FOR OFFICIAL USE

C

KU	PS

Total Marks

0500/31/01

NATIONAL QUALIFICATIONS 2012

MONDAY, 14 MAY
10.50 AM – 12.20 AM

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 9 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. The grid shows the formulae of some gases.

A CO	B NO_2	C CO_2
D H_2	E HCl	F O_2

(*a*) Identify the **two** toxic gases produced during the burning of polyvinylchloride (PVC).

A	B	C
D	E	F

1

(*b*) Identify the gas which burns with a pop.

A	B	C
D	E	F

1

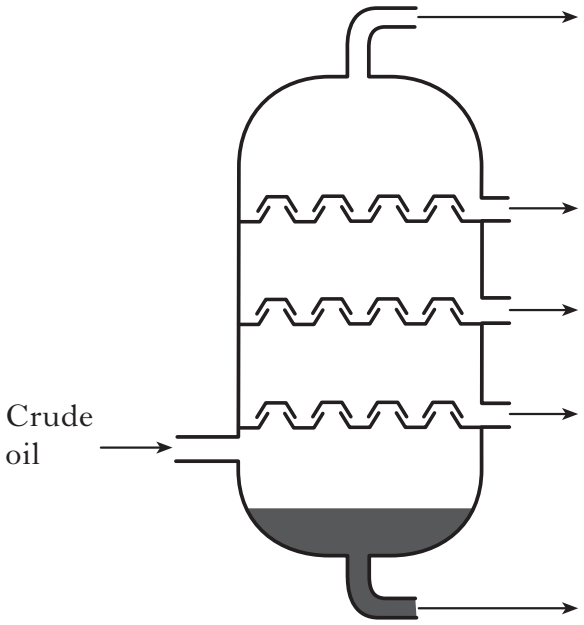
(2)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks KU PS

2. The table shows some fractions from crude oil.



Fraction	Boiling range/°C	Name of fraction
A	–160 to 20 °C	Refinery Gas
B	20 to 120 °C	Naphtha
C	120 to 240 °C	Kerosene
D	240 to 350 °C	Gas Oils
E	Over 350 °C	Residue

(*a*) Identify the fraction with the longest chain length.

A
B
C
D
E

1

(*b*) Identify the fraction which is used as fuel for aeroplanes.

A
B
C
D
E

1

(2)

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

3. Lead(II) nitrate solution reacts with potassium iodide solution to give a yellow solid.

$Pb^{2+}(aq) + 2NO_3^-(aq) + 2K^+(aq) + 2I^-(aq) \rightarrow Pb^{2+}(I^-)_2(s) + 2K^+(aq) + 2NO_3^-(aq)$

Identify the **two** spectator ions in the reaction.

A	Pb^{2+}
B	NO_3^-
C	K^+
D	I^-

A
B
C
D

(1)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

4. The grid shows information about some particles.

	Number of		
Particle	**protons**	**neutrons**	**electrons**
A	11	12	11
B	9	10	9
C	11	13	11
D	19	20	18
E	9	10	10

(*a*) Identify the particle which is a negative ion.

A
B
C
D
E

1

(*b*) Identify the particle which would give a lilac flame colour.
You may wish to use the data booklet to help you.

A
B
C
D
E

1

(*c*) Identify the **two** particles which are isotopes.

A
B
C
D
E

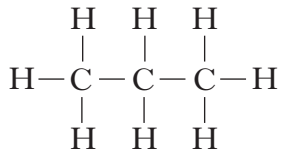
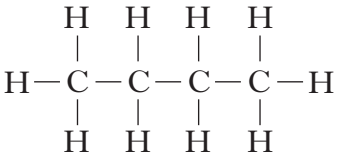
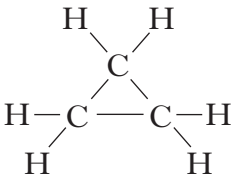
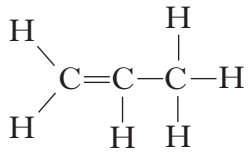
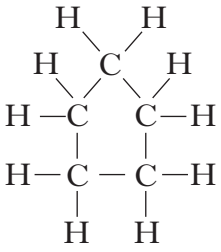
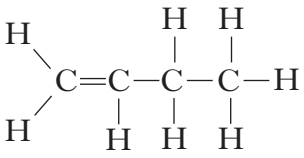
1

(3)

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

5. The grid shows the structural formulae of some hydrocarbons.

A 	B 	C 
D 	E 	F 

(*a*) Identify the hydrocarbon which reacts with hydrogen to form butane.

