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GCSE

3430U50-1

FRIDAY, 27 MAY 2022 – MORNING

SCIENCE (Double Award)

Unit 5 – CHEMISTRY 2

FOUNDATION TIER

1 hour 15 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	13	
2.	9	
3.	9	
4.	8	
5.	6	
6.	7	
7.	8	
Total	60	

ADDITIONAL MATERIALS

In addition to this examination paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid. You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

Question **5** is a quality of extended response (QER) question where your writing skills will be assessed.
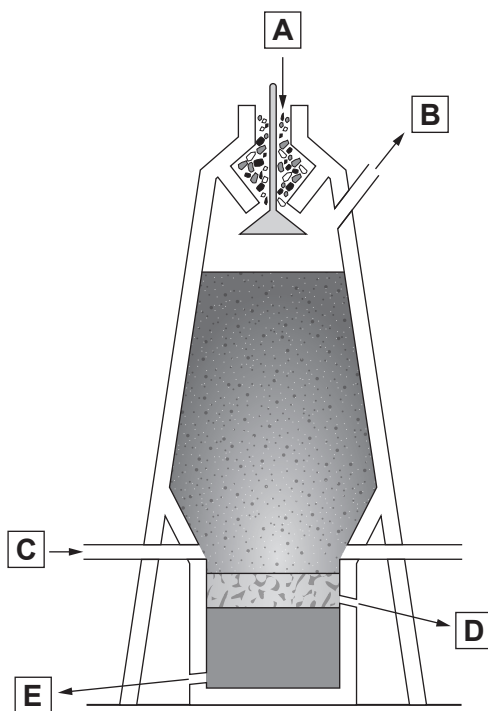
The Periodic Table is printed on the back cover of this paper and the formulae for some common ions on the inside of the back cover.

Answer **all** questions.

1. (a) The diagram shows a blast furnace which is used to extract iron.

Labels **A**, **B**, **C**, **D** and **E** show where substances enter and leave the furnace.

(i) Give the letter, **A**, **B**, **C**, **D** or **E**, that shows where

iron ore enters the furnace ....

waste gases leave the furnace ....

slag is removed .... [3]

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(ii) One of the main reactions inside the blast furnace is represented by the following equation.

①

iron oxide   +   carbon monoxide   ⟶   iron   +   carbon dioxide

②   ③
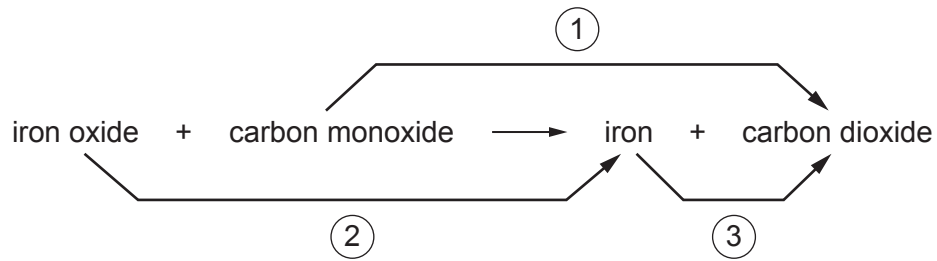
Give the number of the arrow that shows oxidation. [1]

....

(iii) Limestone is added to the furnace to remove impurities.

The chemical name for limestone is calcium carbonate.

Calcium carbonate contains the ions Ca^{2+} and CO_3^{2-}.

Circle the correct formula for calcium carbonate. [1]

CaCO   **Ca$_2$CO$_3$**   **CaCO$_3$**   **Ca(CO$_3$)$_2$**

(iv) One of the waste gases that leaves the blast furnace is carbon dioxide, CO_2.

