

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 (a) Figure 1 shows a metal spoon.



Figure 1

This spoon is made of silver.

(i) Give a reason why silver is a suitable material to use for making a spoon.

(1)

(ii) Some spoons are made of wood or plastic, not metal.

The raw material for wooden spoons is trees and the raw material for plastic spoons is crude oil.

Explain an advantage, other than cost, of using wood rather than plastic.

(2)

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(b) Some people wear spectacles so that they can see more clearly.

(i) Which property of glass makes it suitable for use in spectacles?

(1)

- A glass does not conduct electricity
- B glass is a poor conductor of heat
- C glass is transparent
- D glass shatters when dropped

(ii) Some spectacles have a coating made of nanoparticles on the glass.

Which statement describes nanoparticles?

(1)

- A nanoparticles are larger than small molecules
- B nanoparticles are a type of atom
- C nanoparticles are very small molecules
- D nanoparticles are the monomers in DNA

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P 7 4 4 2 5 A 0 3 3 2

(c) One nanoparticle has a cube shape that is shown in Figure 2.

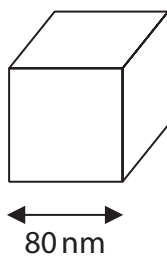


Figure 2

Calculate the surface area of this nanoparticle.

$$\text{surface area} = \text{area of one face} \times \text{number of faces}$$

(2)

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surface area = nm²

(Total for Question 1 = 7 marks)

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2 This question is about the metals and non-metals in period 3 of the periodic table.

(a) Figure 3 shows some data about some of the elements in period 3.

symbol	atomic number	melting point in °C
Na	11	98
Mg	12	650
Al	13	660
Si	14	1410
P	15	44
Cl	17	-101
Ar	18	-189

Figure 3

Use the periodic table to answer these questions.

(i) Give the **name** of the element in period 3 that is not shown in Figure 3. (1)

.....

(ii) Give the relative atomic mass of silicon. (1)

.....

(iii) State which metal and which non-metal in Figure 3 have the lowest melting points. (2)

metal with lowest melting point

.....

non-metal with lowest melting point

.....



(b) Alkali metals react with water to produce an alkaline solution and hydrogen gas.

A test tube of gas can be tested to see if the gas is hydrogen by putting a lighted splint at the top of the test tube.

A student suggests the following method to show that an alkaline solution and hydrogen gas are produced in this reaction.

step 1 pour 150 cm^3 water into the container shown in Figure 4

step 2 add a small piece of lithium to the water in the container shown in Figure 4

step 3 hold a lighted splint above the container

step 4 hold some damp red litmus paper above the mixture in the container.

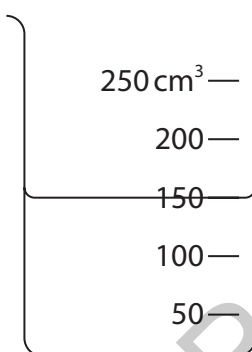


Figure 4

(i) Give the name of the container shown in Figure 4.

(1)

(ii) A teacher says that step 3 and step 4 will **not** work to show that hydrogen gas and an alkaline solution are produced in the reaction.

Explain **one** change that could be made in each step to make the method work.

(3)

step 3.....

.....

.....

step 4.....

.....

.....

(Total for Question 2 = 8 marks)



3 Compound **A** contains either aluminium ions or copper ions or iron(II) ions.

Figure 5 is a flow chart of the method for the test to identify the ions in compound **A**.