A	B	C
D	E	F

1

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

A	B	C
D	E	F

1

(*c*) Identify the structural formula which represents propene.

A	B	C
D	E	F

1

(3)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

6. Equations are used to represent chemical reactions.

A	$Zn(s) \longrightarrow Zn^{2+}(aq) + 2e^-$
B	$C_2H_5OH(\ell) + 3O_2(g) \longrightarrow 2CO_2(g) + 3H_2O(\ell)$
C	$SO_2(g) + H_2O(\ell) \longrightarrow 2H^+(aq) + SO_3^{2-}(aq)$
D	$H^+(aq) + OH^-(aq) \longrightarrow H_2O(\ell)$
E	$SO_4^{2-}(aq) + 2H^+(aq) + 2e^- \longrightarrow SO_3^{2-}(aq) + H_2O(\ell)$

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

A
B
C
D
E

1

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

A
B
C
D
E

1

(2)

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

7. The grid shows the names of some soluble compounds.

A sodium iodide	B potassium chloride	C lithium chloride
D barium bromide	E sodium hydroxide	F potassium sulphate

(*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)

[Turn over

DO NOT WRITE IN THIS MARGIN

8. The grid shows the names of some processes.

A	distillation
B	precipitation
C	filtering
D	electrolysis
E	dissolving

(*a*) Identify the process which is used to increase the alcohol concentration of fermentation products.

A
B
C
D
E

Marks **1**

(*b*) Identify the **two** processes which should be used to separate magnesium carbonate from a mixture of solid magnesium carbonate and solid magnesium chloride.

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

A
B
C
D
E

1

(2)

KU	PS

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

9. A student made some statements about the particles in an atom.

A	It has a negative charge.
B	It is found inside the nucleus.
C	It has zero charge.
D	It is found outside the nucleus.
E	It has a relative mass of almost zero.
F	It has a relative mass of 1.

Identify the **two** statements which apply to a proton.

A
B
C
D
E
F

(2)

[Turn over for Part 2 on *Page twelve*

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

PART 2

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

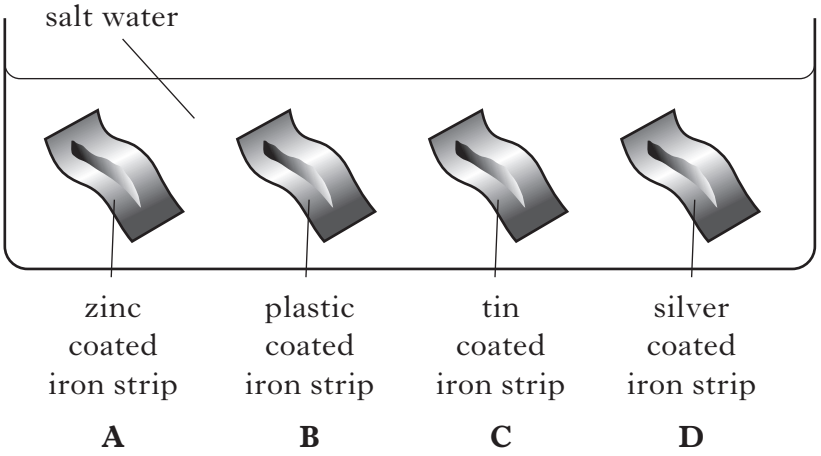
10. Iron can be coated with a physical barrier to prevent rusting.

(*a*) How does coating iron prevent rusting?

_____

_____ **1**

(*b*) A student investigated the rusting of iron. The coatings on four strips of iron were **scratched** to expose the iron. The strips were then placed in salt water.



(i) Which iron strip has been galvanised, **A**, **B**, **C** or **D**?

_____ **1**

(ii) Which iron strip would have rusted most quickly, **A**, **B**, **C** or **D**?

