



Chapter 10 Organic Reactions

Name: _____

Class: _____

Date: _____

Time: **85 minutes**

Marks: **85 marks**

Comments:

1

This question is about organic compounds.

(a) Ethanol burns in air.

Use the correct answer from the box to complete the word equation for the reaction.

| | | |
|---------------|-----------------|---------------|
| carbon | hydrogen | oxygen |
|---------------|-----------------|---------------|

ethanol + → carbon dioxide + water

(1)

(b) Use the correct answer from the box to complete the sentence.

| | | |
|-------------|-------------------|----------------|
| milk | hard water | vinegar |
|-------------|-------------------|----------------|

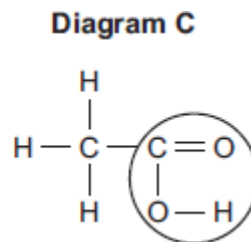
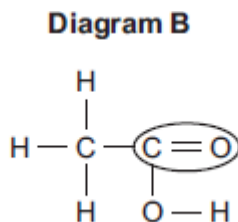
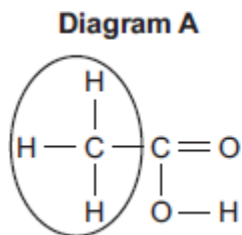
Ethanoic acid is in

(1)

(c) Ethanoic acid is a carboxylic acid.

Which diagram, **A**, **B** or **C**, has a ring around the functional group of a carboxylic acid?

Write your answer in the box.



Diagram

(1)

(d) Ethyl propanoate is produced by reacting ethanol with propanoic acid.

What type of organic compound is ethyl propanoate?

Tick (✓) **one** box.

Alcohol

Carboxylic acid

Ester

(1)

(e) Organic compounds such as ethyl propanoate are used in perfumes.

Give **two** properties of these compounds that make them suitable for use in perfumes.

.....

.....

(2)

(Total 6 marks)

2

This question is about compounds produced from crude oil.

The table below shows four of these compounds.

| Compound | Melting point in °C | Boiling point in °C |
|--|---------------------|---------------------|
| methane (CH ₄) | -183 | -164 |
| ethene (C ₂ H ₄) | -169 | -104 |
| decane (C ₁₀ H ₂₂) | -30 | +174 |
| icosane (C ₂₀ H ₄₂) | +37 | +343 |

(a) Tick (✓) **two** correct statements about the four compounds.

| Statement | Tick (✓) |
|---|----------|
| Methane has the lowest melting point and icosane has the highest boiling point. | |
| Ethene and methane are alkanes. | |
| Methane and decane are gases at room temperature (20°C). | |
| Decane and icosane are liquid at 100°C. | |

(2)

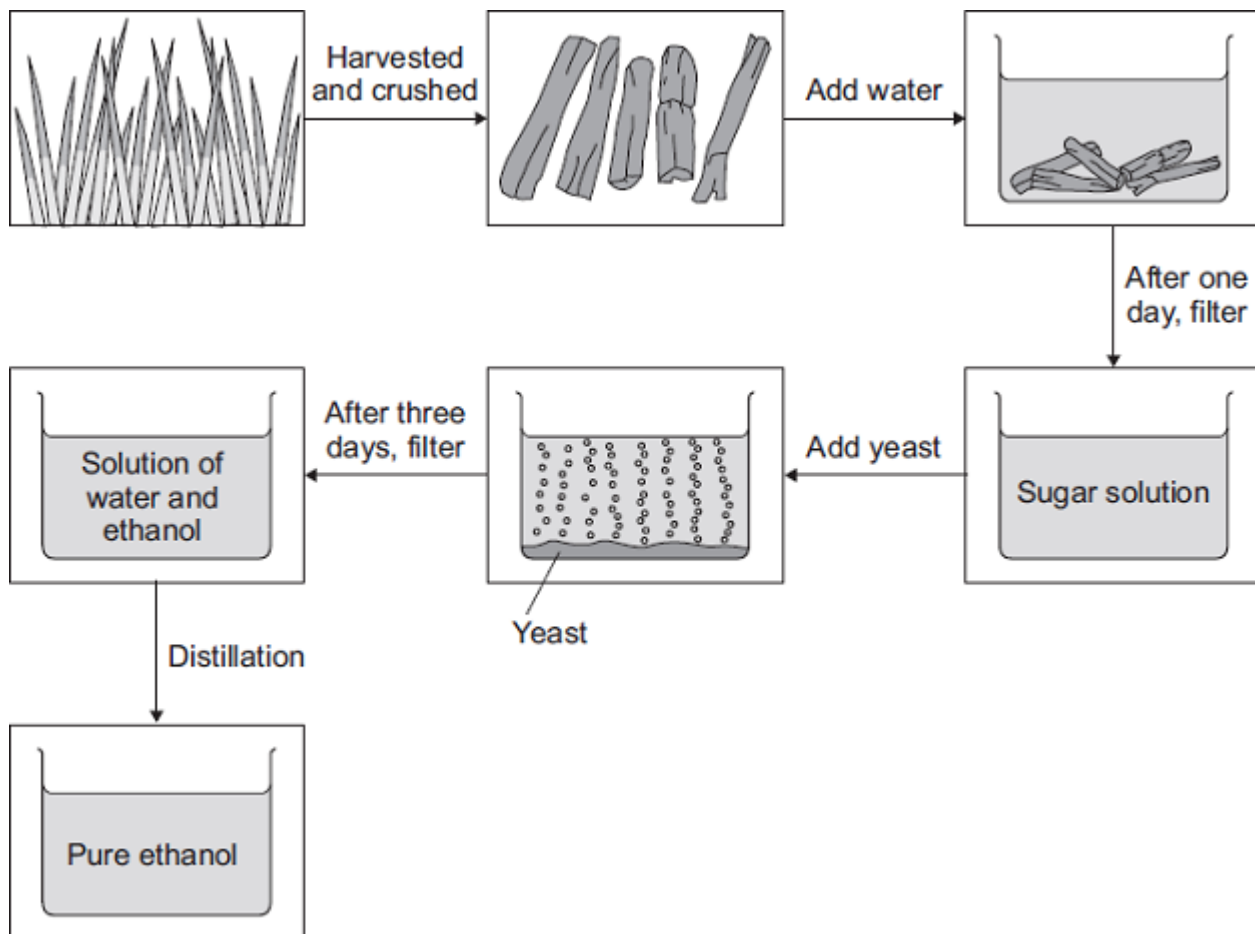
(b) Petrol contains a mixture of compounds, including octane (C₈H₁₈).

