AQA

Please write clearly in block capitals.

Centre number

Candidate number

Surname

Forename(s)

Candidate signature

# GCSE
# CHEMISTRY

F

Foundation Tier        Paper 1

Thursday 16 May 2019        Morning        Time allowed: 1 hour 45 minutes

## Materials

For this paper you must have:
- a ruler
- a scientific calculator
- the periodic table (enclosed).

## Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer all questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

## Information

- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

| For Examiner's Use | |
|---|---|
| Question | Mark |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| TOTAL | |

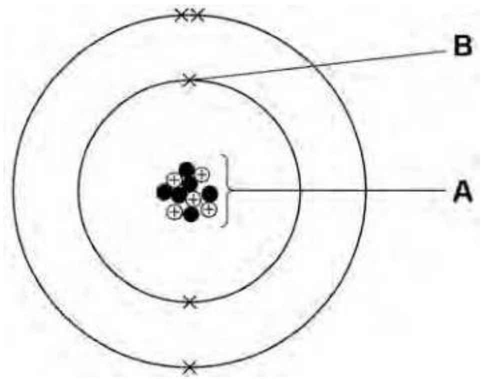
*Do not write outside the box*

Answer **all** questions in the spaces provided.

**0 1** This question is about atomic structure.

Figure 1 represents an atom of element **Z**.

Figure 1




**0 1 . 1** Name the parts of the atom labelled **A** and **B**.

Choose answers from the box.

[2 marks]

| | | | |
|---|---|---|---|
| electron | neutron | nucleus | proton |

A ____________________

B ____________________

Do not write outside the box

0 1 . 2 Which particle has the lowest mass?

Choose the answer from the box.

[1 mark]

| | | | |
|---|---|---|---|
| electron | neutron | nucleus | proton |

0 1 . 3 Which group of the periodic table contains element Z?

Use Figure 1.

[1 mark]

Group ____________________

0 1 . 4 Give the atomic number and the mass number of element Z .

Use Figure 1.

Choose answers from the box.

[2 marks]

| | | | | |
|---|---|---|---|---|
| 1 | 5 | 6 | 11 | 16 |

Atomic number ____________________

Mass number ____________________

Question 1 continues on the next page

Do not write outside the box

Bromine has two different types of atom.

The atoms have a different number of neutrons but the same number of protons.

**01.5** What is the name for this type of atom?

[1 mark]

Tick (□) one box.

Compound ☐

Ion ☐

Isotope ☐

Molecule ☐

**01.6** The different types of bromine atom can be represented as 798135Br and

35Br

The relative atomic mass (*A*r) of bromine is 80

Which statement is true about the number of each type of atom in bromine?

[1 mark]

Tick (□) one box.

There are fewer 79Br a81 35toms than 35Br atoms. ☐

There are more $^{79}_{35}$Br atoms than $^{81}_{35}$Br atoms. ☐

There are the same number of $^{79}_{35}$Br atoms and $^{81}_{35}$Br atoms. ☐

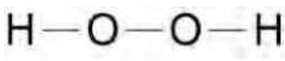
8

Do not write outside the box

0 2 This question is about compounds of oxygen and hydrogen.

Figure 2 represents the structure of hydrogen peroxide.

Figure 2




0 2 . 1 What is the correct formula of hydrogen peroxide?

[1 mark]

Tick (✓) one box.

H2O2 ☐

HO2 ☐

H2O2 ☐

H2O2 ☐

0 2 . 2 Which type of bonding is shown in Figure 2?

[1 mark]

Tick (✓) one box.

Covalent ☐

Ionic ☐

Metallic ☐

Do not write outside the box

0 2 . 3 Hydrogen peroxide decomposes in the presence of a catalyst.

Which elements are often used as catalysts?

[1 mark]

Tick (✓) one box.