_____ **1**

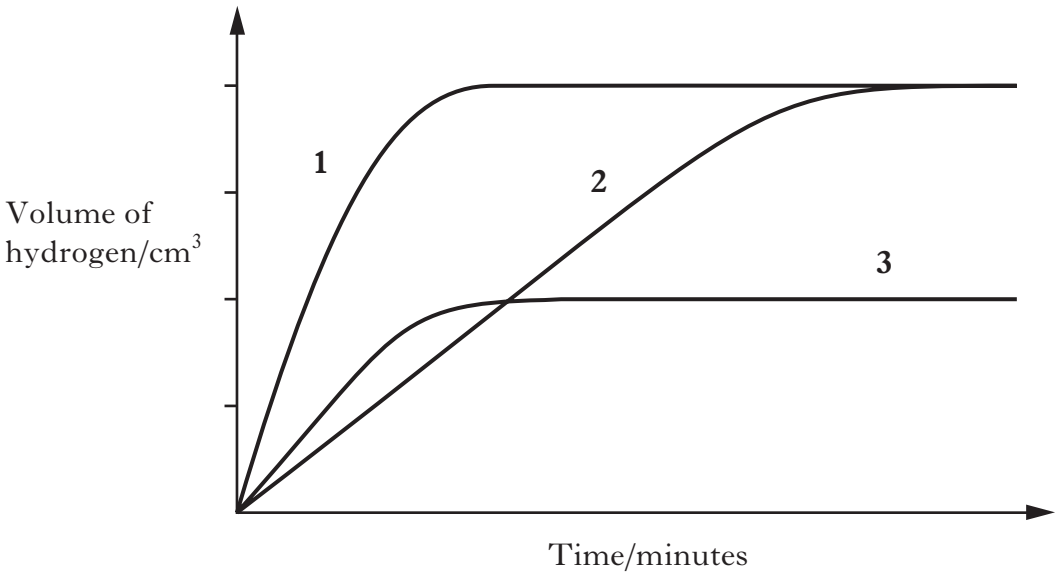
(3)

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

11. A student carried out some experiments between zinc and excess 1 mol/l hydrochloric acid.

The graph shows the results of each experiment.



(*a*) In which experiment did the reaction take longest to finish, **1**, **2** or **3**?

_____ **1**

(*b*) In **all** three experiments she kept the temperature the same and used the same volume of 1 mol/l hydrochloric acid.

(i) Suggest one factor that could have been changed from experiment **1** to produce the results in experiment **2**.

_____ **1**

(ii) 1 g of zinc was used in experiment **1**.

What mass of zinc was used in experiment **3**?

_____ g **1**

(3)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks KU PS

12. Ammonia is produced in the Haber process.

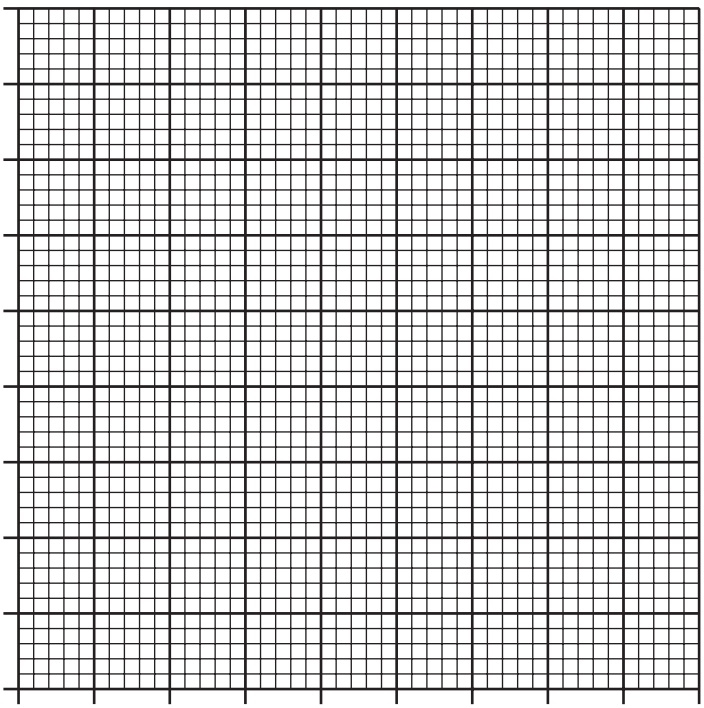
The percentage yield of ammonia, obtained at different pressures, is shown in the table.

Pressure/ atmospheres	Percentage yield of ammonia
50	6
100	10
150	14
200	19
250	22
350	29
400	32

(*a*) Draw a line graph of the results.