Complete the word equation for the complete combustion of octane.

octane + oxygen → +

(2)

- (c) Most petrol used in cars contains about 5% ethanol (C_2H_5OH). Ethanol can be produced from sugar cane.



- (i) Draw a ring around the correct answer to complete the sentence.

The reaction to produce ethanol from sugar solution is

combustion.
displacement.
fermentation.

(1)

- (ii) Some people say that increasing the production of ethanol from sugar cane will be **good** for the environment.

Suggest **two** reasons why.

1

.....

.....

2

.....

.....

(2)

- (iii) Other people say that increasing the production of ethanol from sugar cane will be **bad** for the environment.

Suggest **two** reasons why.

1

.....

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2

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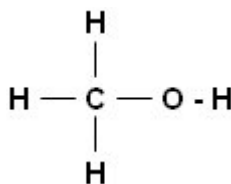
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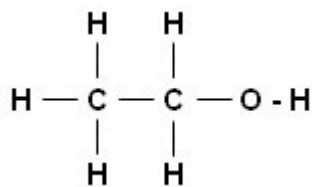
(Total 9 marks)

3

The structures shown are of the first two members of a homologous series of organic compounds.



Methanol



Ethanol

- (a) (i) Complete the diagram for propanol, the next member of the homologous series.



Propanol

(1)

- (ii) Which **one** of the statements about ethanol is correct?

Tick (✓) **one** box.

| Statement | Tick (✓) |
|--|----------|
| Ethanol dissolves in water to form a neutral solution. | |
| Ethanol reacts with sodium to produce chlorine. | |
| Ethanol does not burn in air. | |

(1)

- (b) Ethanoic acid (CH_3COOH) can be produced from ethanol ($\text{CH}_3\text{CH}_2\text{OH}$).

- (i) What type of reaction happens when ethanoic acid is produced from ethanol?

.....

(1)

- (ii) State one use of ethanoic acid.