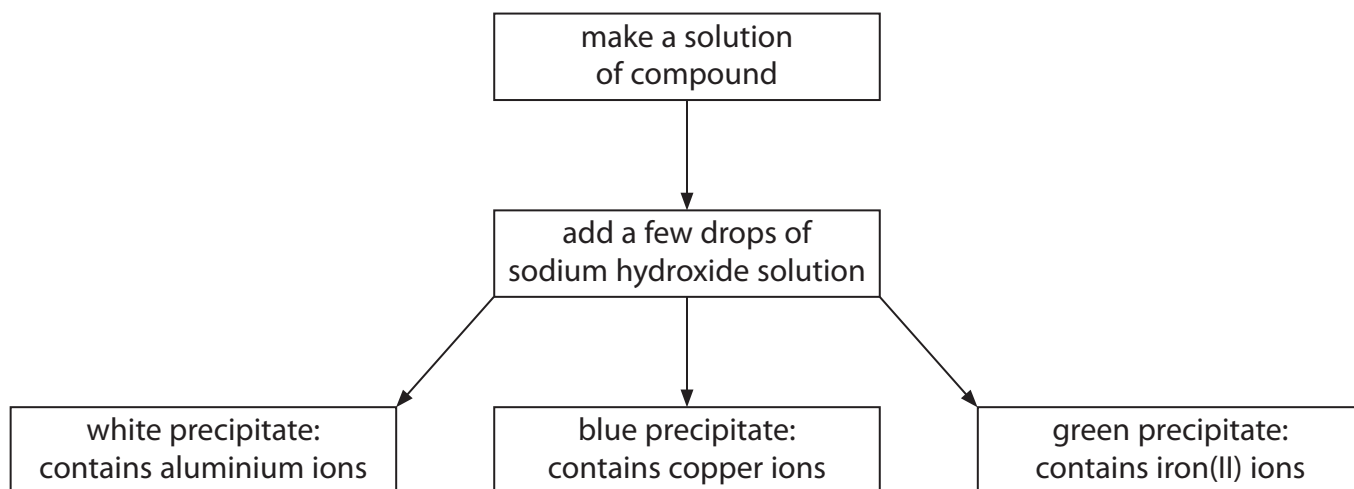


Figure 5

(a) The precipitates formed in this test are solids.

Which state symbol is used for precipitates in equations?

(1)

- A aq
- B g
- C l
- D s

(b) A student is given a container of solid **A** and a bottle of dilute sodium hydroxide solution.

Describe how the student should carry out the test in Figure 5.

Include the names of the apparatus needed.

(3)

.....

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.....



(c) Iron(II) chloride is tested using the method in Figure 5.

(i) State what would be **seen** when iron(II) chloride is tested.

(1)

(ii) What is the formula of an iron(II) ion?

(1)

A Fe_2

B Fe_2^+

C 2Fe^+

D Fe^{2+}

(d) A different compound is tested using the method in Figure 5.

(i) When the sodium hydroxide solution is added, no precipitate forms.

State what can be concluded from this result.

(1)

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- (ii) In an experiment, the height of the precipitate formed in a reaction is measured using a 10 cm ruler.

The apparatus is shown in Figure 6.

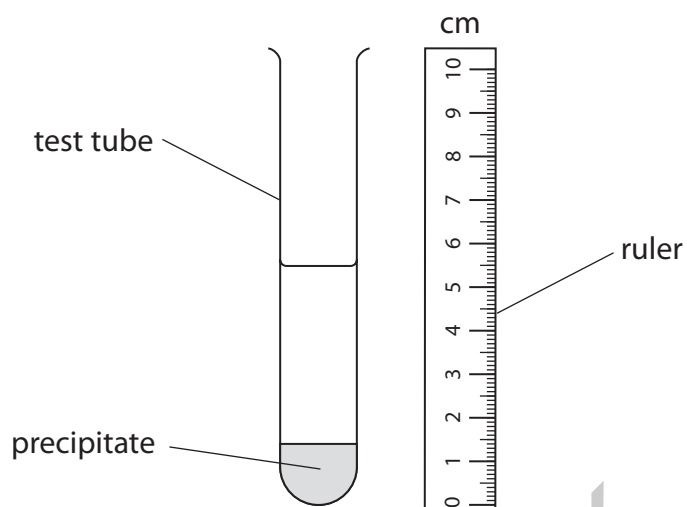


Figure 6

Give the height of the precipitate in mm.

(2)

height = mm

(Total for Question 3 = 9 marks)

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P 7 4 4 2 5 A 0 1 1 3 2

4 (a) In one reaction the temperature of the reaction mixture decreases.

Which word describes this type of reaction?

(1)

- A displacement
- B endothermic
- C exothermic
- D neutralisation

(b) In an experiment, a salt is dissolved in water.

The temperature change is measured.

Figure 7 shows the apparatus that is used.

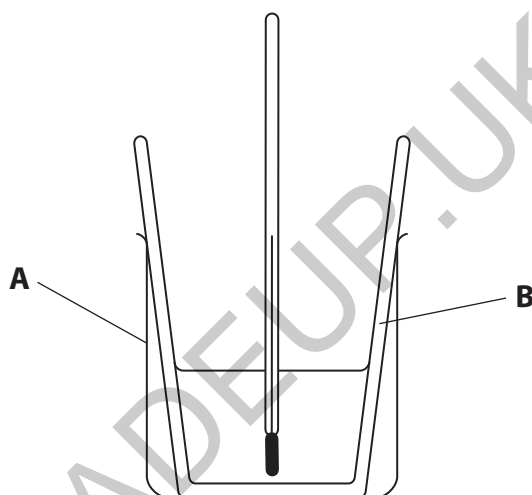


Figure 7

(i) State what is used to measure the temperature change in Figure 7.