Put a tick (✓) in the box next to the diagram that best represents a carbon dioxide molecule. [1]

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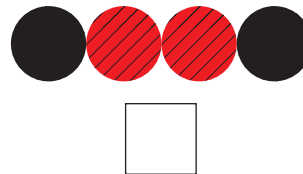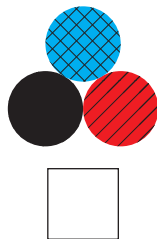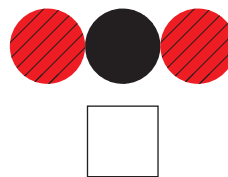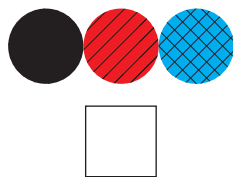
(b)   The diagram shows an electrolysis cell used in the extraction of aluminium.
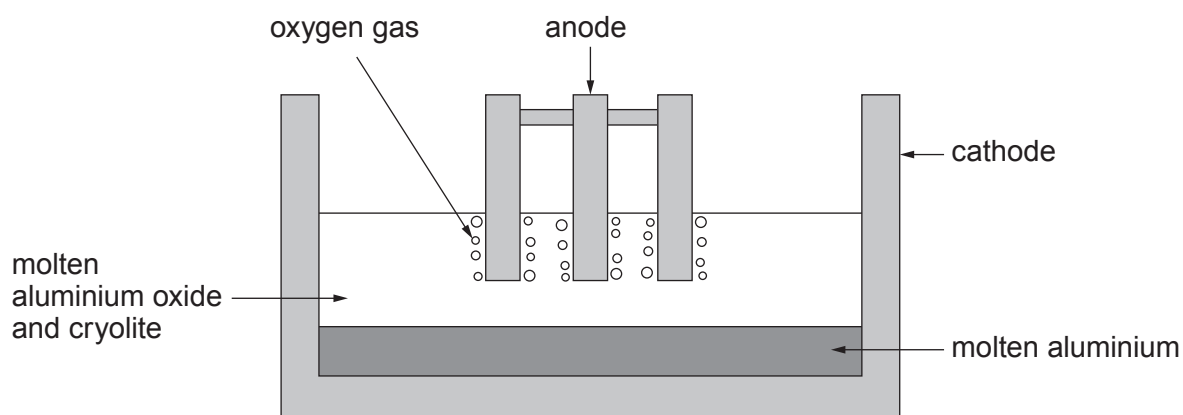
(i)   Draw **one** line from each term to its correct definition.   [3]

Term	Definition

Term

anode

electrolyte

electrolysis

Definition

positive electrode

a substance that removes impurities

a substance that is split up during the process

using electricity to make a compound

using electricity to split up a compound

negative electrode

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(ii) Underline the correct word in the brackets to complete each sentence. [3]

Cryolite is added to lower the (**density / melting point / boiling point**) of the electrolyte.

When choosing a location for an aluminium plant in the UK, it is important to be near a port to (**import / export / clean**) the aluminium ore.

At the temperature inside the cell, the aluminium is produced as a (**solid / liquid / gas**).

(iii) The equation for the reaction that takes place during the extraction of aluminium is given below.

$$2Al_2O_3 \longrightarrow \boxed{} Al \ + \ 3O_2$$

Choose a number from the box to balance the equation. [1]

2	4	6

13

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2. **(a)** Hannah and Evan investigated the temperature increase when sodium hydroxide solution was added to dilute hydrochloric acid.

The method they used to collect their results is given below.

1. Measure $25\,cm^3$ of hydrochloric acid into a polystyrene cup.

2. Record the temperature of the hydrochloric acid.

3. Measure $25\,cm^3$ of sodium hydroxide and add it to the hydrochloric acid.

4. Record the highest temperature of the mixture.

5. Calculate the temperature increase for the reaction.

(i) Choose apparatus from the box to complete the following sentences. [2]

balance	**Bunsen burner**	**thermometer**	**measuring cylinder**
test tube	**stopwatch**	**tongs**	**beaker**

Hannah and Evan used a .... to measure $25\,cm^3$

of hydrochloric acid accurately.

Hannah and Evan used a .... to measure the

temperature of the mixture.

(ii) Give **one** way that Hannah and Evan could check that the method produces consistent results. [1]

....

(iii) Hannah and Evan calculated a temperature increase of 17 °C.

Give the term used to describe a reaction that gives a temperature increase. [1]

....

