FOR OFFICIAL USE

C

	KU	PS
Total Marks		

0500/402

NATIONAL QUALIFICATIONS 2009

MONDAY, 11 MAY
10.50 AM – 12.20 PM

CHEMISTRY
STANDARD GRADE
Credit Level

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth
Day Month Year

Scottish candidate number

Number of seat

1 All questions should be attempted.

2 Necessary data will be found in the Data Booklet provided for Chemistry at Standard Grade and Intermediate 2.

3 The questions may be answered in any order but all answers are to be written in this answer book, and must be written clearly and legibly in ink.

4 Rough work, if any should be necessary, as well as the fair copy, is to be written in this book.

Rough work should be scored through when the fair copy has been written.

5 Additional space for answers and rough work will be found at the end of the book.

6 The size of the space provided for an answer should not be taken as an indication of how much to write. It is not necessary to use all the space.

7 Before leaving the examination room you must give this book to the invigilator. If you do not, you may lose all the marks for this paper.

PART 1

In Questions 1 to 8 of this part of the paper, an answer is given by circling the appropriate letter (or letters) in the answer grid provided.

In some questions, two letters are required for full marks.

If more than the correct number of answers is given, marks will be deducted.

A total of 20 marks is available in this part of the paper.

SAMPLE QUESTION

A CH_4	B H_2	C CO_2
D CO	E C_2H_5OH	F C

(*a*) Identify the hydrocarbon.

(A)	B	C
D	E	F

The one correct answer to part (*a*) is A. This should be circled.

(*b*) Identify the **two** elements.

A	(B)	C
D	E	(F)

As indicated in this question, there are **two** correct answers to part (*b*). These are B and F. Both answers are circled.

If, after you have recorded your answer, you decide that you have made an error and wish to make a change, you should cancel the original answer and circle the answer you now consider to be correct. Thus, in part (*a*), if you want to change an answer A to an answer D, your answer sheet would look like this:

~~(A)~~	B	C
(D)	E	F

If you want to change back to an answer which has already been scored out, you should enter a tick (✓) in the box of the answer of your choice, thus:

✓~~(A)~~	B	C
~~(D)~~	E	F

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

1. Many solutions are used for chemical tests.

A Benedict's reagent	B lime water	C bromine solution
D pH indicator	E iodine solution	F ferroxyl indicator

(*a*) Identify the solution which could be used to test for maltose.

A	B	C
D	E	F

1

(*b*) Identify the solution which is used to test for $Fe^{2+}(aq)$.

A	B	C
D	E	F

1

(2)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

2. Many chemical compounds contain ions.

A strontium chloride	B lithium oxide	C calcium oxide
D barium fluoride	E sodium fluoride	F potassium chloride

(*a*) Identify the compound which produces a green flame colour.

You may wish to use the data booklet to help you.

A	B	C
D	E	F

1

(*b*) Identify the compound in which **both** ions have the same electron arrangement as argon.

A	B	C
D	E	F

1

(2)

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

3. The table contains information about some substances.

			Conducts as	
Substance	**Melting point/°C**	**Boiling point/°C**	**a solid**	**a liquid**
A	639	3228	yes	yes
B	2967	3273	no	no
C	159	211	no	no
D	1402	2497	no	yes
E	27	677	yes	yes

(*a*) Identify the substance which exists as a covalent network.

A
B
C
D
E

1

(*b*) Identify the substance which could be calcium fluoride.

A
B
C
D
E

1

(2)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

4. The grid shows the names of some ionic compounds.

A aluminium bromide	B sodium chloride	C potassium hydroxide
D sodium sulphate	E potassium bromide	F calcium chloride

(*a*) Identify the base.

A	B	C
D	E	F

1

(*b*) Identify the **two** compounds whose solutions would form a precipitate when mixed.

You may wish to use the data booklet to help you.

A	B	C
D	E	F

1

(*c*) Identify the compound with a formula of the type $\mathbf{XY_2}$, where **X** is a metal.

A	B	C
D	E	F

1

(3)

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

5. The names of some hydrocarbons are shown in the grid.

A ethane	B pentene	C cyclohexane
D pentane	E cyclopentane	F propene

(*a*) Identify the **two** isomers.

A	B	C
D	E	F

1

(*b*) Identify the hydrocarbon with the highest boiling point.