Use appropriate scales to fill most of the graph paper.

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



2

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

12. (continued)

(*b*) Using your graph, estimate the yield of ammonia at 300 atmospheres.

_____ % **1**

(*c*) Temperature is another factor which affects the percentage yield of ammonia.

Temperature/°C	**Percentage yield of ammonia**
200	88
300	67
400	49
500	18

Suggest a reason why 500 °C is the temperature chosen to operate an industrial ammonia plant rather than 200 °C.

_____

_____ **1**

(4)

[Turn over

DO NOT WRITE IN THIS MARGIN

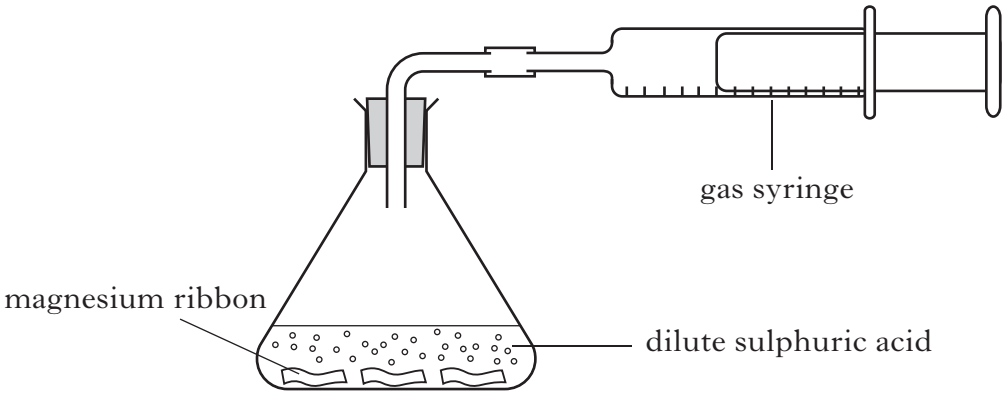
Marks | KU | PS

13. Hydrogen gas is made up of diatomic molecules.

(*a*) Draw a diagram to show how the electrons are arranged in a molecule of hydrogen, H_2.

1

(*b*) Hydrogen gas is produced when magnesium reacts with dilute sulphuric acid.



The equation for the reaction is:

$$Mg(s) + H_2SO_4(aq) \longrightarrow MgSO_4(aq) + H_2(g)$$

(i) Circle the formula for the salt in the above equation. **1**

Marks | KU | PS

13. (*b*) (continued)

(ii) The table shows the volume of hydrogen gas produced over fifty seconds.

Time/s	**Volume of gas/cm^3**
0	0
10	20
20	40
30	55
40	65
50	72

The average rate at which gas is produced can be calculated as shown.

$$\text{average rate between 10 and 20 seconds} = \frac{\text{change in volume of gas during time period}}{\text{length of time period}}$$

$$= \frac{40-20}{20-10} = \frac{20}{10}$$

$$= 2\ \text{cm}^3/\text{s}$$

Calculate the average rate at which gas is produced between **20 seconds** and **30 seconds**.

_____ cm^3/s **1**

(3)

DO NOT WRITE IN THIS MARGIN

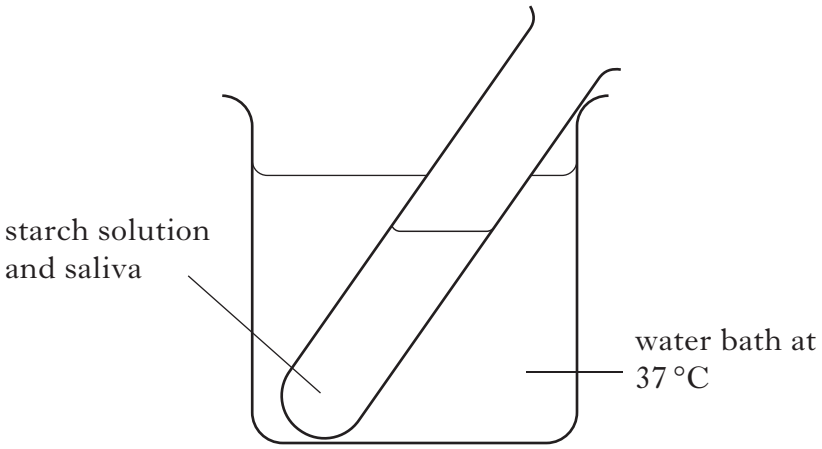
Marks	KU	PS

14. Saliva contains an enzyme which breaks down starch.

(*a*) Name the type of chemical reaction taking place when starch breaks down.