Alkali metals ☐

Halogens ☐

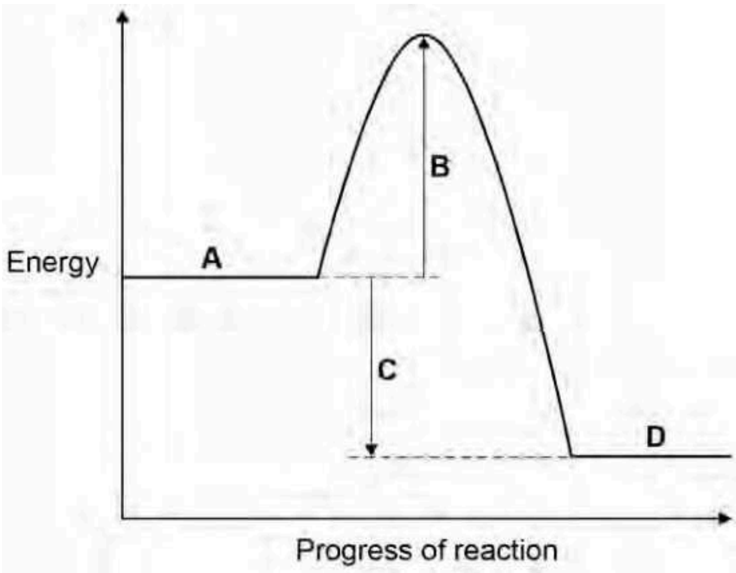
Transition metals ☐

Figure 3 shows the reaction profile for the decomposition of hydrogen peroxide.

The word equation for this reaction is:

hydrogen peroxide → water + oxygen

Figure 3



Do not write outside the box

Labels A, B, C and D each represent a different part of the reaction profile.

Use Figure 3 to answer Questions 02.4 and 02.5

0 2 . 4 Which label shows the activation energy?

[1 mark]

Tick (✓) one box.

A B C D

0 2 . 5 Which label shows the energy of hydrogen peroxide?

[1 mark]

Tick (✓) one box.

A B C D

0 2 . 6 The decomposition of hydrogen peroxide gives out energy to the surroundings.

What type of reaction is this?

[1 mark]

Tick (✓) one box.

Displacement

Endothermic

Exothermic

Neutralisation

Question 2 continues on the next page

Do not write outside the box

0 2 . 7 Hydrogen and oxygen form water.

A hydrogen atom contains one electron.

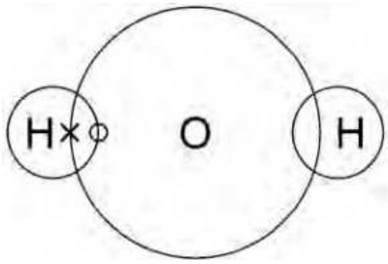
An oxygen atom contains six electrons in the outer shell.

Complete Figure 4 to show a dot and cross diagram for a water molecule.

Show the outer electrons only.

[2 marks]

Figure 4




8

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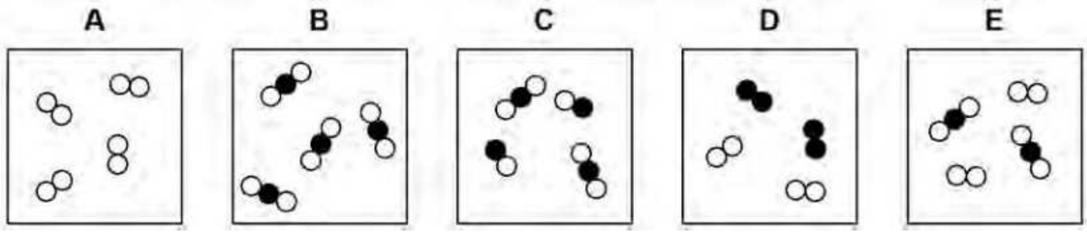
**0 3** This question is about elements, compounds and mixtures.

Figure 5 shows five different substances, A, B, C, D and E.

○ and ● represent atoms of different elements.

Figure 5




Use Figure 5 to answer Questions 03.1 to 03.3

**0 3 . 1** Which substance is only one compound?

[1 mark]

Tick (✓) one box.

A ☐ B ☐ C ☐ D ☐ E ☐

**0 3 . 2** Which substance is a mixture of elements?

Tick (✓) one box.

[1 mark]

A ☐ B ☐ C ☐ D ☐ E ☐

**0 3 . 3** Which substance is a mixture of an element and a compound?

Tick (✓) one box.

[1 mark]

A ☐ B ☐ C ☐ D ☐ E ☐

Turn over ►

Do not write outside the box

Substances are separated from a mixture using different methods.

0 3 . 4 Draw one line from each method of separation to the substance and mixture it would separate.

[2 marks]

| Method of separation | Substance and mixture |
| --- | --- |
| | blue food colour from a mixture of food colours |
| chromatography | |
| | copper from an alloy of copper and zinc |
| | copper sulfate from copper sulfate solution |
| crystallisation | |
| | ethanol from a mixture of ethanol and water |

Do not write outside the box

0 3 . 5 Sand does not dissolve in water. A student separates a mixture of sand and water by filtration.

Draw a diagram of the apparatus the student could use.

You should label:

• where the sand is collected
• where the water is collected.