You may wish to use the data booklet to help you.

A	B	C
D	E	F

1

(*c*) Identify the **two** hydrocarbons which can take part in an addition reaction with hydrogen.

A	B	C
D	E	F

1

(3)

[Turn over

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6. Reactions can be represented using chemical equations.

A	$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$
B	$Fe^{2+}(aq) \rightarrow Fe^{3+}(aq) + e^-$
C	$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$
D	$2H_2O(\ell) + O_2(g) + 4e^- \rightarrow 4OH^-(aq)$
E	$SO_2(g) + H_2O(\ell) \rightarrow 2H^+(aq) + SO_3^{2-}(aq)$

(*a*) Identify the equation which shows the formation of acid rain.

A
B
C
D
E

1

(*b*) Identify the equation which represents a combustion reaction.

A
B
C
D
E

1

(*c*) Identify the **two** equations which are involved in the corrosion of iron.

A
B
C
D
E

2

(4)

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7. The grid contains information about the particles found in atoms.

A relative mass = 1	B charge = zero	C relative mass almost zero
D charge = 1–	E found outside the nucleus	F charge = 1+

Identify the **two** terms which can be applied to protons.

A	B	C
D	E	F

(2)

[Turn over

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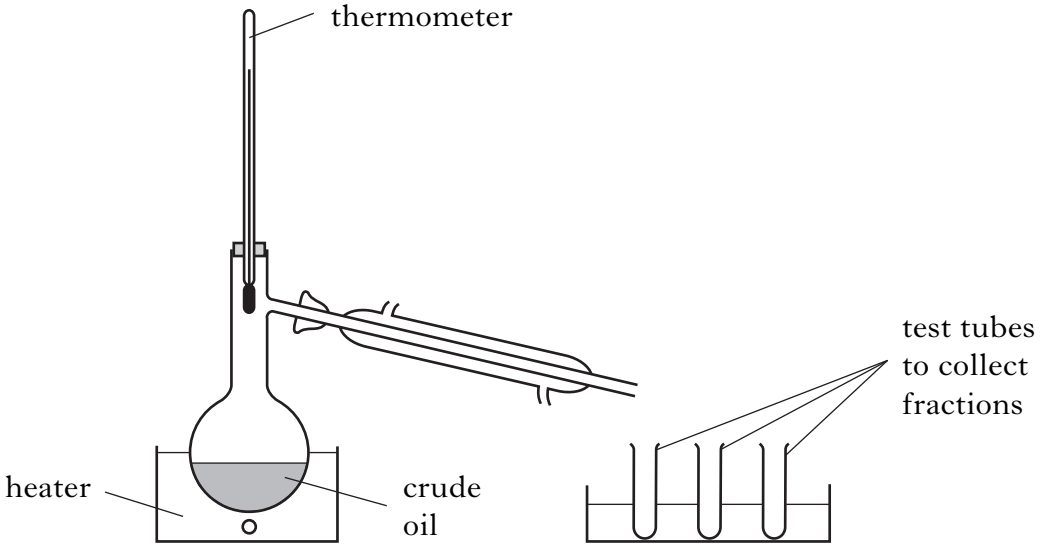
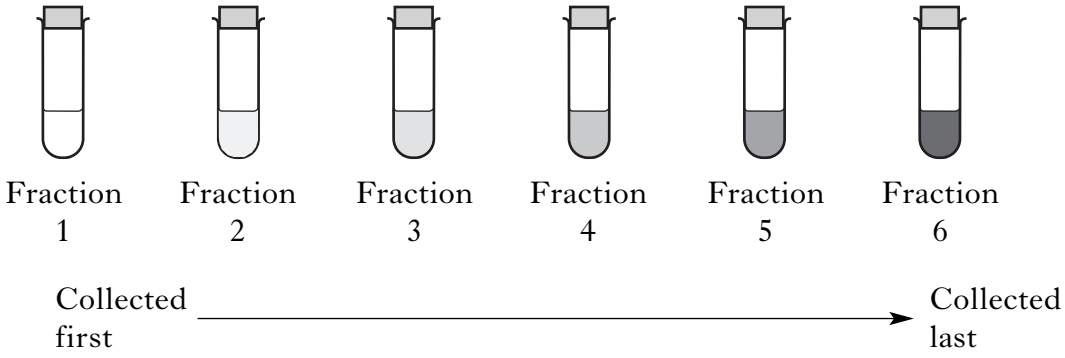
Marks	KU	PS

8. The fractional distillation of crude oil was demonstrated to a class.



Six fractions were numbered in the order they were collected.



