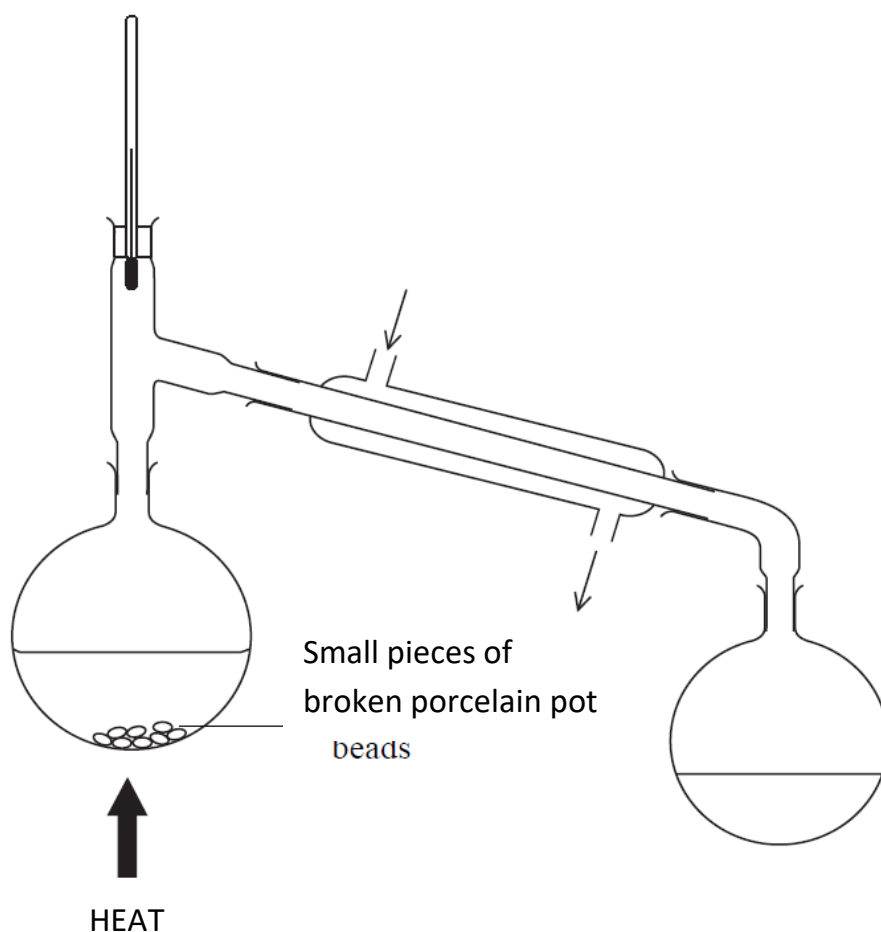
Organic compound	2-methylbutan-2-ol	2-chloro-2-methylbutane
Boiling point / °C	102	85.5

(b) Why is it necessary to continuously shake the 2-methylbutan-2-ol and the concentrated hydrochloric acid for the reaction to occur (step 2)?

(c) Sodium hydrogen carbonate solution is added in step 4. Explain:

- the purpose of adding the sodium hydrogen carbonate
- the reason for opening the tap of the separating funnel at regular intervals

(d) An incorrect diagram of the distillation apparatus is shown below.
The clamps are NOT shown but the equipment is adequately held in place.



(i) Circle **three mistakes** with the experimental set-up.