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(b)   When chlorine reacts with hydrogen, hydrogen chloride is formed.

$$H — H \ + \ Cl — Cl \ \longrightarrow \quad \begin{matrix} H — Cl \\ H — Cl \end{matrix}$$
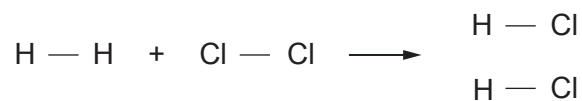
The bond energies are given in the table.

Bond	Bond energy (kJ)
H — H	436
Cl — Cl	243
H — Cl	432

(i)   The energy needed to break the bonds in the hydrogen and chlorine molecules is 679 kJ. Show how this value is calculated. [1]

(ii)   Calculate the energy released when **two** molecules of hydrogen chloride are formed. [2]

Energy released = ... kJ

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(iii) The energy profile diagram for the reaction between hydrogen and chlorine is given below.
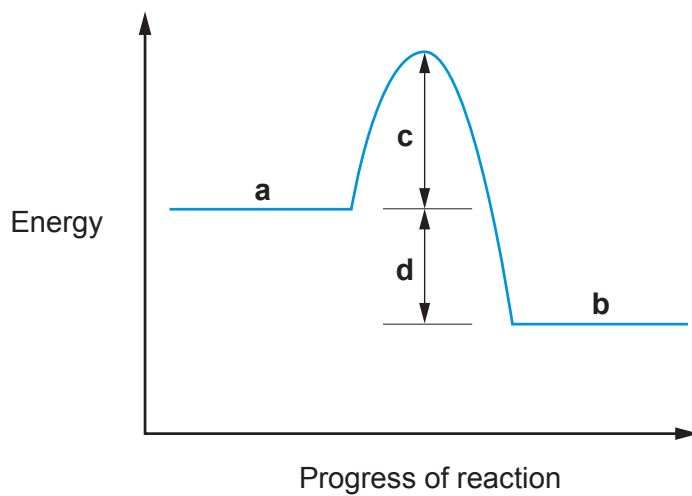
Give the letter that shows

the activation energy ....

the overall energy change for the reaction .... [2]

9

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Turn over.

3. **(a)** The diagram shows apparatus that can be used to investigate the products formed when methane gas burns. Methane has the formula CH_4.

burning methane gas

ice

suction pump

colourless gas **Y**

colourless liquid **X**

limewater turns milky
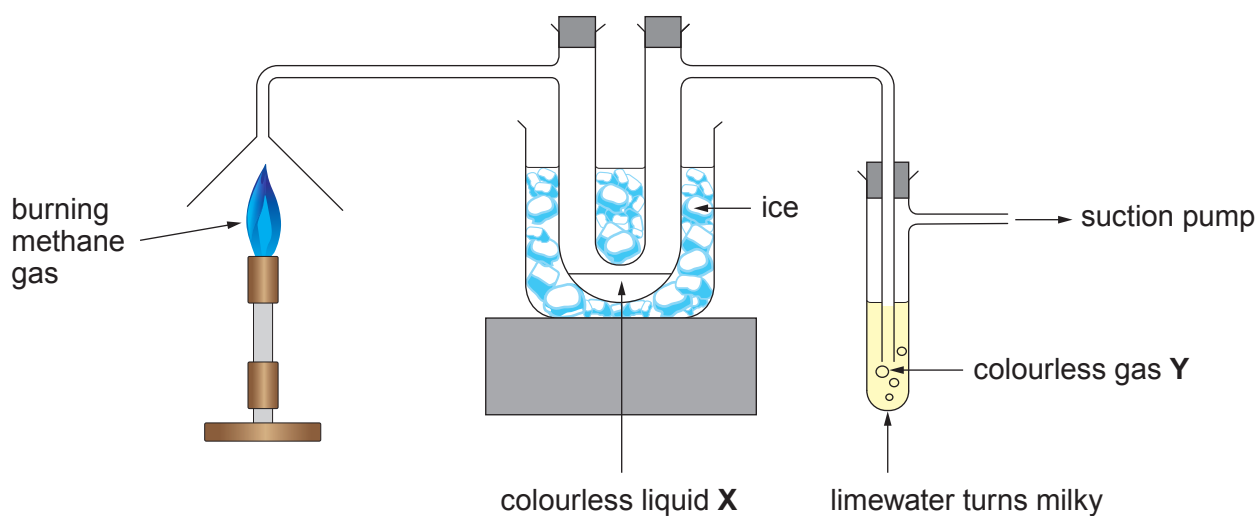
(i) Name the gas present in the air that is needed for methane to burn. [1]

....