Identify the **two** correct statements.

A	Fraction 6 evaporates most easily.
B	Fraction 5 is less viscous than fraction 4.
C	Fraction 2 is more flammable than fraction 3.
D	Fraction 1 has a lower boiling range than fraction 2.
E	The molecules in fraction 3 are larger than those in fraction 4.

A
B
C
D
E

(2)

[Turn over for Part 2 on *Page twelve*

DO NOT WRITE IN THIS MARGIN

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PART 2

A total of 40 marks is available in this part of the paper.

9. There are three different types of neon atom.

Type of atom	Number of protons	Number of neutrons
$^{20}_{10}\mathrm{Ne}$		
$^{21}_{10}\mathrm{Ne}$		
$^{22}_{10}\mathrm{Ne}$		

(*a*) Complete the table to show the number of protons and neutrons in each type of neon atom. **1**

(*b*) What term is used to describe these different types of neon atom?

_____ **1**

(*c*) A natural sample of neon has an average atomic mass of 20·2.

What is the mass number of the most common type of atom in the sample of neon?

_____ **1**

(3)

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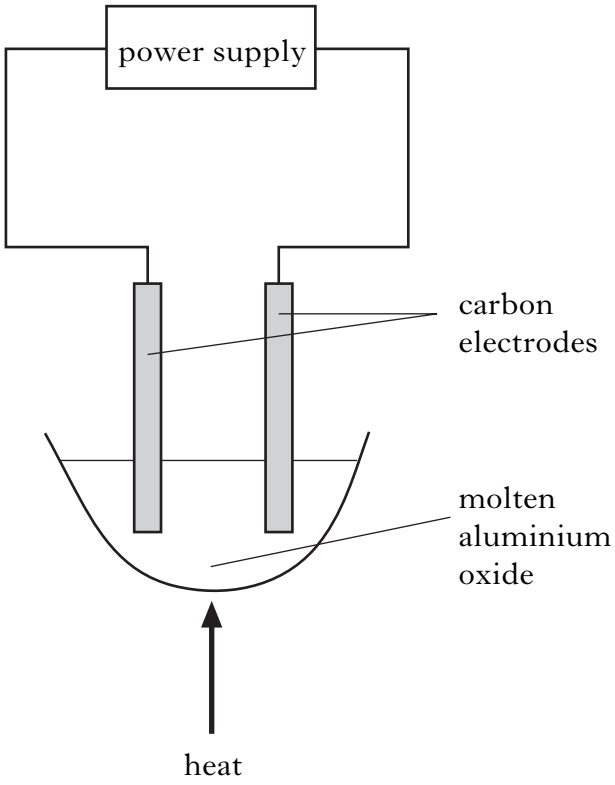
Marks	KU	PS

10. Aluminium metal can be produced by passing electricity through molten aluminium oxide.



(*a*) Name this process.

_____ **1**

(*b*) Write the ionic formula for aluminium oxide.

1

(*c*) Why do ionic compounds, like aluminium oxide, conduct electricity when molten?

_____

_____ **1**

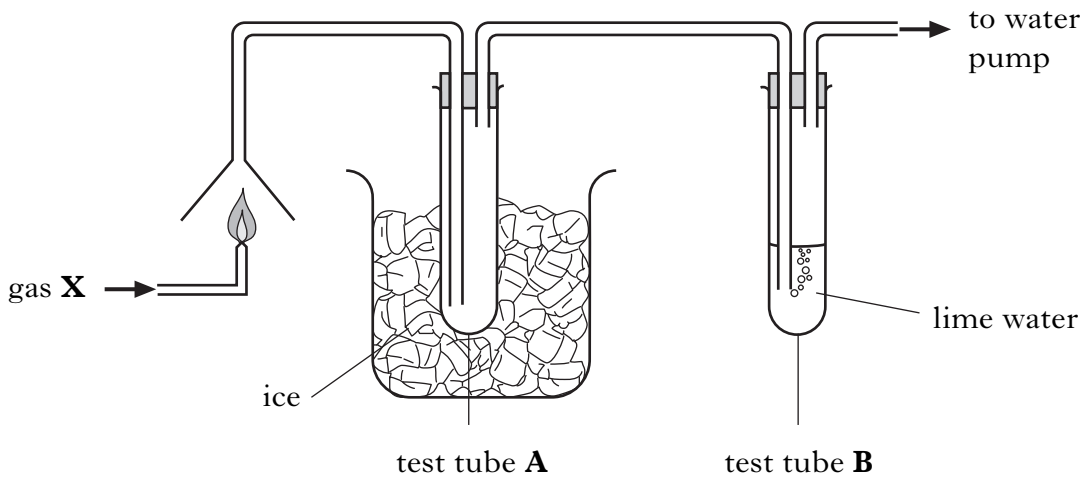
(3)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