[3 marks]

Diagram

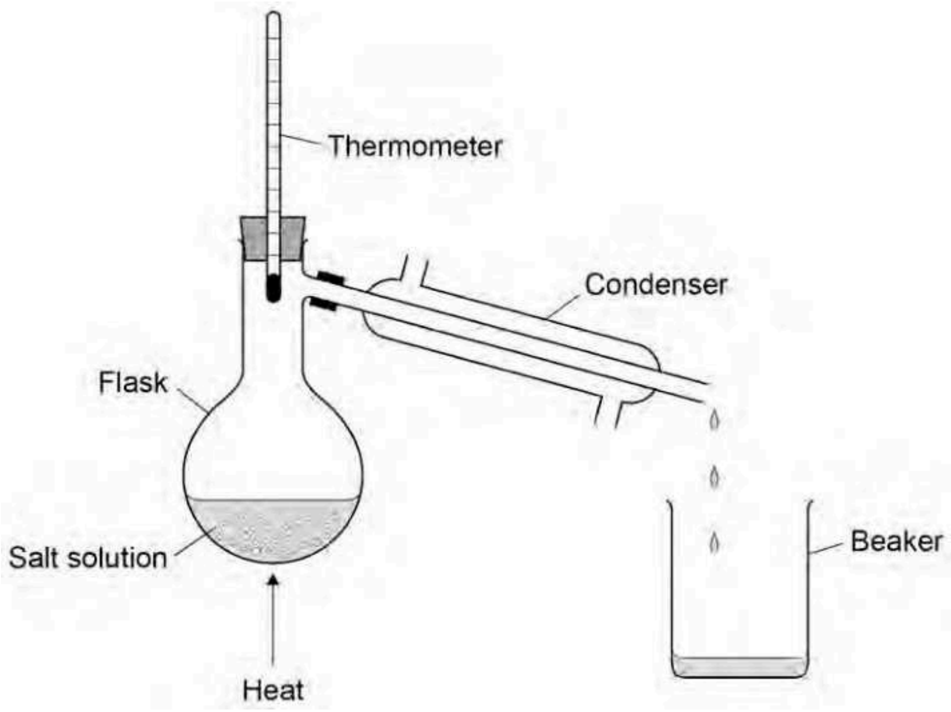
Question 3 continues on the next page

Do not write outside the box

0 3 . 6 A student distils a sample of salt solution to produce pure water.

Figure 6 shows the apparatus.

Figure 6




What temperature would you expect the thermometer to show?

[1 mark]

Tick (✓) one box.

0 °C ☐

10 °C ☐

50 °C ☐

100 °C ☐

Do not write outside the box

0 3 . 7 Describe how the process of distillation shown in Figure 6 produces pure water from salt solution.

[4 marks]

13

Turn over for the next question

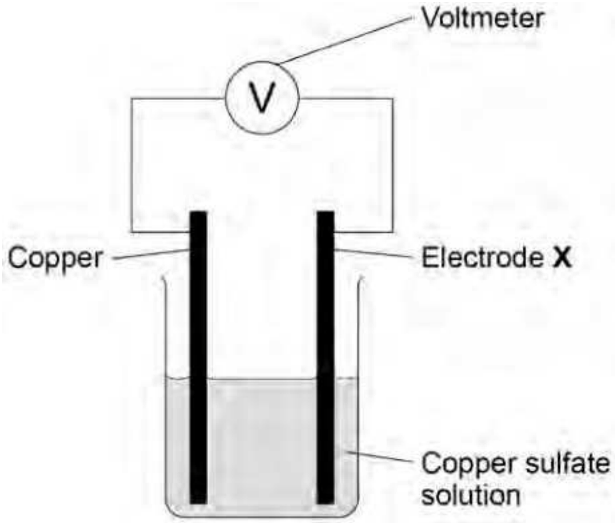
Do not write outside the box

0 4 This question is about chemical cells and batteries.

A student investigated the voltage produced by different chemical cells.

Figure 7 shows the apparatus.

Figure 7




This is the method used.

1. Use cobalt metal as electrode X.

2. Record the cell voltage.

3. Repeat steps 1 and 2 using different metals as electrode X.

0 4 . 1 Suggest two variables the student should keep the same to make the investigation valid.

[2 marks]

1

2

Do not write outside the box

Table 1 shows the student's results.

Table 1

| Electrode X | Voltage of the cell in volts |
|---|---|
| cobalt | 0.62 |
| magnesium | 2.71 |
| zinc | 1.10 |

**0 4 . 2** Write the three metals used for electrode X in order of reactivity.

Use Table 1.

