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Organic Chemistry

Alcohols

Name

Class



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That's what we focus on - developing a personal connection with our students, so that we are able to cater for their needs, build their strengths, and develop their weaknesses. We aim to produce well-rounded individuals who can set their sights high and achieve their dreams.

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Outcomes

A student:

- analyses and evaluates primary and secondary data and information CH11/12-5
- solves scientific problems using primary and secondary data, critical thinking skills and scientific processes CH11/12-6
- communicates scientific understanding using suitable language and terminology for a specific audience or purpose CH11/12-7
- analyses the structure of, and predicts reactions involving, carbon compounds CH12-14

Content Focus

Students focus on the principles and applications of chemical synthesis in the field of organic chemistry. Current and future applications of chemistry include techniques to synthesise new substances – including pharmaceuticals, fuels and polymers – to meet the needs of society.

Each class of organic compounds displays characteristic chemical properties and undergoes specific reactions based on the functional groups present. These reactions, including acid/base and oxidation reactions, are used to identify the class of an organic compound. In this module, students investigate the many classes of organic compounds and their characteristic chemical reactions. By considering the primary, secondary and tertiary structures of organic materials, students are provided with opportunities to gain an understanding of the properties of materials – including strength, density and biodegradability – and relate these to proteins, carbohydrates and synthetic polymers.

Content

Inquiry question: How can alcohols be produced and what are their properties?

Students:

- investigate the structural formulae, properties and functional group including:
 - primary
 - secondary
 - tertiary alcohols
- explain the properties within and between the homologous series of alcohols with reference to the intermolecular and intramolecular bonding present

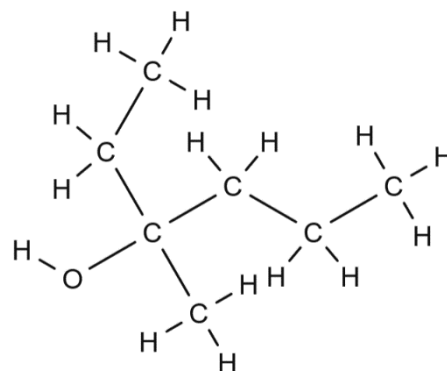
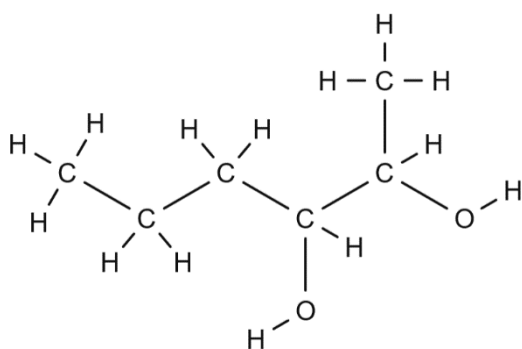
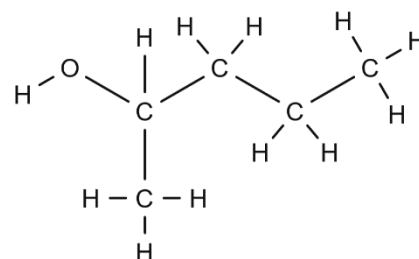
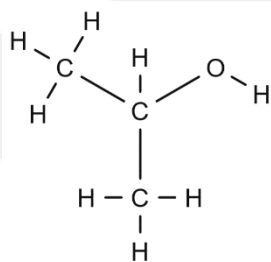


- conduct a practical investigation to measure and reliably compare the enthalpy of combustion for a range of alcohols
- write equations, state conditions and predict products to represent the reactions of alcohols, including but not limited to (ACSCH128, ACSCH136):
 - combustion
 - dehydration
 - substitution with HX
 - oxidation
- investigate the production of alcohols, including:
 - substitution reactions of halogenated organic compounds
 - fermentation
- investigate the products of the oxidation of primary and secondary alcohols
- compare and contrast fuels from organic sources to biofuels, including ethanol



Question 1

Name the following molecules and label them as primary, secondary, and tertiary alcohols.