11. A student burned gas **X** and the products were passed through the apparatus shown.



(*a*) The results are shown in the table.

Observation in test tube A	**Observation in test tube B**
colourless liquid forms	lime water turns milky

Using the information in the table, name two **elements** which **must** be present in gas **X**.

_____ **1**

(*b*) The experiment was repeated using hydrogen gas.

Complete the table showing the results which would have been obtained.

Observation in test tube A	**Observation in test tube B**

1

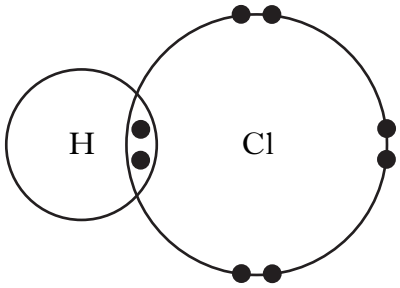
(2)

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

12. Hydrogen can form bonds with other elements.

The diagram shows the arrangement of outer electrons in a molecule of hydrogen chloride.



● = outer electron

(*a*) What type of bonding is present in a hydrogen chloride molecule?

_____ **1**

(*b*) Draw a similar diagram, showing **all** outer electrons, to represent a molecule of phosphine, PH_3.

1

(2)

[Turn over

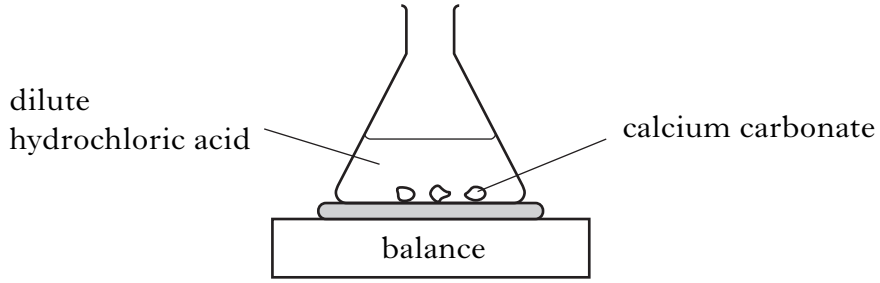
DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

13. The apparatus below was used to investigate the reaction between lumps of calcium carbonate and dilute hydrochloric acid.

Excess acid was used to make sure all the calcium carbonate reacted.

A balance was used to measure the mass lost during the reaction.



(*a*) Name the type of chemical reaction taking place when calcium carbonate reacts with dilute hydrochloric acid.

_____ **1**

(*b*) The results are shown in the table.

Time/minutes	0	0·5	1·0	2·0	3·0	4·0	5·0
Mass lost/g	0	0·36	0·52	0·70	0·80	0·86	0·86

(i) Why is mass lost during the reaction?