_____ **1**

(*b*) A student carried out an experiment to break down starch.



He repeated the experiment using water at 100 °C.

What effect would this have on the activity of the enzyme?

_____ **1**

(*c*) The monosaccharide glucose is produced when starch is broken down.

Name another monosaccharide.

_____ **1**

(3)

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

15. Potassium hydroxide reacts with sulphuric acid to form potassium sulphate, which can be used as a fertiliser.

$$KOH(aq) + H_2SO_4(aq) \longrightarrow K_2SO_4(aq) + H_2O(\ell)$$

(*a*) Balance the above equation. **1**

(*b*) Name the type of chemical reaction taking place.

_____ **1**

(*c*) Calculate the percentage, by mass, of potassium in potassium sulphate, K_2SO_4.

Show your working clearly.

_____ % **2**

(*d*) Ammonium phosphate is also used as a fertiliser.

Write the **ionic** formula for ammonium phosphate.

1

(5)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

16. Titanium is an important metal used in aircraft manufacture.

(*a*) Titanium can be produced from titanium chloride as shown.

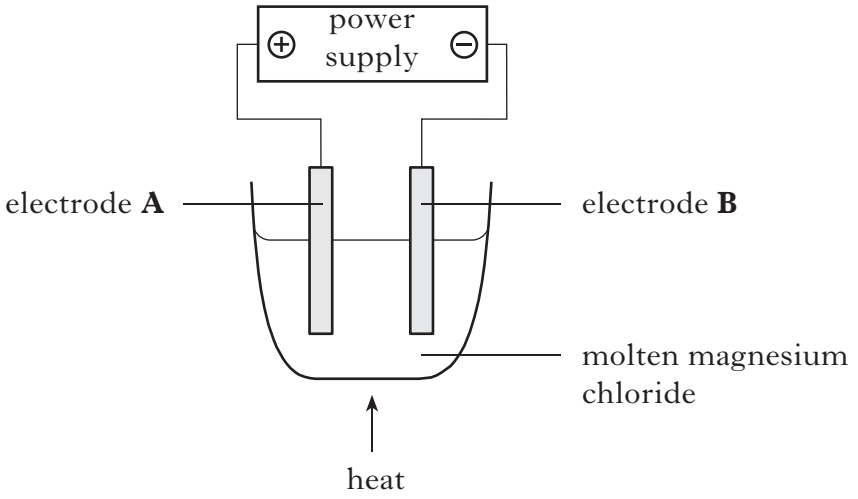
$$2Mg(s) + TiCl_4(\ell) \longrightarrow 2MgCl_2(s) + Ti(s)$$

Name the type of chemical reaction represented by the equation.

_____

1

(*b*) The magnesium chloride produced can be electrolysed as shown.



(i) At which electrode would magnesium be produced, **A** or **B**?

_____

1

(ii) Write the ion-electron equation for the formation of chlorine.
You may wish to use the data booklet to help you.

1

(3)

DO NOT WRITE IN THIS MARGIN

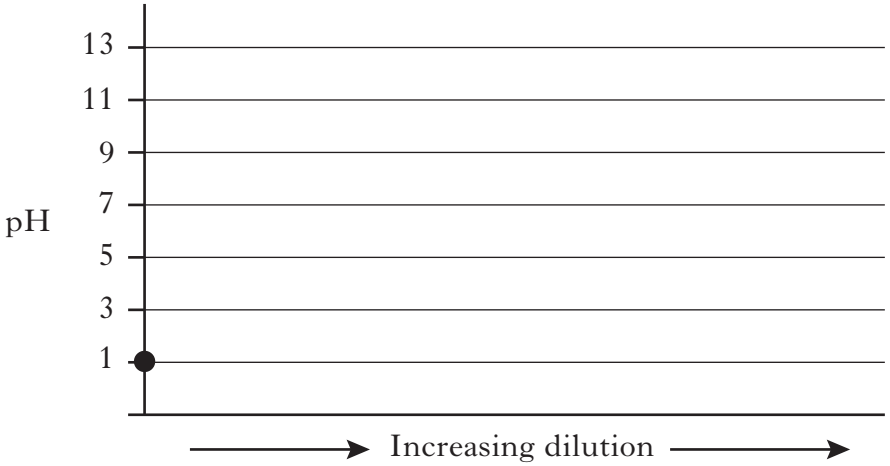
Marks | KU | PS

17. A solution of 0·1 mol/l hydrochloric acid has a pH of 1.

(*a*) (i) What colour would universal indicator turn when added to a solution of hydrochloric acid?