Question 2

Draw the following alcohols.

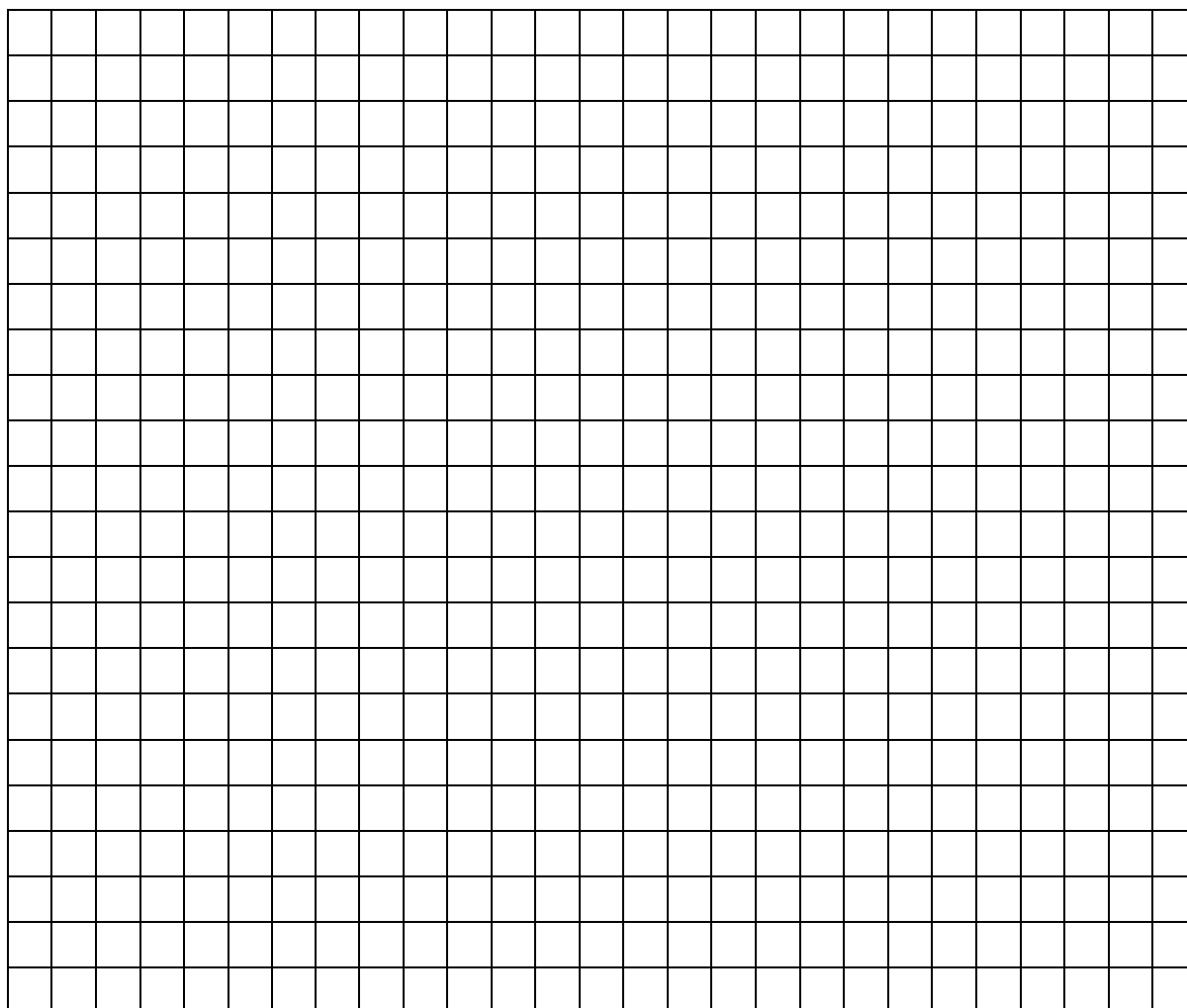
Hexan-3-ol	
Butan-1-ol	
2-methylpropan-2-ol	
4-methylhexan-2,3-diol	



Question 3

Represent the follow data on a graph.