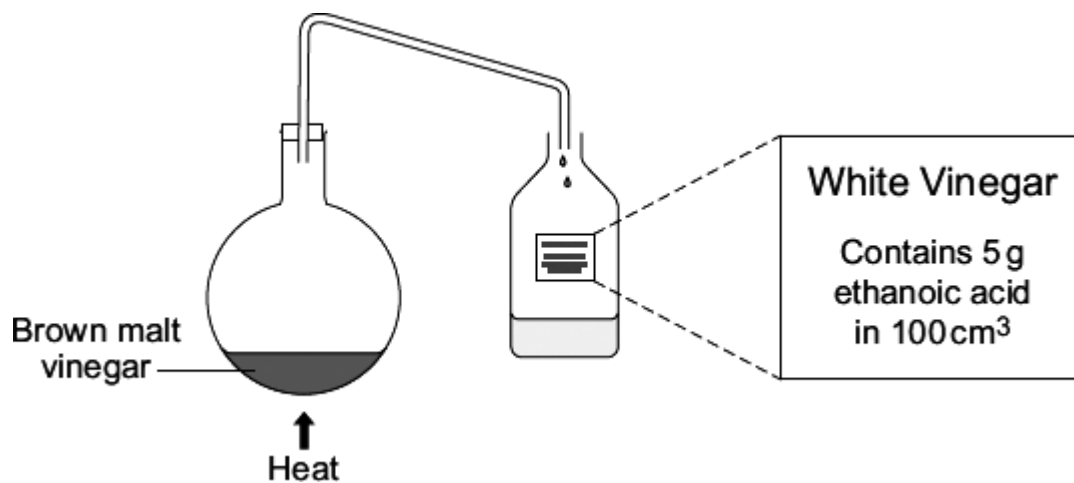
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(1)

(Total 4 marks)

4

White vinegar can be made by distillation of brown malt vinegar.



- (a) White vinegar contains only water (boiling point 100 °C) and ethanoic acid (boiling point 118 °C).

Suggest why the brown colour remains in the flask during the distillation.

.....
.....

(1)

- (b) Ethanoic acid is a weak acid.

- (i) Draw a ring around the correct answer to complete the sentence.

Weak acids are

| |
|------------|
| completely |
| not |
| partially |

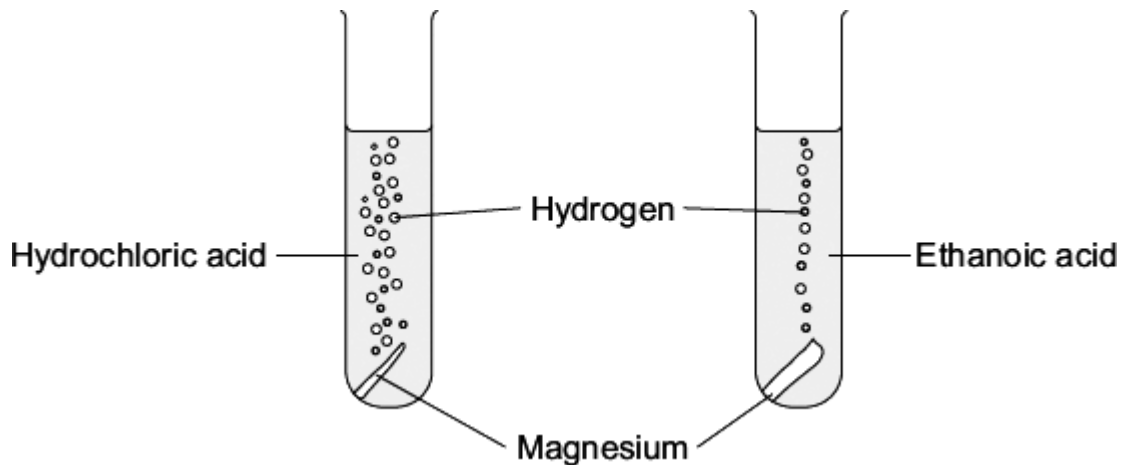
 ionised in water.

(1)

(ii) Hydrochloric acid and ethanoic acid were reacted with magnesium metal to produce hydrogen gas.

At the start:

- both acids were the same concentration
- both pieces of magnesium were the same size.



Give **two** observations which show that ethanoic acid is a weaker acid than hydrochloric acid.

1

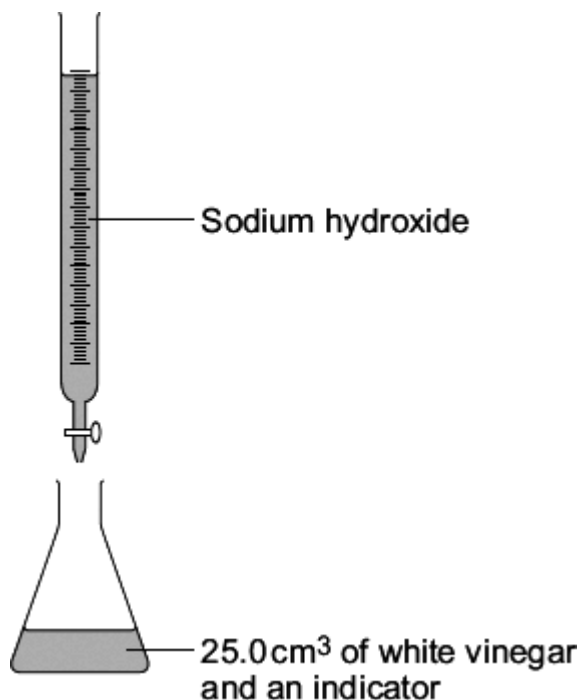
.....