_____ **1**

(ii) Starting at pH 1, draw a line to show how the pH of this acid changes when diluted with water.



1

(*b*) Calculate the number of moles of hydrochloric acid in 50 cm^3 of 0·1 mol/l hydrochloric acid solution.

_____ mol **1**

(3)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

18. A student investigated how the concentration of sodium chloride in water affected the freezing point.

(*a*) What type of bond is broken in sodium chloride when it dissolves in water?

_____ **1**

(*b*) The table shows information about the freezing point of different sodium chloride solutions.

Concentration of sodium chloride solution (mol/l)	0	0·09	0·18	0·27	0·37	0·46
Freezing point (°C)	0	−0·2	−0·5	−0·8	−1·1	−1·5

Describe the relationship between the concentration and freezing point.

_____

_____ **1**

(*c*) Predict the freezing point of a 0·55 mol/l sodium chloride solution.

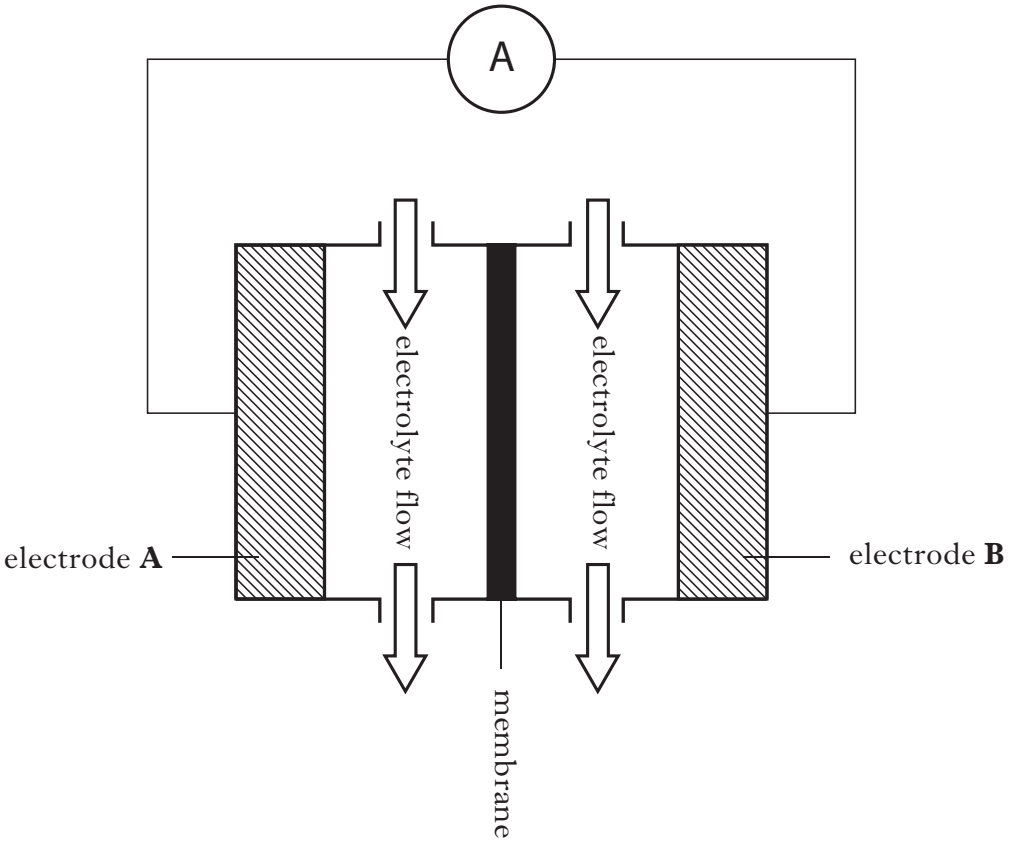
_____°C **1**

(3)

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

19. In Australia flow cells are used to store the energy from solar cells.



(*a*) The reaction taking place at electrode **A** when the cell is providing electricity is:

$$Zn \longrightarrow Zn^{2+} + 2e^{-}$$

Name the type of chemical reaction taking place at electrode **A**.