(ii) Name the products formed. [2]

Colourless liquid **X** ....

Colourless gas **Y** ....

(iii) Tick (✓) the box that gives the name of the group of substances that methane belongs to. [1]

alkenes ☐

monomers ☐

polymers ☐

alkanes ☐

(b) Methane has the formula CH_4. Its molecules consist of one carbon atom and four hydrogen atoms bonded together.

   (i) Draw a diagram in the box to show how the atoms bond to form a methane molecule. [2]
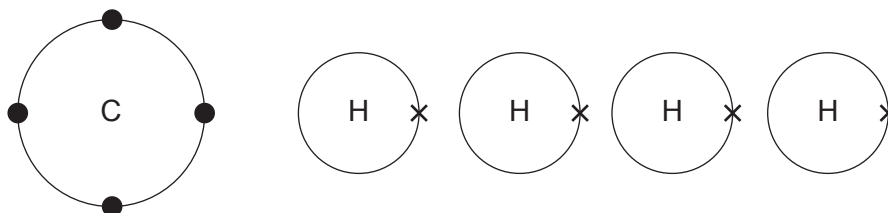
   (ii) Give the name of this type of bonding. [1]

   ....

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(c)   The fire triangle can be used to explain how fires are extinguished.
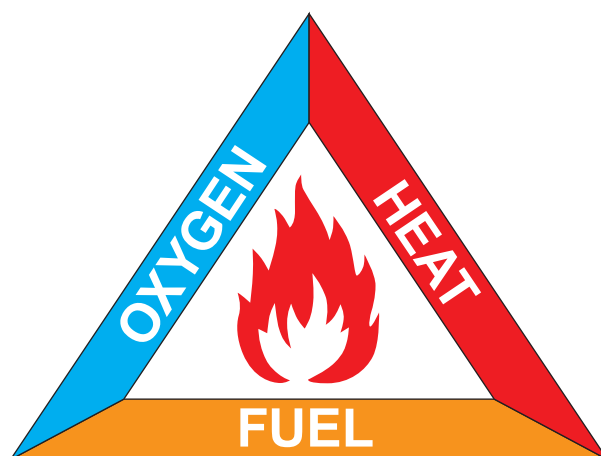
The following table gives information about three different types of fire and the methods used to extinguish them.

However, each of the three fires has an **error** in **one** of the columns.

Fire	Type of fire	Firefighting method	How method works
1	chip pan fire	tea towel	removes the heat
2	bonfire	fire blanket	removes the heat
3	electrical fire	fire breaks	removes the fuel

Circle the errors for fires **1** and **2** and then correct them in the table below.

The error for fire **3** has already been circled and the correction given.   [2]

Fire	Correction
1	
2	
3	Fire breaks are used to extinguish a forest fire

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(3430U50-1) **Turn over.**

4. **(a)** Supermarkets across the UK now charge customers a minimum of 5p for every plastic carrier bag supplied.

The reason for the charge is to reduce the number of plastic carrier bags used by consumers and therefore reduce waste and litter.

Since the introduction of the charge for plastic carrier bags in Wales, the number of these bags used by consumers has fallen by over 70 %.

Similarly, reports in England claim that supermarkets have issued 83 % fewer bags since the charge was introduced.

It is estimated that every person in the UK currently uses around 25 plastic carrier bags per year, compared to around 140 before charges were introduced.

The majority of the money retailers generate from sales of carrier bags is donated to good causes. A survey of retailers across England and Wales reported that £87 million had been donated to good causes since the introduction of the 5p charge, amounting to 4p for every bag sold.

(i) Use the information in the passage to decide whether the following statements are **true** or **false**.