_____

_____ **1**

DO NOT WRITE IN THIS MARGIN

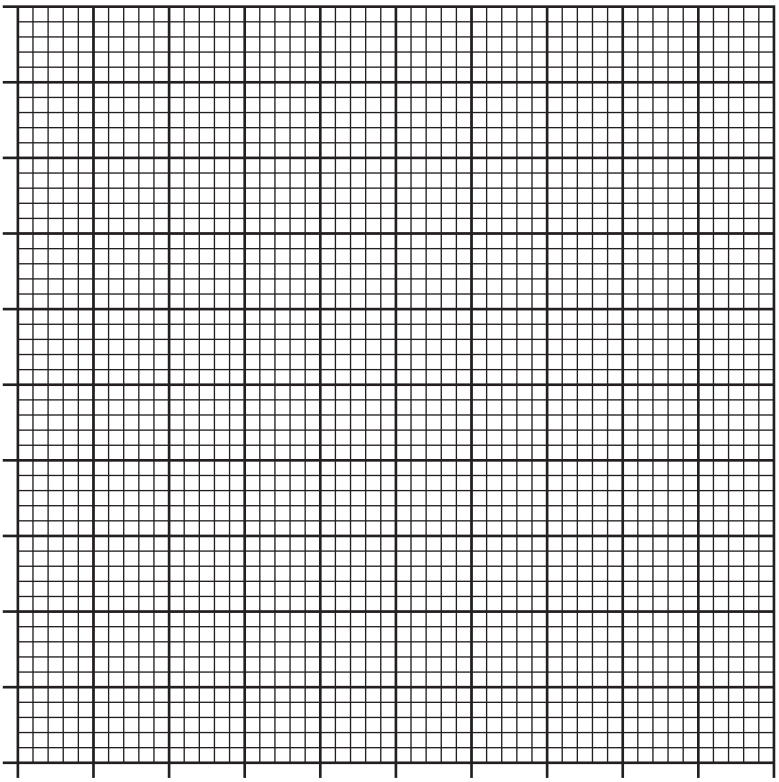
Marks | KU | PS

13. (*b*) (continued)

(ii) Draw a line graph of the results.

Use appropriate scales to fill most of the graph paper.

(Additional graph paper, if required, will be found on page 26.)



2

(*c*) The experiment was repeated using the same volume and concentration of acid. The same mass of calcium carbonate was used but **powder** instead of lumps.

Suggest how much mass would have been lost after three minutes.

_____ g **1**

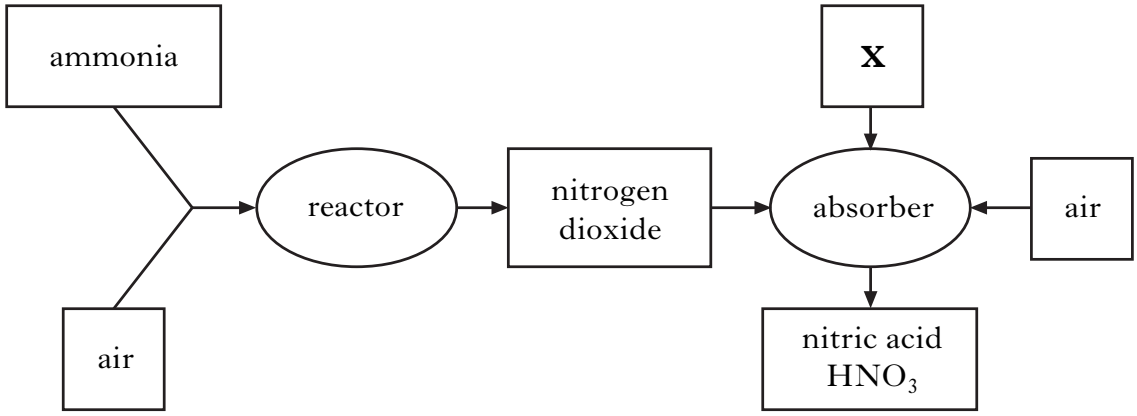
(5)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

14. (*a*) The flow diagram shows how ammonia is converted to nitric acid.



(i) Name the industrial process used to manufacture nitric acid.

_____ **1**

(ii) The reactor contains a platinum catalyst.

Why is it **not** necessary to continue heating the catalyst once the reaction has started?

_____

_____ **1**

(iii) Name substance **X**.

_____ **1**

(*b*) Ammonia and nitric acid react together to form ammonium nitrate, NH_4NO_3.

Calculate the percentage by mass of nitrogen in ammonium nitrate.

Show your working clearly.

_____% **2**

(5)

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

15. A student carried out some experiments with four metals and their oxides. The results are shown in the table.

Metal	Reaction with cold water	Reaction with dilute acid	Effect of heat on metal oxide
W	no reaction	no reaction	no reaction
X	no reaction	gas produced	no reaction
Y	gas produced	gas produced	no reaction
Z	no reaction	no reaction	metal produced

(*a*) Place the four metals in order of reactivity (**most reactive first**).

_____ **1**

(*b*) Name the gas produced when metal **Y** reacts with cold water.