_____ **1**

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

(*c*) Name the non-metal, that conducts electricity, which could be used as an electrode.

_____ **1**

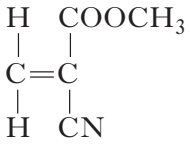
(3)

[Turn over

DO NOT WRITE IN THIS MARGIN

Marks	KU	PS

20. The monomer in superglue has the following structure.



(*a*) Draw a section of the polymer, showing **three** monomer units joined together.

1

(*b*) The polymer does **not** change shape on heating.

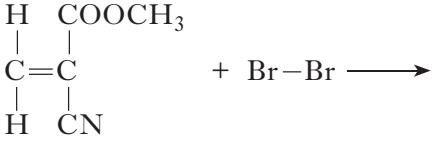
What term is used to describe this type of polymer?

_____

1

(*c*) Bromine reacts with the monomer to produce a saturated compound.

Draw the structural formula for this compound.



1

(3)

DO NOT WRITE IN THIS MARGIN

Marks | KU | PS

21. Aluminium is extracted from the ore bauxite.

(*a*) (Circle) the correct phrase to complete the sentence.

Aluminium is extracted from its ore { by heating with carbon / by heating alone / by electrolysis }. **1**

(*b*) Aluminium can be mixed with other metals to make a magnet.

What term is used to describe a mixture of metals?

_____ **1**

(*c*) The composition of a 250 g magnet is shown.

Metal	aluminium	nickel	cobalt	copper	titanium	iron
% by mass	10	25	20	4	1	40

(i) Calculate the mass, in grams, of aluminium in the magnet.

Show your working clearly.

_____ g **1**

(ii) Using your answer to (*c*)(i), calculate the number of moles of aluminium in the magnet.

Show your working clearly.

_____ mol **1**

(4)

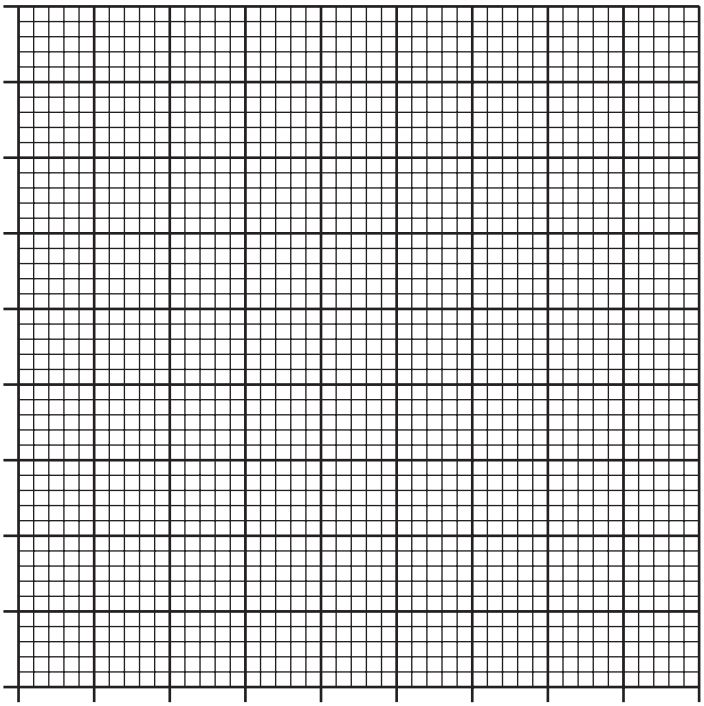
[*END OF QUESTION PAPER*]

DO NOT WRITE IN THIS MARGIN

KU	PS

ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL GRAPH PAPER FOR QUESTION 12(*a*)



DO NOT WRITE IN THIS MARGIN

KU	PS

ADDITIONAL SPACE FOR ANSWERS

DO NOT WRITE IN THIS MARGIN

KU	PS

ADDITIONAL SPACE FOR ANSWERS