[1 mark]

Most reactive ____________________

____________________

Least reactive ____________________

**0 4 . 3** Copper is used as electrode X in Figure 7.

Predict the voltage of this cell.

Give one reason for your answer.

[2 marks]

Voltage = ____________________ volts

Reason ______________________________________________

______________________________________________

Turn over ►

Do not write outside the box

0 4 . 4 Describe how to make a 12 V battery using 1.5 V cells.

[2 marks]

0 4 . 5 Which is the most suitable use for a non-rechargeable cell?

[1 mark]

Tick (✓) one box.

Electric toy ☐

Laptop computer ☐

Mobile phone ☐

0 4 . 6 Hydrogen fuel cells or rechargeable cells can be used to power electric vehicles.

Suggest one advantage and one disadvantage of using a hydrogen fuel cell compared with a rechargeable cell.

[2 marks]

Advantage of hydrogen fuel cell

Disadvantage of hydrogen fuel cell

10

*Do not write outside the box*

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 5

A student investigated the reaction between lumps of calcium carbonate and dilute hydrochloric acid.

This is the method used.

1. Pour 100 cm3 of dilute hydrochloric acid into a conical flask.
2. Place the conical flask on a balance.
3. Add 2 g of calcium carbonate lumps to the conical flask.
4. Wait until the calcium carbonate stops reacting.
5. Record the decrease in mass of the conical flask and contents.
6. Repeat steps 1 to 5 three more times.

The equation for the reaction is:

$CaCO3(X) + 2\ HCl(aq) \rightarrow CaCl2(aq) + CO2(g) + H2O(l)$

0 5 . 1

What is the state symbol X in the equation?

[1 mark]

Tick (□) one box.

aq g l s

☐ ☐ ☐ ☐

Do not write outside the box

Table 2 shows the student's results.

Table 2

| Decrease in mass of the conical flask and contents in g | Result 1 | Result 2 | Result 3 | Result 4 |
|---|---|---|---|---|
| | 0.84 | 0.79 | 0.86 | 0.47 |

0 5 . 2 Why does the mass of the conical flask and contents decrease during the reaction?

[1 mark]

Tick (✓) one box.

A gas escapes. ☐

A new solution is made. ☐

The dilute hydrochloric acid is used up. ☐

The calcium carbonate lumps decrease in size. ☐

0 5 . 3 What is the range of the four results in Table 2?

[1 mark]

From ______________ g to ______________ g

0 5 . 4 Calculate the mean decrease in mass of the conical flask and contents.

Do not include the anomalous result.

Use Table 2.

[2 marks]