(1)

(ii) State **one** reason for using the piece of equipment **A** in Figure 7.

(1)

.....

.....

.....



(iii) A student suggests putting a lid on piece of equipment **B**.

State why this would help to give a more accurate value for the temperature change.

(1)

(iv) Four different salts, **P**, **Q**, **R** and **S**, are dissolved in water.

Figure 8 shows the starting temperature of the water and the final temperature of the solution after the salt dissolves.

	salt P	salt Q	salt R	salt S
starting temperature in °C	20.0	20.0	20.0	20.0
final temperature in °C	22.4	19.5	23.0	18.5
temperature change in °C	+2.4	-0.5
salt that absorbed most heat energy when it dissolved				

Figure 8

Complete the table

- to show the temperature changes when salt **R** and salt **S** dissolve
- by placing a tick (✓) in the box, on the bottom row, for the salt that **absorbs** the most heat energy when it dissolves.

(4)

(v) One of the salts dissolved is barium chloride, BaCl_2 .

Barium chloride contains the chloride ion, Cl^- .

Give the **formula** of the barium ion in barium chloride.

(1)

(Total for Question 4 = 9 marks)



- 5 (a) Figure 9 shows the structure of one molecule of three different compounds, **X**, **Y** and **Z**.

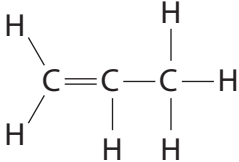
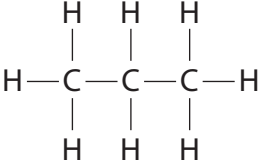
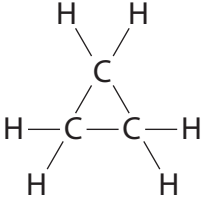
X	Y	Z
		

Figure 9

The molecules of the compounds shown in Figure 9 all contain the same number of carbon atoms.

- (i) Give the number of carbon atoms in a molecule of compound **X**. (1)
-
- (ii) Compound **X** contains carbon and one other element.
Give the **name** of the other element in compound **X**. (1)
-
- (iii) Which of the compounds in Figure 9 is a hydrocarbon? (1)
- A** **X** only
- B** **Y** only
- C** **X** and **Y** only
- D** **X**, **Y** and **Z**
- (iv) Which of the compounds in Figure 9 have the same molecular formula? (1)
- A** none of them
- B** **X** and **Y** only
- C** **X** and **Z** only
- D** **X**, **Y** and **Z**



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(b) Figure 10 shows where fractions are produced in the fractional distillation of crude oil.

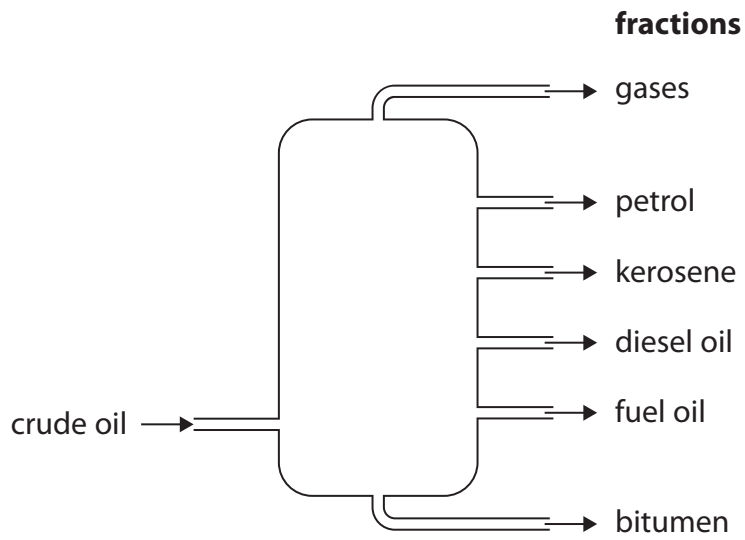


Figure 10

Complete the sentences about fractions obtained from crude oil.