2

.....

(2)

- (c) A student did a titration to find out if the white vinegar contains 5 g of ethanoic acid in 100 cm³.



- (i) Choose the correct words from the box to complete the sentences.
Use each word once or not at all.

| | | | |
|----------------|----------------------|----------------|--------------------|
| burette | conical flask | pipette | thermometer |
|----------------|----------------------|----------------|--------------------|

To do this titration 25.0 cm³ of the white vinegar is measured
using a

The 25.0 cm³ of white vinegar is then run into a

An indicator is added to the white vinegar.

Sodium hydroxide solution is added to the white vinegar
from a

(3)

- (ii) How does the student know when to stop adding the sodium hydroxide solution?

.....
.....
.....
.....

(2)

(d) The titration is repeated three more times. The results are shown in the table.

| Titration | 1 | 2 | 3 | 4 |
|---|------|------|------|------|
| Volume of sodium hydroxide in cm ³ | 23.5 | 20.1 | 19.9 | 20.0 |

(i) The student decided that the mean of these results was 20.0 cm³.

Explain why.

Use the figures from the table in your explanation.

.....

.....

.....

.....

(2)

(ii) From the results, the student calculated that the concentration of the ethanoic acid was 48 g per cubic decimetre.

Did the white vinegar contain 5 g of ethanoic acid in 100 cm³ ?

Explain your answer.

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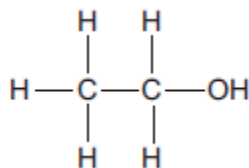
(1)

(Total 12 marks)

5

(a) The structure of an alcohol is shown in **Figure 1**.

Figure 1



(i) Draw a circle around the functional group in the structure of the alcohol.

(1)

(ii) What is the chemical name of this alcohol?

.....

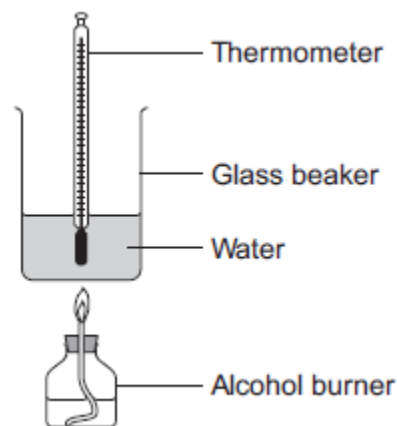
(1)

(b) Alcohols are used as fuels.

A student plans an experiment to find the energy released per gram of alcohol burned.

The student uses the apparatus shown in **Figure 2**.

Figure 2



(i) Suggest **two** ways that this apparatus could be improved to obtain accurate results.

.....

.....

.....

.....

(2)

- (ii) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Describe how the student should do this experiment.

You should include any measurements the student should make.

Do **not** describe any improvements to the apparatus.

Do **not** describe how to do any calculations.

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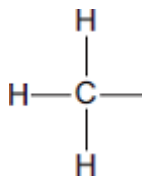
(6)
(Total 10 marks)

6

This question is about organic compounds.

(a) Wine contains ethanol ($\text{CH}_3\text{CH}_2\text{OH}$).

(i) Complete the displayed structure of ethanol.

**(1)**

(ii) Wine left in a glass for several days turns sour.
The sour taste is caused by ethanoic acid.



Complete the sentences.

The ethanoic acid is produced from a reaction between ethanol
and

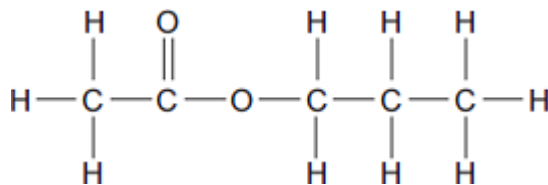
This type of reaction is

(2)

(b) Propyl ethanoate, a fragrance, can be produced by reacting ethanoic acid with an alcohol.

Propyl ethanoate is a member of a series of organic compounds. The members of the series all have the same functional group.

The displayed structure of propyl ethanoate is:



(i) Draw a ring around the functional group for this series on the displayed structure of propyl ethanoate.

(1)

(ii) Name the series of organic compounds with this functional group.

.....

(1)

(iii) The alcohol used to make propyl ethanoate has the formula $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$

Name this alcohol.

.....

(1)

(Total 6 marks)

7

This question is about organic compounds.

- (a) Ethanol is an alcohol.
One use of ethanol is in alcoholic drinks.

Give **two** other uses of ethanol.