Alcohol	Solubility in water (g/100mL)
Methanol	Infinitely Soluble
Ethanol	Infinitely Soluble
Propanol	Infinitely Soluble
1-butanol	7.7
1-pentanol	2.2
1-haxanol	0.59
1-heptanol	0.18
1-octanol	Insoluble in Water



Describe the trend in solubility seen in the above graph

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Question 4

What type of intermolecular bonding exists in alcohols? How would this affect their boiling point?

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Question 5

Give the chemical equation and molecular structural diagrams for the following reactions:

a. Combustion of Butan-1-ol

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b. Propanol and Hydrogen fluoride

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c. Dehydration of Pentan-2-ol

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d. Hexan-2-ol and Oxygen

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e. 3-methylpentan-3-ol (left at room temperature)

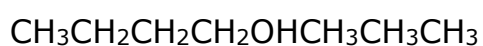
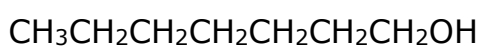
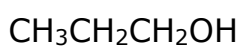
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Question 6

Arrange the following compounds in increasing order of boiling point. Provide reasons for your answer.



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Question 7

Butan-1-ol is miscible with heptane but methanol is not. Explain this phenomenon.

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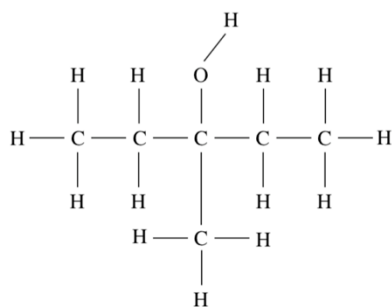
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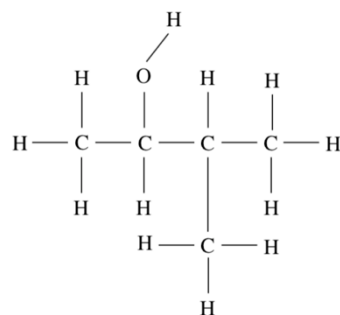
Question 8

Name each alcohol and classify it as primary, secondary, or tertiary.

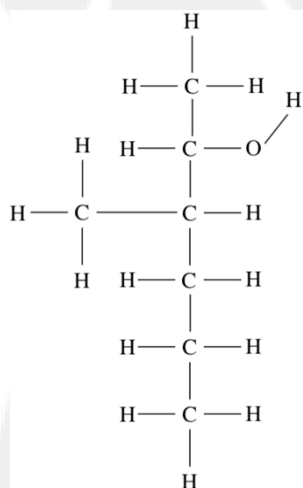
a.



b.



c.



Question 9

$C_5H_{12}O$ has three isomers that are alcohols.

a. Name all three isomers.

b. Classify each isomer as a primary, secondary, or tertiary alcohol.

c. Write down the chemical equation for $C_5H_{12}O$.



Question 10

Name the products formed when each of the following pairs of compounds react.

- a. 2-Chlorobutane and aqueous sodium hydroxide

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- b. 2-bromopentane and water in the presence of a catalyst

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- c. 1-bromobutane and aqueous sodium hydroxide

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Question 11

Write balanced chemical equations for the production of:

- a. Ethanol from chloroethane

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- b. Butan-1-ol from 1-chlorobutane

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Question 12

Ethanol is produced through the substitution of halogenated organic compounds and by fermentation.

- a. Write the general equation of substitution of a halogenated organic compound.

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- b. Write the equation for fermentation.

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- c. Outline the conditions for fermentation.

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- d. Summarise the steps of fermentation and explain how it produces a biofuel.

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Question 13

Compare and contrast the uses of ethanol from an organic source.