______________________________________________

______________________________________________

______________________________________________

Mean decrease in mass = ______________ g

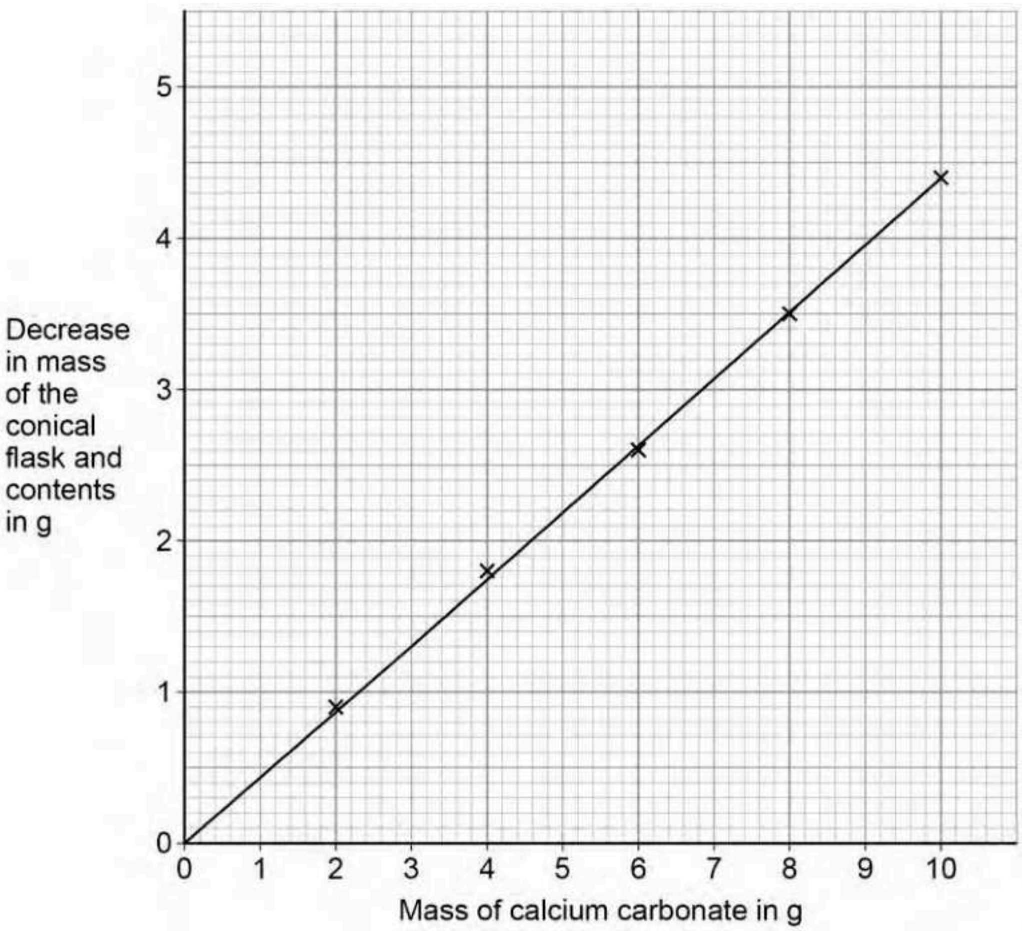
Do not write outside the box

A teacher demonstrated the investigation.

The teacher used different masses of calcium carbonate.

Figure 8 shows the teacher's results.

Figure 8




0 5 . 5 What type of variable is the mass of calcium carbonate?

[1 mark]

Tick (✓) one box.

Control ☐

Dependent ☐

Independent ☐

*Do not write outside the box*

Use Figure 8 to answer Questions 05.6 and 05.7

0 5 . 6 Complete the sentence.

[1 mark]

As the mass of calcium carbonate used increases, the decrease in mass of

the conical flask and contents . ____________________

0 5 . 7 What is the decrease in mass of the conical flask and contents when a 3 g sample of calcium carbonate is used?

[1 mark]

Decrease in mass = ____________________ g

8

Turn over for the next question

Turn over ►

Do not write outside the box

**0 6** This question is about the extraction of metals.

**0 6 . 1** Tungsten is a metal.

The symbol of tungsten is W

Tungsten is produced from tungsten oxide by reaction with hydrogen.

The equation for the reaction is:

$WO_3 + 3\ H_2 \rightarrow W + 3\ H_2O$

Calculate the percentage atom economy when tungsten is produced in this reaction.

Use the equation:

$$\text{percentage atom economy} = \frac{184}{(M_r\ WO_3) + (3 \times M_r\ H_2)} \times 100$$

Relative formula masses ($M_r$): $WO_3 = 232$ $H_2 = 2$

[2 marks]

Percentage atom economy = ____________ %

Do not write outside the box

Aluminium is extracted from aluminium oxide.

0 6 . 2 38% of a rock sample is aluminium oxide.

Calculate the mass of aluminium oxide in 40 kg of the rock sample.

[2 marks]

Mass of aluminium oxide = ____________ kg

0 6 . 3 The formula of aluminium oxide is Al2O3

Calculate the relative formula mass ($M$r) of aluminium oxide.

Relative atomic masses ($A$r): O = 16 Al = 27

[2 marks]

Relative formula mass ( $M$r) = ____________

Question 6 continues on the next page

Do not write outside the box

**0 6 . 4** 60.0 kg of aluminium oxide produces a maximum of 31.8 kg of aluminium.

In an extraction process only 28.4 kg of aluminium is produced from 60.0 kg of aluminium oxide.
Calculate the percentage yield.

Give your answer to 3 significant figures.

Use the equation:

$$\text{percentage yield} = \frac{\text{mass of product actually made}}{\text{maximum theoretical mass of product}} \times 100$$

[3 marks]

_______________________________________________

_______________________________________________

_______________________________________________

_______________________________________________

_______________________________________________

_______________________________________________

Percentage yield = ____________ %

**0 6 . 5** Extracting metals by electrolysis is a very expensive process.

Explain why aluminium is extracted using electrolysis and not by reduction with carbon.

[2 marks]

_______________________________________________

_______________________________________________

_______________________________________________

_______________________________________________

11

Turn over for the next question



Turn over ►

Do not write outside the box

0 7 This question is about energy changes in reactions.

0 7 . 1 Ammonium nitrate dissolves in water.

The change is endothermic.

Which piece of equipment uses this change?

Tick (✓) one box. [1 mark]

Hand warmer ☐

Self-heating can ☐

Sports injury pack ☐

A student investigated the temperature change in the reaction between dilute sulfuric acid and potassium hydroxide solution.

This is the method used.