Put a tick (✓) in the correct column for each statement. [3]

Statement	True	False
The number of plastic bags used in Wales and England has reduced since charging for them		
Retailers donate all the money generated from the sale of plastic bags to good causes		
Plastic bags are no longer used		
The charge for plastic bags has totally stopped their use in Wales		
The use of plastic bags leads to environmental problems		
The charge for plastic bags is beneficial to good causes		

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(ii)   How many fewer plastic bags will each person in the UK use over a 5-year period, based on the estimated number of bags used per person before and after the charge was introduced?   [2]

Number of bags = ...

(b)   More than half of all consumers still regularly buy plastic bags.

The pie chart shows the results of a survey where 100 consumers were asked what is the most they would pay for a plastic bag.
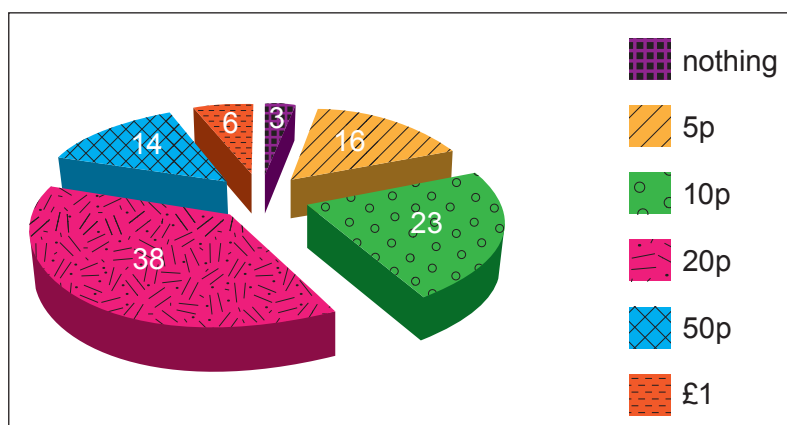
Give the number of consumers that would be prepared to pay **more than** 5p for a plastic bag.   [2]

Number of consumers = ...

(c)   Give **one** property of plastics which leads to long-term environmental problems.   [1]

....

8

(3430U50-1)   **Turn over.**

5. Seren and Ethan carried out an experiment to compare the reactivities of three metals.

The table shows the results obtained when each metal was placed into solutions of the nitrates of the other metals.

A tick (✓) indicates that a reaction took place and a cross (×) indicates that no reaction took place.

	magnesium	iron	copper
magnesium nitrate		×	×
iron(II) nitrate	✓		×
copper(II) nitrate	✓	✓	

Use the results to give the order of reactivity of the metals. Explain your answer in terms of the reactions taking place. Include equations in your answer. [6 QER]

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6

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(3430U50-1) **Turn over.**

6. Polymer gels are commonly used in disposable nappies.

A company that manufactures disposable nappies was investigating the effect of temperature on the mass of water the polymer gel in their nappies is able to absorb.

(a) The results collected using water at 40 °C are given below. The initial mass of the polymer gel bead was 0.035 g.

Time (hours)	Mass of bead (g)	Mass of water absorbed by bead (g) (to 1 decimal place)
0	0.035	0.0
2	4.048	4.0
4	6.030	6.0
6	7.280	7.2
8	7.891	7.9
10	8.181	8.1
12	8.181	8.1

(i) The percentage increase in the mass of the bead is calculated using the following equation.

$$\text{percentage increase} = \frac{\text{mass of water absorbed}}{\text{initial mass of bead}} \times 100$$

Calculate the percentage increase in the mass of the bead after 2 hours.
Give your answer to the nearest whole number. [1]

Percentage increase = ... %

(ii) What property of polymer gels does the figure calculated in part (i) demonstrate? [1]

....

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(b)   (i)   On the grid below, plot the results using water at 40 °C and draw a suitable line. Use the mass of water absorbed by the bead to 1 decimal place.