.....

.....

(2)

- (b) Which gas is produced when sodium reacts with ethanol?

Tick (✓) **one** box.

Carbon dioxide

Carbon monoxide

Hydrogen

Oxygen

(1)

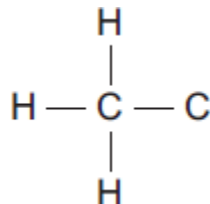
(c) Ethanoic acid (CH_3COOH) can be produced from ethanol ($\text{CH}_3\text{CH}_2\text{OH}$).

(i) What type of reaction produces ethanoic acid from ethanol?

.....

(1)

(ii) Complete the displayed structure of ethanoic acid.



(1)

(iii) Solutions of ethanoic acid and hydrochloric acid with the same concentration have different pH values.

Explain why the solution of ethanoic acid has a higher pH than the solution of hydrochloric acid.

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.....

(2)

(d) Ethanol and ethanoic acid react in the presence of a catalyst to form an ester.

(i) Name the ester made from ethanol and ethanoic acid.

.....

(1)

(ii) What type of chemical is used as a catalyst in this reaction?

.....

(1)

(iii) Esters are used in perfumes because they smell pleasant and are volatile.

What does volatile mean?

.....

(1)

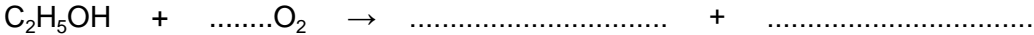
(Total 10 marks)

8

Most petrol used in cars contains about 5% ethanol (C₂H₅OH).

(a) The complete combustion of ethanol produces carbon dioxide and water.

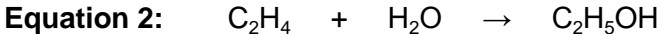
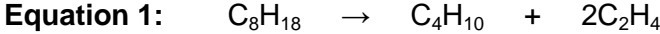
Complete and balance the symbol equation for the complete combustion of ethanol.



(2)

(b) Ethanol can be produced from octane (C₈H₁₈).

The two chemical equations represent the production of ethanol from octane.



(i) In **Equation 1** the products are a mixture of two gases.

Describe a chemical test that would indicate the presence of ethene (C₂H₄) in the mixture.

.....
.....
.....
.....

(2)

- (ii) Describe, as fully as you can, the conditions used for the two reactions to produce ethanol from octane.

Use **Equation 1** and **Equation 2** to help you with your answer.

.....

.....

.....

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.....

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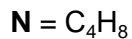
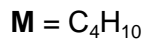
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(4)
(Total 8 marks)

9

The molecular formulae of two hydrocarbons **M** and **N** are given.



(a) **M** reacts with chlorine to form C₄H₉Cl.

- (i) Write a balanced chemical equation for the reaction of chlorine with **M**.

.....

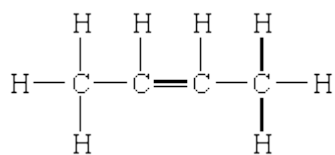
(2)

- (ii) Name this type of reaction.

.....

(1)

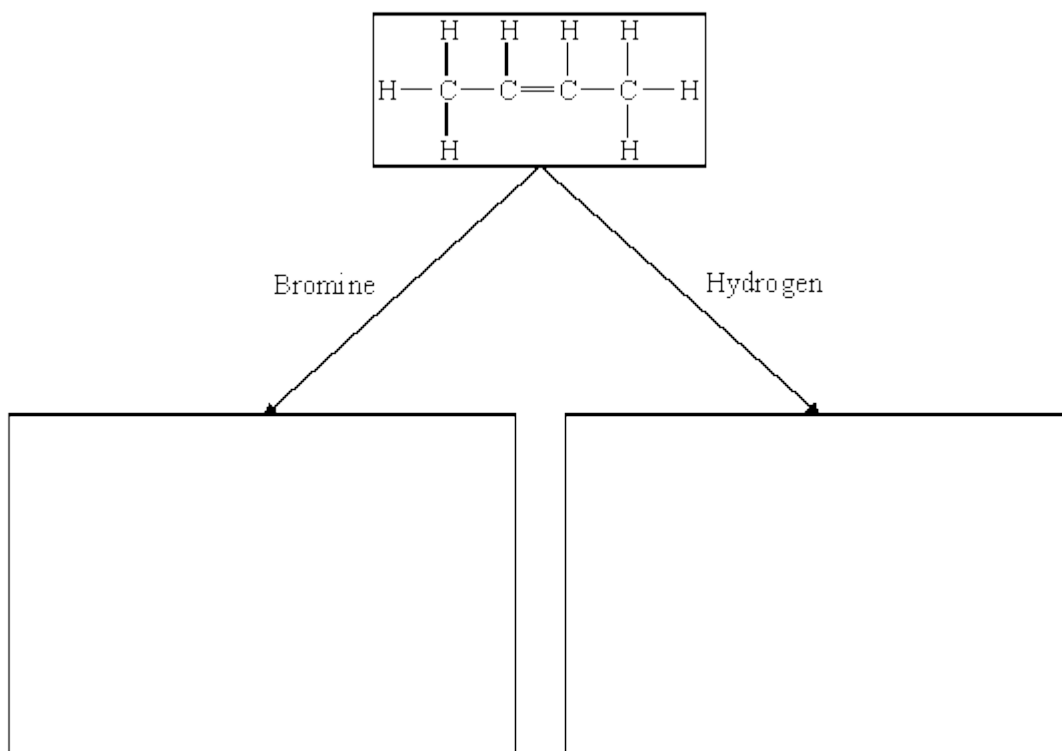
(b) A displayed structural formula for **N** is:



Draw a displayed structural formula of a compound which is an isomer of **N**.

(1)

(c) Complete the boxes to show the displayed structural formula for each of the products formed.



(2)

(Total 6 marks)

10

(a) Ethanol is an alcohol. The structural formula of ethanol is $\text{CH}_3\text{CH}_2\text{OH}$.

(i) Draw the displayed structure of ethanol, showing all the bonds.

(1)

(ii) Ethanol reacts with sodium to produce a gas.

What is the gas produced in this reaction?

.....

(1)

(b) (i) The structural formula of ethanoic acid is CH_3COOH .

Dilute solutions of ethanol can be converted into dilute solutions of ethanoic acid.

Use a word from the box to complete the sentence.

neutralised

oxidised

reduced

In this reaction the ethanol is

(1)

(ii) What is the common name for a dilute solution of ethanoic acid?

.....

(1)

(iii) What is the functional group in ethanoic acid?

.....

(1)

(c) Ethanoic acid reacts with propanol to give propyl ethanoate, $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_3$

(i) What type of organic compound is propyl ethanoate?

.....

(1)

(ii) Suggest a use for propyl ethanoate.

.....
.....

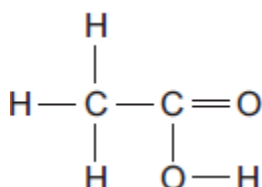
(1)

(Total 7 marks)

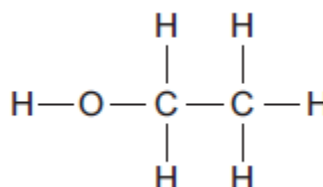
11

The diagrams represent two compounds, **A** and **B**.

Compound A



Compound B



(a) (i) Compound **B** is an alcohol.

Name compound **B**.

.....

(1)

(ii) Use the correct answer from the box to complete the sentence.

| | | |
|--------|------------|----------|
| burned | decomposed | oxidised |
|--------|------------|----------|

To form compound **A**,

compound **B** is

(1)

(iii) Compounds **A** and **B** are both colourless liquids.

A test tube contains a colourless liquid, which could be either compound **A** or compound **B**.

Describe a simple **chemical** test to show which compound, **A** or **B**, is in the test tube.

.....
.....
.....
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.....

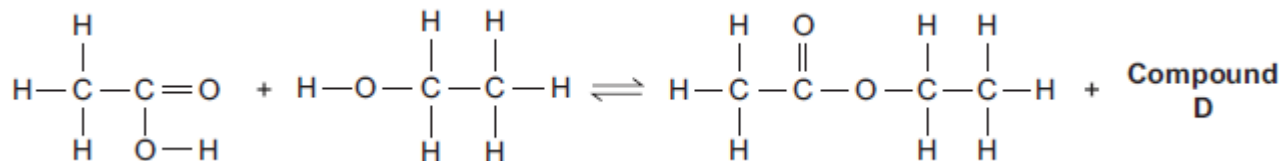
(2)

(b) Compounds **A** and **B** react to produce compound **C** and compound **D**.

Compound A

Compound B

Compound C



(i) What is the formula of compound **D**?

.....

(1)

(ii) Compound **C** is an ester.

Name compound **C**.

.....

(1)

(iii) State **one** use of esters.

.....