_____ **1**

(*c*) Suggest names for metals **Y** and **Z**.

metal **Y** _____ metal **Z** _____ **1**

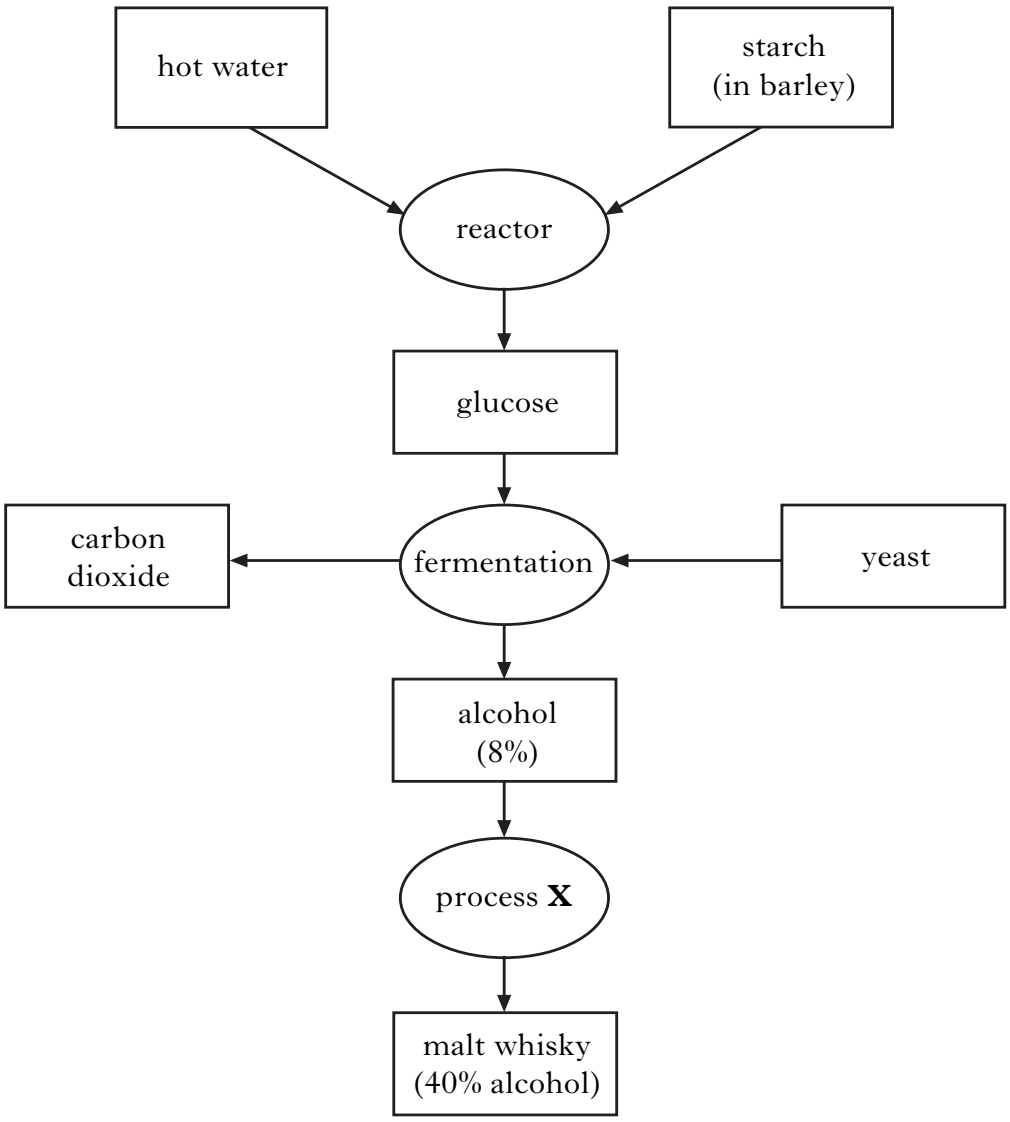
(3)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

16. The diagram shows the main stages in the making of malt whisky.



(*a*) Name the type of chemical reaction which takes place in the reactor.

_____ **1**

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

16. (continued)

(*b*) The equation for the reaction taking place during fermentation is:

$$C_6H_{12}O_6 \longrightarrow C_2H_5OH + CO_2$$

Balance this equation. **1**

(*c*) What name is given to process **X**?