(3)

The fraction with the smallest molecules is called

Compared to petrol, the boiling point of kerosene is

When petrol burns, one product is

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(c) When some impure hydrocarbon fuels are burned, sulfur dioxide is one of the products.

Some sulfur dioxide gas is dissolved in water to form solution **W**.

When solution **W** is added to sodium hydroxide solution of pH 12

- the pH changes
- the temperature increases.

Explain how the pH changes and why the temperature increases.

(3)

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(Total for Question 5 = 10 marks)

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6 This question is about bromine.

(a) Give the colour and physical state of bromine at room temperature.

(2)

colour

physical state

(b) Bromine reacts with hydrogen to form hydrogen bromide.

(i) Write the word equation for this reaction.

(2)

..... + →

(ii) Hydrogen bromide dissolves in water to form a solution.

This solution of hydrogen bromide reacts with alkalis.

State the type of reaction that occurs when a solution of hydrogen bromide reacts with an alkali.

(1)

.....
.....

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(c) Bromine and the other halogens react with hot iron wool.

Figure 11 shows the relative speed of some of these reactions.

halogen	relative speed of reaction
fluorine	
chlorine	reacts very quickly
bromine	reacts quickly
iodine	reacts slowly

Figure 11

Fluorine also reacts with hot iron wool.

Use Figure 11 to predict the relative speed of this reaction.

(1)

.....

.....

(d) Potassium bromide contains 32.8% potassium by mass.

Calculate the mass of potassium and the mass of bromine in 500 g potassium bromide.

(3)

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mass of potassium = g

mass of bromine = g

(Total for Question 6 = 9 marks)

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- 7 (a) The structure of one molecule of compound **L** is shown in Figure 12.

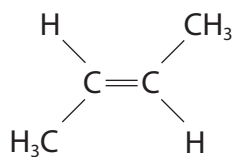


Figure 12

- (i) State what the lines between the atom symbols represent in Figure 12.

(1)

- (ii) Explain why compound **L** is an alkene.

(2)

- (iii) 1 molecule of compound **L** has a mass of 9.302×10^{-23} g.

82,500 molecules of compound **L** combine to form
1 polymer molecule.

Calculate the mass of this polymer molecule.

(2)

mass = g



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(b) Some naturally occurring molecules are polymers.

Draw **one** straight line from each natural polymer to its monomer.

(2)

natural polymer

monomer

DNA

amino acids

proteins

nucleotides

starch

PVC

sugars

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P 7 4 4 2 5 A 0 2 1 3 2

*(c) Figure 13 shows information about four compounds, **E**, **F**, **G** and **H**.

The compounds are in no particular order

- butane
- carbon dioxide
- ethane
- ethene.

compound	boiling point in °C	reaction with limewater	reaction with bromine water	products when burned in oxygen
E	-78	mixture turns milky	no reaction	does not burn
F	-104	no reaction	mixture goes colourless	carbon dioxide and water
G	-89	no reaction	no reaction	carbon dioxide and water
H	-1	no reaction	no reaction	carbon dioxide and water

Figure 13

Use all of the information in Figure 13 to identify which of the four compounds, **E**, **F**, **G** and **H**, is

- butane
- carbon dioxide
- ethane
- ethene.

You must give reasons for your choices.

(6)

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(Total for Question 7 = 13 marks)



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- 8 A student investigates the reaction between marble chips and dilute hydrochloric acid.

The student measures the total volume of carbon dioxide gas produced each minute, for 10 minutes.

- (a) Figure 14 shows part of the apparatus used in the experiment.

Complete Figure 14 by drawing and labelling apparatus that could be used to collect and measure the volume of the carbon dioxide gas.

(2)

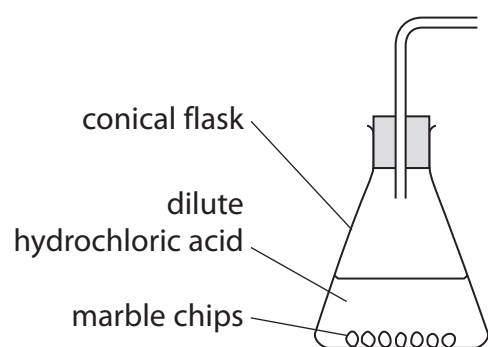


Figure 14

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(b) Figure 15 shows a graph of the results of the experiment.

A tangent has been drawn on the curve at a time of 3.5 minutes.