(1)

(Total 7 marks)

Mark schemes

- 1** (a) oxygen
allow correct answer shown in box if answer line blank 1
- (b) vinegar
allow correct answer shown in box if answer line blank 1
- (c) C 1
- (d) Ester 1
- (e) pleasant smell 1
- volatile
allow low boiling point / evaporates 1
- [6]**
- 2** (a) Methane has the lowest melting point and icosane has the highest boiling point 1
- Decane and icosane are liquid at 100°C 1
- (b) water / H₂O
either order 1
- carbon dioxide / CO₂
allow hydrogen oxide 1
- (c) (i) fermentation 1
- (ii) any **two** from:
- sugar cane / plants absorb carbon dioxide
ignore oxygen released
 - growing sugar cane / plants reduces global warming
allow ethanol from plants is carbon neutral
 - renewable resource / sustainable
accept conserves fossil fuels / petrol

2

(iii) any **two** from:

- destruction of habitats / forests (to grow sugar cane/crops)
- fermentation releases carbon dioxide
- production plants cause visual pollution
- pollution from the transportation of sugar cane / Ethanol
- growing sugar cane / plants uses a lot of land

2

[9]

3

(a) (i) 7 C-H bonds **and** 1 C-O-H bond

1

(ii) ethanol dissolves in water to form a neutral solution

1

(b) (i) oxidation

1

(ii) any **one** from:

- in vinegar
- to make esters

1

[4]

4

(a) it / brown colour has a high(er) boiling point
allow it / brown colour is a solid

1

(b) (i) partially

1

(ii) for ethanoic acid –

accept converse points for hydrochloric acid

fewer bubbles **or** gas produced at a slower rate

1

more magnesium remains **or**
magnesium disappears more slowly

accept less temperature rise or less energy released for ethanoic acid

1

(c) (i) pipette

1

conical flask

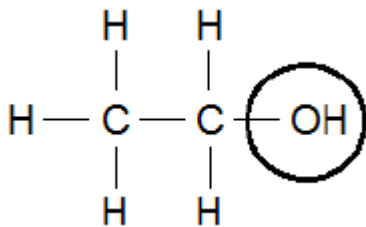
1

- burette
answers must be in the order shown 1
- (ii) indicator 1
- colour changes
if indicator named then any stated colours must be correct 1
- (d) (i) 23.5 is anomalous / rough titration / overshoot 1
- the mean of the other 3 is 20.0 1
- (ii) (no)
- it only contained 4.8g of ethanoic acid in 100cm³ 1

[12]

5

(a) (i)



1

(ii) ethanol

allow ethyl alcohol

do not accept ethanal

ignore all formulae

1

(b) (i) any **two** from:

- lid
- *metal* calorimeter
allow metal beaker
- insulation (around sides of beaker)
do not allow flammable insulation / beaker
- excluding draughts
- stirrer
allow stirring

2

(ii) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks

No relevant content

Level 1 (1–2 marks)

*There is a description of part of an experimental method **or** a measurement which should be taken.*

Level 2 (3–4 marks)

*There is a description of some parts of an experimental method **and** a measurement which should be taken.*

Level 3 (5–6 marks)

*There is a description of an experimental method **and** measurements which should be taken.*

Examples of the point that may be made in the response

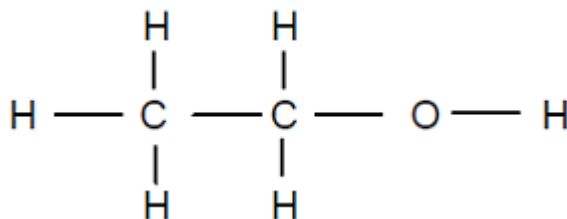
- *light ethanol and heat water*
- *extinguish ethanol*
- *after suitable temperature rise **or** after a suitable time*
- *stir water*
- *measure mass / volume of water*

- *measure initial temperature of water*
- *measure final temperature of water*
- *measure temperature rise*
- *measure initial mass of ethanol (and burner)*
- *measure final mass of ethanol (and burner)*
- *measure change in mass of ethanol*

6

[10]

6 (a) (i)



allow other arrangements provided connectivity is correct

allow — OH

1

(ii) oxygen

accept O₂

allow O

1

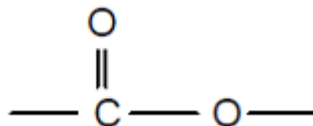
oxidation

allow oxidisation / oxidising / oxidised

allow redox

1

(b) (i) ring around



1

(ii) ester(s)