The results using water at 10 °C have already been plotted.   [3]
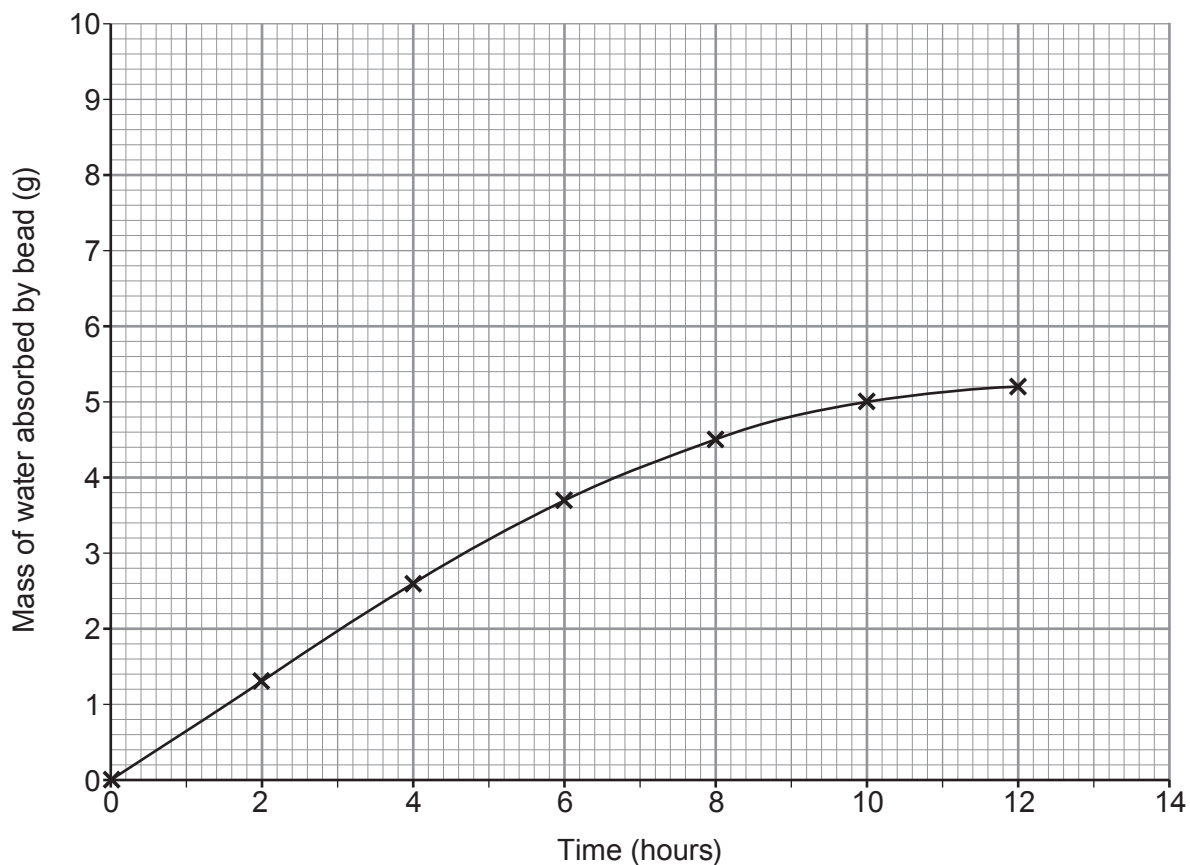
(ii)   Give **two** differences between the absorbing properties of the bead using water at 10 °C and at 40 °C.   [2]

Difference 1 ....

....

Difference 2 ....

....

7

Turn over.

7. The reactions of acids with metals, bases and carbonates are summarised in the following equations.

- acid + metal → salt + hydrogen
- acid + base → salt + water
- acid + carbonate → salt + water + carbon dioxide

(a) The diagram shows some reactions of hydrochloric acid, HCl.

$$KCl + \text{substance } \mathbf{D}$$

↑ KOH

| substance $\mathbf{C}$ + H_2O | ← CuO — | hydrochloric acid HCl | — substance $\mathbf{A}$ → | $MgCl_2$ + H_2 |