1. Measure 25 cm3 of potassium hydroxide solution into a glass beaker.

2. Add 5 cm3 of dilute sulfuric acid.

3. Stir the solution.

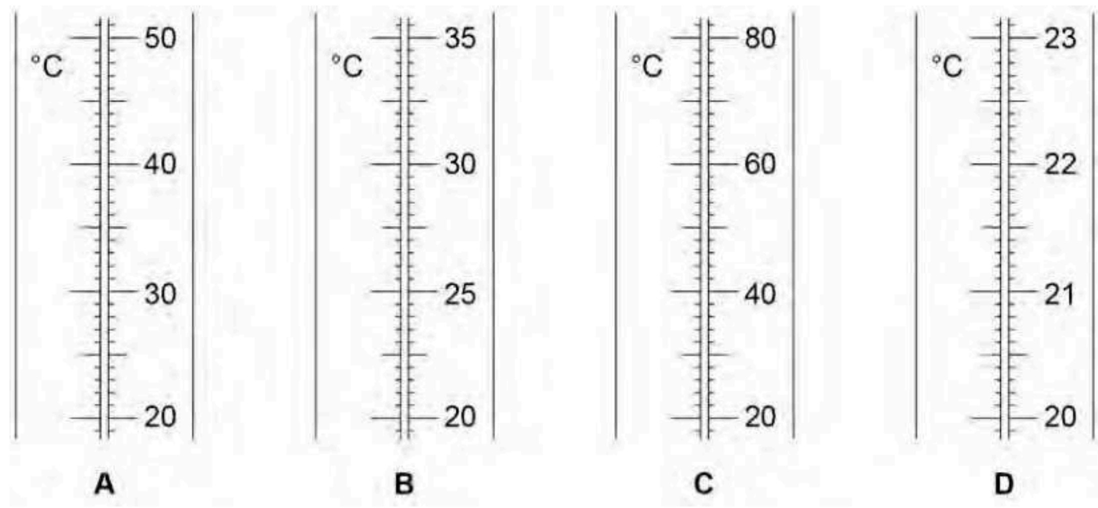
4. Measure the temperature of the solution.

5. Repeat steps 2 to 4 until a total of 30 cm3 of dilute sulfuric acid has been added.

Do not write outside the box

0 7 . 2 Figure 9 shows part of the scales of four thermometers, A, B, C and D.

Figure 9




The student wanted to measure the temperature to a resolution of 0.1 °C

Which thermometer should the student use?

[1 mark]

Tick (✓) one box.

A B C D

0 7 . 3 Energy is lost to the surroundings during the reaction.

What type of error does this cause in the results?

[1 mark]

Tick (✓) one box.

Human error

Random error

Systematic error

Zero error

0 7 . 4 The student used a glass beaker for the reaction.

Name a container the student could use instead of the glass beaker to improve the accuracy of the results.

[1 mark]

0 7 . 5 Table 3 shows the student's results.

Table 3

| | Volume of dilute sulfuric acid added in cm3 | Temperature in °C |
|---|---|---|
| 5 | | 21.2 |
| 10 | | 22.0 |
| 15 | | 22.8 |
| 20 | | 23.6 |
| 25 | | 24.4 |
| 30 | | 25.2 |

Plot the data from Table 3 on Figure 10.