_____ **1**

(*d*) Ethanol, C_2H_5OH, is the alcohol found in whisky.
A bottle of whisky contains 230 g of ethanol.
Calculate the number of moles of ethanol present in the whisky.
Show your working clearly.

_____ mol **2**

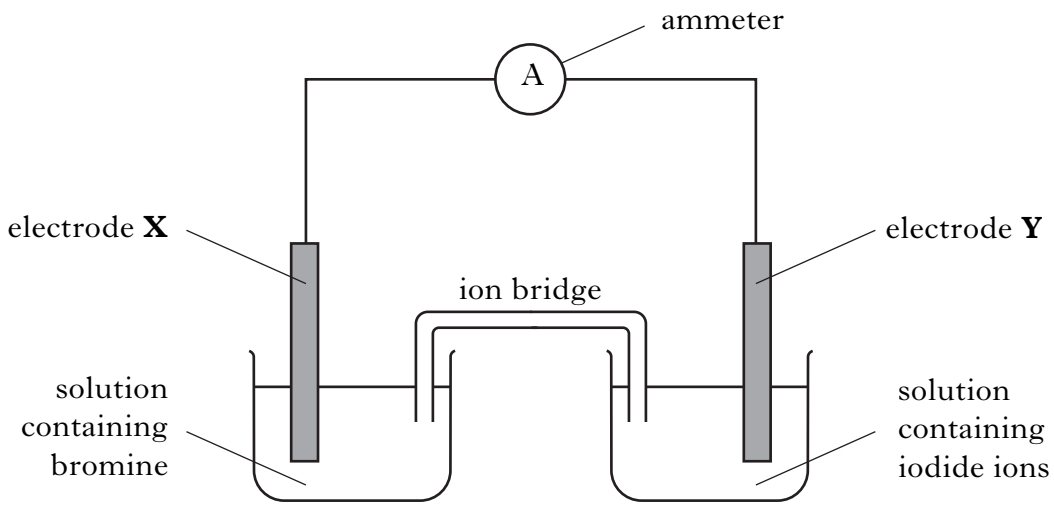
(5)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

17. A student set up the cell shown.



The reaction taking place at electrode **Y** is:

$$2I^-(aq) \longrightarrow I_2(s) + 2e^-$$

(*a*) Name the type of chemical reaction taking place at electrode **Y**.

_____ **1**

(*b*) **On the diagram**, clearly mark the path and direction of the electron flow. **1**

(*c*) Describe a test, including the result, which would show that iodine had formed at electrode **Y**.

_____

_____ **1**

(*d*) Write the ion-electron equation for the chemical reaction taking place at electrode **X**.

1

(4)

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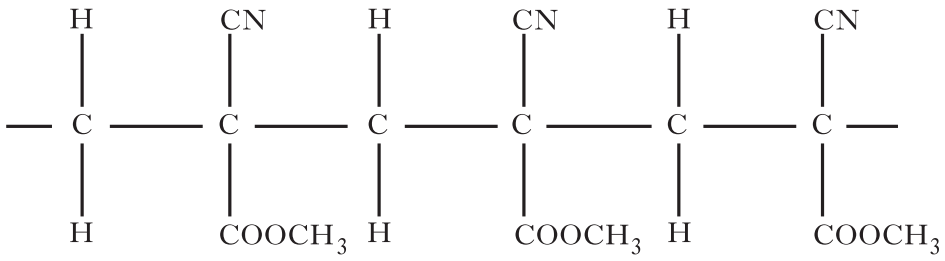
Marks | KU | PS

18. When superglue sets, a polymer is formed.

Part of the polymer structure is shown.



(*a*) Draw the structure of the repeating unit in the superglue polymer.

1

(*b*) The polymer shown above contains methyl groups (CH_3).

Another type of superglue, used to close cuts, has the methyl groups replaced by either butyl groups (C_4H_9) or octyl groups.

Complete the table to show the number of carbon and hydrogen atoms in an octyl group.

	Number of atoms	
Group	**Carbon**	**Hydrogen**
methyl	1	3
butyl	4	9
octyl		

1

(*c*) Name a toxic gas given off when superglue burns.

_____

1

(3)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

19. (*a*) The table gives information about some members of the alkane family.