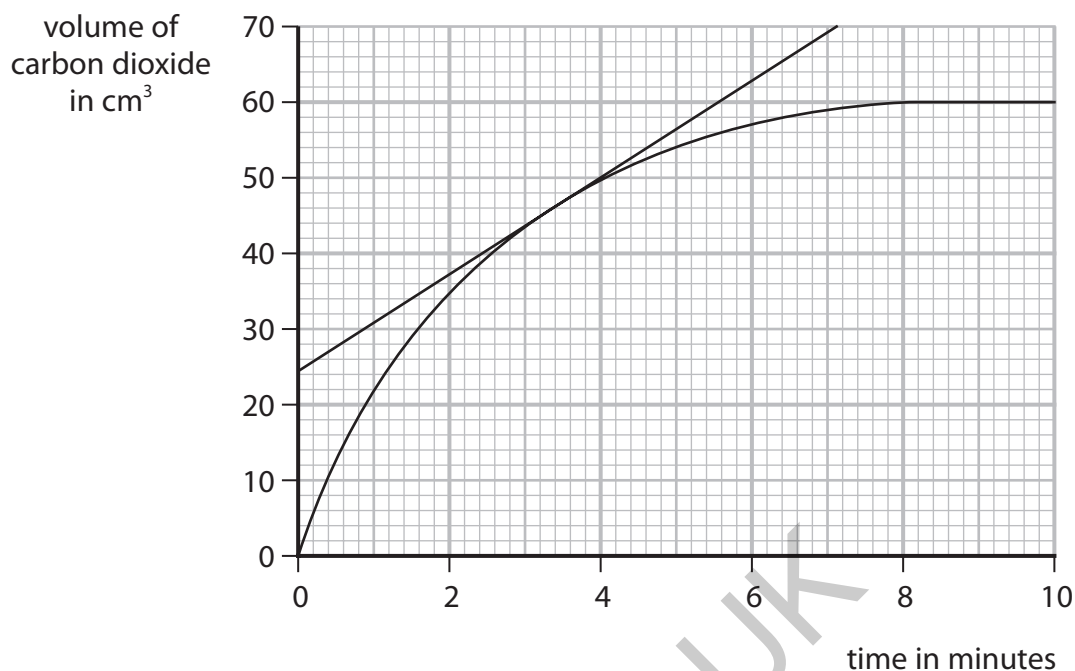


Figure 15

(i) State the total volume of carbon dioxide produced in the first 3.5 minutes.

(1)

volume = cm³

(ii) Using the tangent, calculate the rate of reaction at 3.5 minutes in cm³ per minute.

$$\text{rate of reaction} = \frac{\text{change in gas volume}}{\text{change in time}}$$

(3)

rate = cm³ per minute



- (c) The student repeats the experiment using the same mass of smaller marble chips.
All other conditions remain the same.

Explain the effect on the rate of reaction of using smaller marble chips.

(2)

.....

.....

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.....

- (d) Which change would make the rate of reaction slower?

(1)

- A using the same acid at a higher temperature
- B using acid of a lower concentration
- C using a larger flask
- D adding a catalyst

- (e) In this experiment the volume of carbon dioxide gas produced is measured.

Give a different way that the amount of carbon dioxide produced can be measured.

(1)

.....

.....

.....

- (f) In this experiment there is an excess of dilute hydrochloric acid.

State what you would see in the conical flask at the end of the experiment.

(1)

.....

.....

.....

(Total for Question 8 = 11 marks)



9 This question is about the atmosphere.

(a) Describe the test to show that a gas is oxygen.

(2)

.....

.....

.....

(b) Copper reacts with oxygen to form copper oxide.

2.100 g of copper will react completely with 0.529 g of oxygen.

In an experiment, 4.200 g of copper is heated with 50.000 g of oxygen until the reaction is complete.

Calculate the mass of oxygen remaining at the end of the experiment.

(2)

.....

.....

.....

mass of oxygen = g

(c) Helium, neon and argon are all inert.

(i) Explain, in terms of electrons, why these gases are inert.

(2)

.....

.....

.....

(ii) Two pieces of steel can be joined by heating the metal pieces with a very hot flame.

This process is often carried out in an argon atmosphere rather than in air.

Which property makes argon gas suitable for this use?