↓ $ZnCO_3$

$$ZnCl_2 + H_2O + \text{substance } \mathbf{B}$$
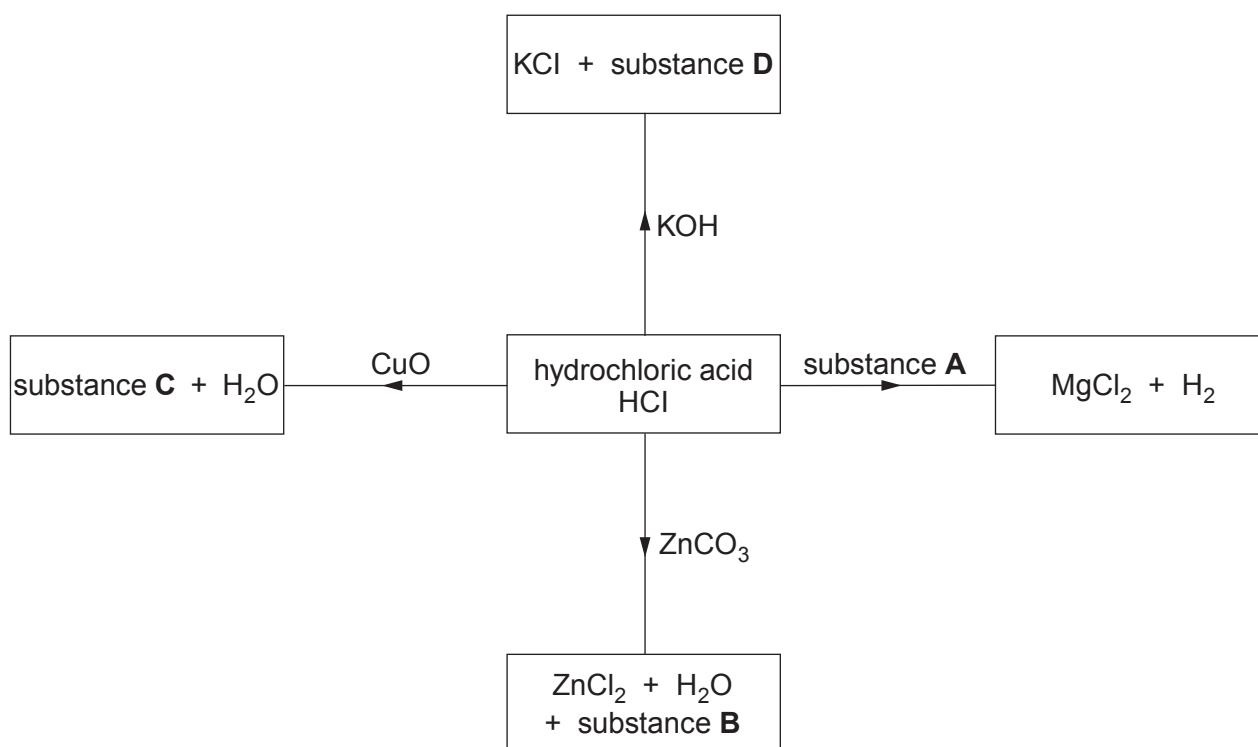
(i) Give the **names** of substances **A** and **B**. [2]

Substance **A** ....

Substance **B** ....

(ii) Give the **formulae** of substances **C** and **D**. [2]

Substance **C** ....

Substance **D** ....

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(b)   Complete the equation for the reaction between hydrochloric acid and sodium carbonate by

- writing the formula of sodium carbonate on the dotted line
- putting a number into the box to balance the equation   [2]

| | HCl   + ... $\longrightarrow$ 2NaCl   + H_2O + CO_2
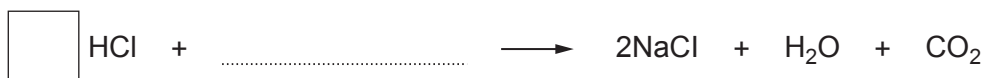
(c)   Silver nitrate solution is used to identify the chloride ions present in hydrochloric acid.

(i)   Give the observation made when silver nitrate solution is added to hydrochloric acid.   [1]

....