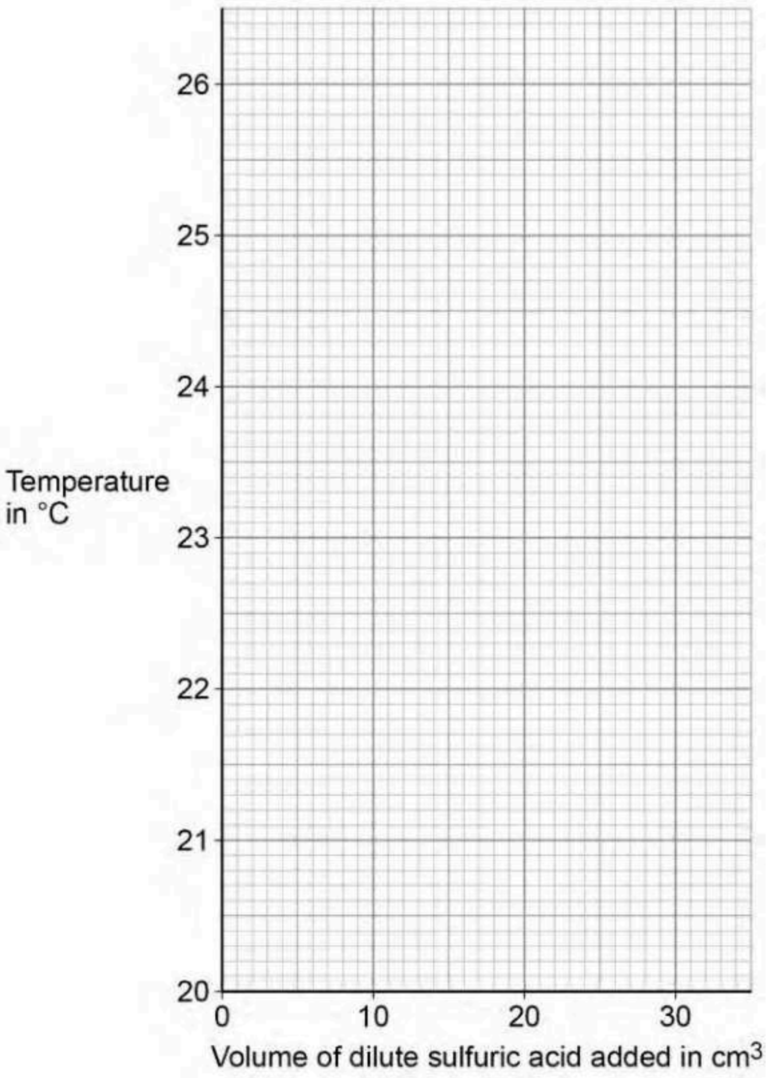
You should:

- draw a line of best fit
- extend your line of best fit to the y-axis.

[4 marks]

Do not write outside the box

Figure 10




0 7 . 6 The intercept on the y-axis of Figure 10 shows the starting temperature of the potassium hydroxide solution.
Give the starting temperature of the potassium hydroxide solution.

[1 mark]

Starting temperature = °C

Do not write outside the box

0 7 . 7 Another student repeated the investigation and obtained an anomalous result.

This result was lower than expected.

What could have caused the anomalous result?

[2 marks]

Tick (✓) two boxes.

| | |
|---|---|
| The mixture was not stirred. | ☐ |
| The temperature in the room increased. | ☐ |
| The thermometer was not accurate. | ☐ |
| Too little sulfuric acid was added. | ☐ |
| Too much potassium hydroxide solution was used. | ☐ |

11

*Do not write outside the box*

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 8 This question is about the periodic table.

In the 19th century, some scientists tried to classify the elements by arranging them in order of their atomic weights.
Figure 11 shows the periodic table Mendeleev produced in 1869.

His periodic table was more widely accepted than previous versions.

Figure 11

| | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 |
|---|---|---|---|---|---|---|---|
| Period 1 | H | | | | | | |
| Period 2 | Li | Be | B | C | N | O | F |
| Period 3 | Na | Mg | Al | Si | P | S | Cl |
| Period 4 | K Cu | Ca Zn | * * | Ti * | V As | Cr Se | Mn Br |
| Period 5 | Rb Ag | Sr Cd | Y In | Zr Sn | Nb Sb | Mo Te | * I |

0 8 . 1 The atomic weight of tellurium (Te) is 128 and that of iodine (I) is 127

Why did Mendeleev reverse the order of these two elements?

[1 mark]

Do not write outside the box

0 8 . 2 Mendeleev left spaces marked with an asterisk *

He left these spaces because he thought missing elements belonged there.

Why did Mendeleev's periodic table become more widely accepted than previous versions?

[3 marks]

0 8 . 3 Mendeleev arranged the elements in order of their atomic weight.

What is the modern name for atomic weight?

[1 mark]

Tick (✓) one box.

Atomic number ☐

Mass number ☐

Relative atomic mass ☐

Relative formula mass ☐

0 8 . 4 Complete the sentence.

[1 mark]

In the modern periodic table, the elements are arranged in order of

________________________________________ .

Do not write outside the box

Chlorine, iodine and astatine are in Group 7 of the modern periodic table.

0 8 . 5 Astatine (At) is below iodine in Group 7.

Predict:

- the formula of an astatine molecule
- the state of astatine at room temperature.

[2 marks]

Formula of astatine molecule ____________________

State at room temperature ____________________

0 8 . 6 Sodium is in Group 1 of the modern periodic table.

Describe what you would see when sodium reacts with chlorine.

[2 marks]

____________________________________________

____________________________________________

____________________________________________

____________________________________________

10

Do not write outside the box

0 9 This question is about acids and alkalis.

0 9 . 1 Which ion do all acids produce in aqueous solution?

[1 mark]

Tick (✓) one box.