(1)

- A argon has a low density
- B argon has a low melting point
- C argon is colourless
- D argon is unreactive



*(d) Figure 16 shows how plant life and the atmosphere of Earth have changed over time.

period of time	plant life	amount of carbon dioxide in atmosphere	amount of oxygen in atmosphere
the earliest Earth	no plant life	very high	none
about 3,500 million years ago	plant life evolved	high	very low
about 10,000 years ago	about 60% of land covered by trees	0.03%	about 21%
today	less than 40% of land covered by trees	0.04%	about 21%

Figure 16

Explain the effect that plant life has had on the Earth's atmosphere and the temperature of the Earth.

You should refer to the information in Figure 16 including

- the plant life
- the amounts of carbon dioxide
- the amounts of oxygen

(6)



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(Total for Question 9 = 13 marks)



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- 10 (a) Figure 17 shows a poly(ethene) bottle containing substance **K** with one of its hazard symbols showing.

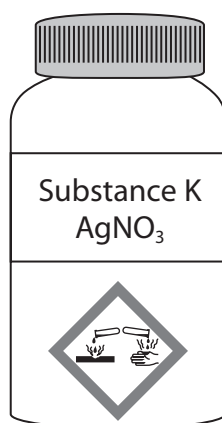


Figure 17

- (i) Explain a safety precaution that should be taken when using a substance with the hazard symbol shown in Figure 17.

(2)

- (ii) Substance **K** has the formula AgNO₃. Give the name of substance **K**.

(1)

- (iii) State **one** property of poly(ethene) that makes it a suitable material to make a container for storing substances.

(1)



(iv) A student tests a solid for chloride ions.

The student uses the following method.

step 1 dissolve a small amount of the solid in water

step 2 add some dilute hydrochloric acid

step 3 add a few drops of a solution of **K**

step 4 observe whether or not a white precipitate forms.

This method to show whether the solid contains chloride ions will not work.

Explain a change that needs to be made to **step 2** to allow this method to work.

(2)

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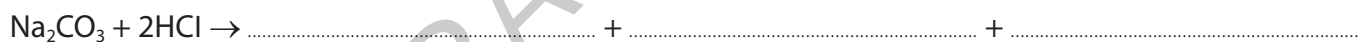
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(b) In the test for carbonate ions, the carbonate ions react with an acid.

Sodium carbonate, Na_2CO_3 , is reacted with dilute hydrochloric acid.

Complete and balance the equation for this reaction.

(3)



(c) The carbonate of element X has the formula X_2CO_3 .
The relative formula mass of this carbonate is 230.

Using this information, calculate the relative atomic mass of X.

(relative atomic masses: C = 12, O = 16)

(2)

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relative atomic mass of X =

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS

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The periodic table of the elements

1	2	3	4	5	6	7	0										
7 Li lithium 3	9 Be beryllium 4	11 Na sodium 11	12 Mg magnesium 12	13 Al aluminium 13	14 Si silicon 14	15 P phosphorus 15	16 S sulfur 16	17 Cl chlorine 17	18 Ar argon 18								
19 K potassium 19	20 Ca calcium 20	21 Sc scandium 21	22 Ti titanium 22	23 V vanadium 23	24 Cr chromium 24	25 Mn manganese 25	26 Fe iron 26	27 Co cobalt 27	28 Ni nickel 28	29 Cu copper 29	30 Zn zinc 30	31 Ga gallium 31	32 Ge germanium 32	33 As arsenic 33	34 Se selenium 34	35 Br bromine 35	36 Kr krypton 36
37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	[98] Tc technetium 43	44 Ru ruthenium 44	45 Rh rhodium 45	46 Pd palladium 46	47 Ag silver 47	48 Cd cadmium 48	49 In indium 49	50 Sn tin 50	51 Sb antimony 51	52 Te tellurium 52	53 I iodine 53	54 Xe xenon 54
55 Cs caesium 55	56 Ba barium 56	57 La* lanthanum 57	72 Hf hafnium 72	73 Ta tantalum 73	74 W tungsten 74	75 Re rhenium 75	76 Os osmium 76	77 Ir iridium 77	78 Pt platinum 78	79 Au gold 79	80 Hg mercury 80	81 Tl thallium 81	82 Pb lead 82	83 Bi bismuth 83	84 Po polonium 84	85 At astatine 85	86 Rn radon 86

1	H hydrogen 1
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relative atomic mass
atomic symbol
name
atomic (proton) number

* The elements with atomic numbers from 58 to 71 are omitted from this part of the periodic table.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