(ii)   Put a tick (✓) in the box next to the correct ionic equation for the reaction between silver nitrate and hydrochloric acid.   [1]

$Ag^+(aq)$ + $Cl^-(aq)$ $\longrightarrow$ $AgCl(aq)$ ☐

$Ag^-(aq)$ + $Cl^+(aq)$ $\longrightarrow$ $AgCl(aq)$ ☐

$Ag^+(aq)$ + $Cl^-(aq)$ $\longrightarrow$ $AgCl(s)$ ☐

$Ag^+(s)$ + $Cl^-(s)$ $\longrightarrow$ $AgCl(s)$ ☐

$Ag^-(aq)$ + $Cl^+(aq)$ $\longrightarrow$ $AgCl(s)$ ☐

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.	Examiner only

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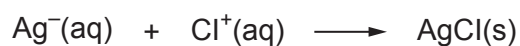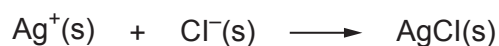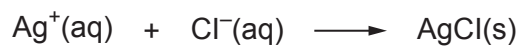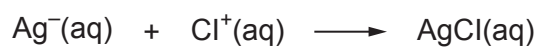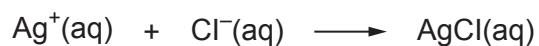
FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
aluminium	Al^{3+}	bromide	Br^-
ammonium	NH_4^+	carbonate	CO_3^{2-}
barium	Ba^{2+}	chloride	Cl^-
calcium	Ca^{2+}	fluoride	F^-
copper(II)	Cu^{2+}	hydroxide	OH^-
hydrogen	H^+	iodide	I^-
iron(II)	Fe^{2+}	nitrate	NO_3^-
iron(III)	Fe^{3+}	oxide	O^{2-}
lithium	Li^+	sulfate	SO_4^{2-}
magnesium	Mg^{2+}		
nickel	Ni^{2+}		
potassium	K^+		
silver	Ag^+		
sodium	Na^+		
zinc	Zn^{2+}		

Turn over.

THE PERIODIC TABLE

Group

1	2												3	4	5	6	7	0
						1 **H** Hydrogen 1												4 **He** Helium 2
7 **Li** Lithium 3	9 **Be** Beryllium 4												11 **B** Boron 5	12 **C** Carbon 6	14 **N** Nitrogen 7	16 **O** Oxygen 8	19 **F** Fluorine 9	20 **Ne** Neon 10
23 **Na** Sodium 11	24 **Mg** Magnesium 12												27 **Al** Aluminium 13	28 **Si** Silicon 14	31 **P** Phosphorus 15	32 **S** Sulfur 16	35.5 **Cl** Chlorine 17	40 **Ar** Argon 18
39 **K** Potassium 19	40 **Ca** Calcium 20	45 **Sc** Scandium 21	48 **Ti** Titanium 22	51 **V** Vanadium 23	52 **Cr** Chromium 24	55 **Mn** Manganese 25	56 **Fe** Iron 26	59 **Co** Cobalt 27	59 **Ni** Nickel 28	63.5 **Cu** Copper 29	65 **Zn** Zinc 30		70 **Ga** Gallium 31	73 **Ge** Germanium 32	75 **As** Arsenic 33	79 **Se** Selenium 34	80 **Br** Bromine 35	84 **Kr** Krypton 36
86 **Rb** Rubidium 37	88 **Sr** Strontium 38	89 **Y** Yttrium 39	91 **Zr** Zirconium 40	93 **Nb** Niobium 41	96 **Mo** Molybdenum 42	99 **Tc** Technetium 43	101 **Ru** Ruthenium 44	103 **Rh** Rhodium 45	106 **Pd** Palladium 46	108 **Ag** Silver 47	112 **Cd** Cadmium 48		115 **In** Indium 49	119 **Sn** Tin 50	122 **Sb** Antimony 51	128 **Te** Tellurium 52	127 **I** Iodine 53	131 **Xe** Xenon 54
133 **Cs** Caesium 55	137 **Ba** Barium 56	139 **La** Lanthanum 57	179 **Hf** Hafnium 72	181 **Ta** Tantalum 73	184 **W** Tungsten 74	186 **Re** Rhenium 75	190 **Os** Osmium 76	192 **Ir** Iridium 77	195 **Pt** Platinum 78	197 **Au** Gold 79	201 **Hg** Mercury 80		204 **Tl** Thallium 81	207 **Pb** Lead 82	209 **Bi** Bismuth 83	210 **Po** Polonium 84	210 **At** Astatine 85	222 **Rn** Radon 86
223 **Fr** Francium 87	226 **Ra** Radium 88	227 **Ac** Actinium 89																

Key

A_r **Symbol** — relative atomic mass Name Z — atomic number

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