Name	Molecular formula	Boiling point/°C
nonane	C_9H_{20}	151
decane	$C_{10}H_{22}$	174
undecane	$C_{11}H_{24}$	196
dodecane	$C_{12}H_{26}$	

Predict the boiling point of dodecane.

_____ °C **1**

(*b*) What term is used to describe any family of compounds, like the alkanes, which have the same general formula and similar chemical properties?

_____ **1**

(*c*) The equation for the burning of nonane is:

$$C_9H_{20} + 14O_2 \longrightarrow 9CO_2 + 10H_2O$$

Calculate the mass of water produced when 6·4 grams of nonane is burned.

Show your working clearly.

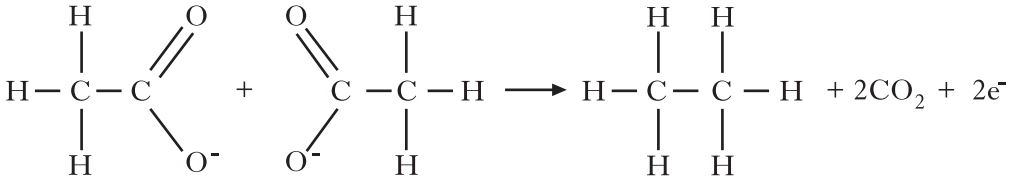
_____ g **2**

DO NOT WRITE IN THIS MARGIN

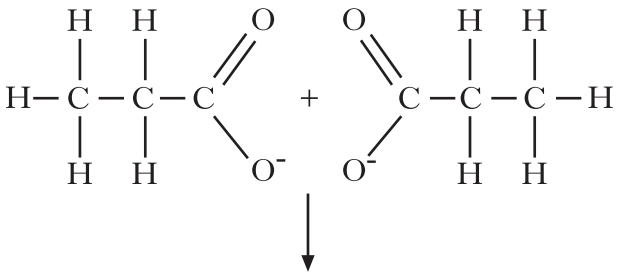
Marks	KU	PS

19. (continued)

(*d*) Alkanes can be prepared by the Kolbé synthesis.



Draw a structural formula for the alkane produced when propanoate ions are used instead of ethanoate ions.



1

(5)

[*END OF QUESTION PAPER*]

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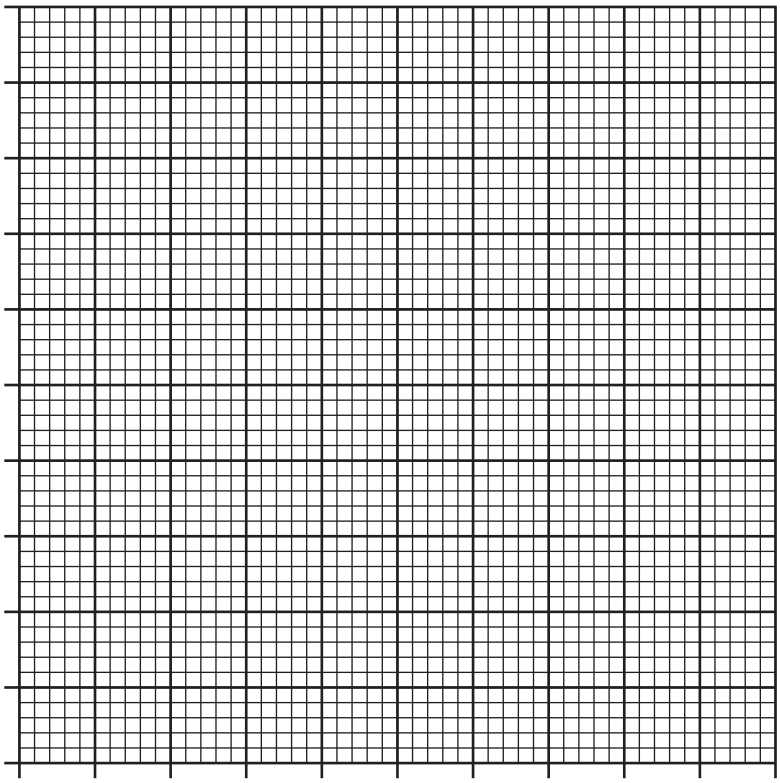
ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL GRAPH PAPER FOR QUESTION 13(*b*)(ii)



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ADDITIONAL SPACE FOR ANSWERS

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