H+ ☐

H− ☐

$O^{2-}$ ☐

OH− ☐

0 9 . 2 Calcium hydroxide solution reacts with an acid to form calcium chloride.

Complete the word equation for the reaction.

[2 marks]

calcium hydroxide + __________ acid → calcium chloride + __________

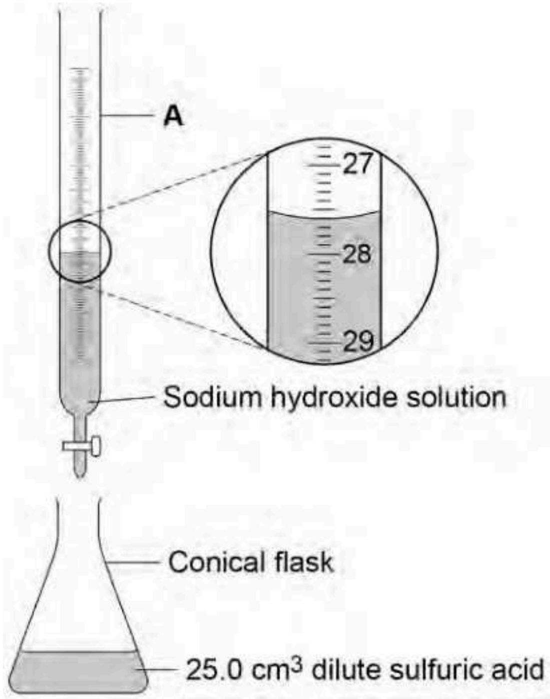
Question 9 continues on the next page

Do not write outside the box

A student investigates the volume of sodium hydroxide solution that reacts with 25.0 cm3 of dilute sulfuric acid.

Figure 12 shows the apparatus the student uses.

Figure 12




Use Figure 12 to answer Questions 09.3 and 09.4

0 9 . 3 Name apparatus A.

[1 mark]

0 9 . 4 What is the reading on apparatus A?

[1 mark]

cm3

Do not write outside the box

0 9 . 5 The higher the concentration of a sample of dilute sulfuric acid, the greater the volume of sodium hydroxide needed to neutralise the acid.

The student tested two samples of dilute sulfuric acid, P and Q.

Describe how the student could use titrations to find which sample, P or Q, is more concentrated.

[6 marks]

11

Turn over ►

Do not write outside the box

1 0 This question is about materials and their properties.

1 0 . 1 Figure 13 shows a carbon nanotube.

Figure 13

The structure and bonding in a carbon nanotube are similar to graphene.

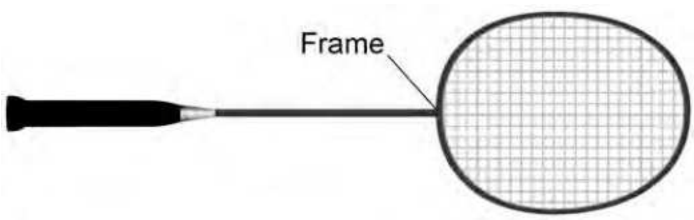
Carbon nanotubes are used in electronics because they conduct electricity.

Explain why carbon nanotubes conduct electricity.

[2 marks]

1 0 . 2 Figure 14 shows a badminton racket.

Figure 14



Do not write outside the box

Table 4 shows some properties of materials.

The materials could be used to make badminton racket frames.

Table 4

| Material | Density in g/cm | Relative strength | Relative stiffness |
|---|---|---|---|
| Aluminium 2.7 0.3 | | | 69 |
| Carbon nanotube 1.5 | 60 | | 1000 |
| Wood 0.71 0.1 | | | 10 |

Evaluate the use of the materials to make badminton racket frames.

Use Table 4.

[4 marks]

Question 10 continues on the next page

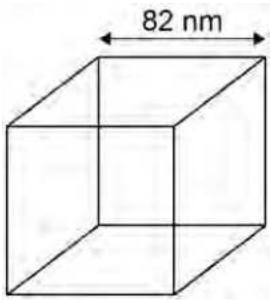
Turn over ►

Zinc oxide can be produced as nanoparticles and as fine particles.

1 0 . 3 A nanoparticle of zinc oxide is a cube of side 82 nm

Figure 15 represents a nanoparticle of zinc oxide.

Figure 15




Calculate the surface area of a nanoparticle of zinc oxide.

Give your answer in standard form.

[3 marks]

Surface area = ____________ nm2

1 0 . 4 Some suncreams contain zinc oxide as nanoparticles or as fine particles.

Suggest one reason why it costs less to use nanoparticles rather than fine particles in suncreams.

[1 mark]

10

END OF QUESTIONS