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Question 14

Write equations with all the products formed for each of the following.

a. Dehydration of 1-butanol

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b. Dehydration of 2-methyl-1-pentanol

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c. 2-pentanol with hydrogen bromide

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d. 2-methyl-hexanol with hydrogen chloride

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e. 2-methyl-2-chloropropane with water

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f. 2-fluoropropane with water

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Question 15

Write structural equations for the oxidation of:

3-butanol	
1-pentanol	
1-butanol	
2-methyl-1-hexanol	



2-methyl-3-heptanol	
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Question 16

A mass of 0.81g 2-pentanol is combusted with excess oxygen and used to heat 200g of water with initial temperature 15.0°C. The reaction stopped when the temperature reached 29.9 °C. Calculate the enthalpy of combustion.

$$q = m \times c \times \Delta T$$

where

q is the amount of heat energy in joules (J)

m is the mass in grams (g)

c is the specific heat capacity in $\text{Jg}^{-1}\text{K}^{-1}$

ΔT is the temperature change in K.

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Question 17

The heat of combustion of methanol is 1260KJmol^{-1} . Calculate the mass of methanol that needs to be burnt to increase the temperature of 250g water by 74°C if 65% of heat is lost to the environment.

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Question 18

Provide reasons as to why alcohols have both higher melting points and boiling points than alkanes.

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Question 19

In an experiment conducted in class, pentanol was combusted containing 40g of water at an initial temperature of 16°C. After burning 0.40g of pentanol, the temperature of the liquid increased to 38°C.

a. Write the equation

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b. Calculate the heat of combustion in per gram and per mol.

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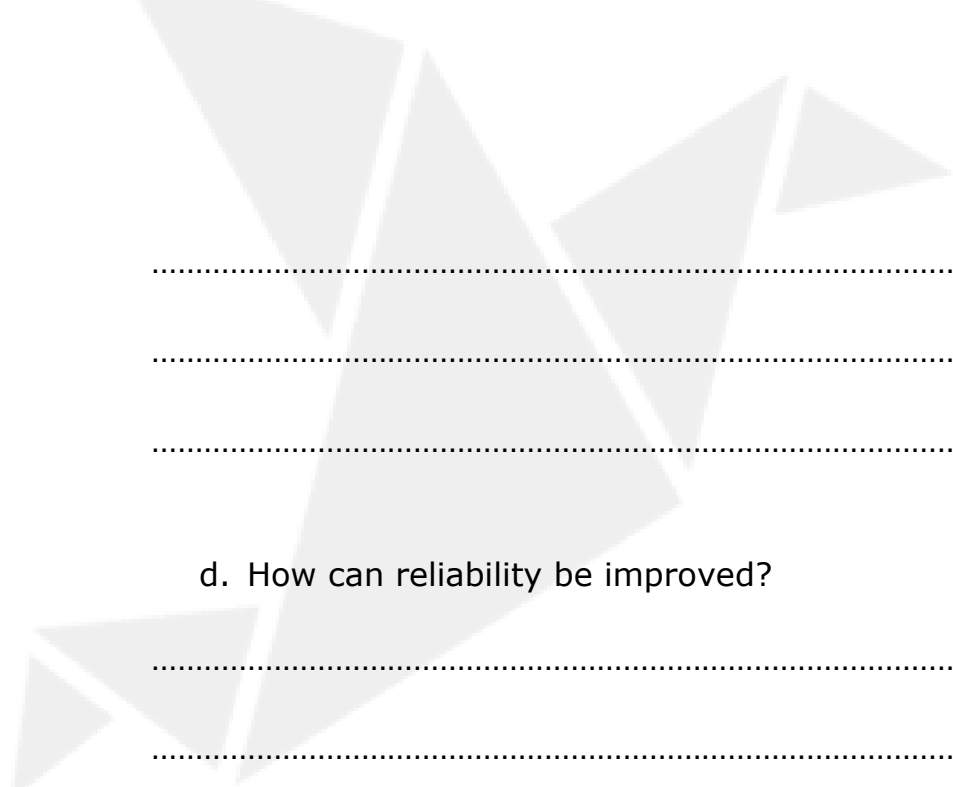
c. Comment on the accuracy of this experiment and provide and possible reasons for error.

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d. How can reliability be improved?

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Question 20

Briefly describe the dehydration of alcohol reaction.

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