*do **not** allow ether(s)*

1

(iii) propanol

propanol accept propan-1-ol

allow propyl alcohol

1

[6]

| | | | |
|----------|---|--|-------------|
| 7 | (a) any two from: | | |
| | • fuel | <i>allow source of energy</i> | |
| | • solvent | <i>allow perfume / aftershave</i> | |
| | • antiseptic | <i>allow antibacterial</i> | 2 |
| | (b) Hydrogen | | 1 |
| | (c) (i) oxidation | <i>do not allow redox</i> | 1 |
| | (ii) correct structure | | 1 |
| | (iii) ethanoic acid is a weak / weaker acid | <i>it = ethanoic acid</i> | 1 |
| | | because it does not completely ionise. | |
| | | <i>allow because it does not completely dissociate</i> | |
| | | <i>allow it has a lower concentration of hydrogen ions</i> | |
| | | <i>allow converse for hydrochloric acid</i> | |
| | | <i>do not allow ionising</i> | 1 |
| | (d) (i) ethyl ethanoate | | 1 |
| | (ii) acid | <i>allow any strong acid</i> | |
| | | <i>allow correct formulae</i> | 1 |
| | (iii) evaporates easily / quickly | <i>allow low boiling point</i> | |
| | | <i>do not allow flammable</i> | 1 |
| | | | [10] |
| 8 | (a) CO ₂ (+) H ₂ O | <i>correct products</i> | 1 |
| | 3 (O ₂) 2 (CO ₂) 3 (H ₂ O) | <i>correct balancing</i> | 1 |

- (b) (i) add bromine water
allow iodine 1
- changes (from orange) to colourless / decolourised
ignore clear 1
- (ii) octane vapours
ignore any references to butane (C₄H₁₀) 1
- are passed over a catalyst (to produce ethene)
ignore incorrect names of catalysts 1

OR

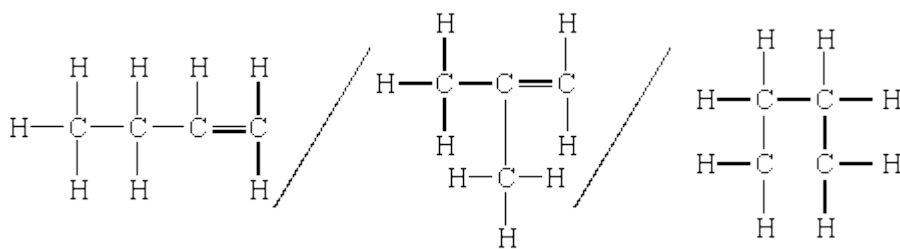
- octane mixed with steam (1)
- at a (very) high temperature (1)
for steam cracking, second mark is conditional on 'steam'
- steam is added (to ethene)
ignore the formula H₂O / water 1
- in the presence of a catalyst (to produce ethanol)
*if no other marks awarded then allow 1 mark for cracking of octane
or hydration of ethene* 1

[8]

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- (a) (i) $C_4H_{10} + Cl_2 \rightarrow C_4H_9Cl + HCl$
reactants 1
- products*
ignore incorrect balancing
no state symbols required 1
- (ii) substitution / chlorination 1

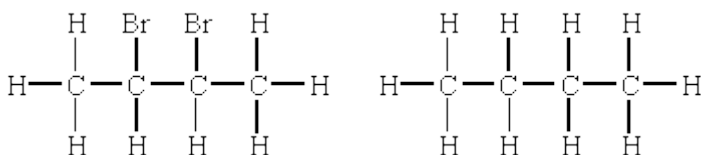
(b)



H atoms **not** necessary

1

(c)

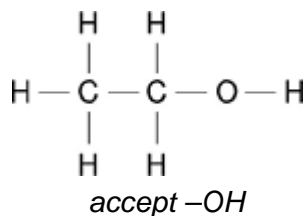


2

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10

(a) (i) correct structure showing all bonds



1

(ii) hydrogen / H₂

1

(b) (i) oxidised

1

(ii) vinegar

1

(iii) COOH / carboxylic acid

1

(c) (i) ester

1

(ii) flavouring / perfume / solvent

1

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(a) (i) ethanol

1

(ii) oxidised

1

(iii) **Test**

add any named carbonate or hydrogen carbonate

*the first mark is for the test; the second is for the result
if the test is incorrect award 0 marks.*

1

Result

A will effervesce (carbon dioxide) **or B** will not effervesce.

if the result is incorrect, award the first mark only

1

or

candidates do not have to name a gas but penalise an incorrect gas.

Test

add a named (magnesium, aluminium, zinc, iron or tin) metal
give credit to any test that will work.

Result

A will effervesce (hydrogen), **B** will not
allow a test that would identify B.

or

Test

add an acid-base indicator

Result

credit any acid colour for that indicator eg for universal indicator allow red, yellow or orange

give credit for the neutral colour for **B**

or

Test

add an alcohol (+ acid catalyst)

Result

sweet or fruity smell of esters.

(b) (i) H₂O

1

(ii) ethyl ethanoate

1

(iii) any **one** from:

- flavourings
- perfumes
- solvents
- plasticisers

allow any correct use of esters

1

[7]