**Oasis Academy South Bank**

**Year 11 Mock Revision**

**Chemistry Combined Paper 1: Higher**

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Class: \_\_\_\_\_\_\_\_\_**

**Teacher: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step 1: Knowledge**  Learn each of the quiz questions and answers off by heart. This could be done by:   * turning them into **flash cards** and testing yourself * using **‘look, cover, write, check’** * asking a friend or family member to **quiz** you | | | | |
| **Topic** | **LCWC** | **Quiz 1** | **Quiz 2** | **Quiz 3** |
| The Three States (C.1) |  |  |  |  |
| Elements, compounds (C.2) |  |  |  |  |
| Mixtures (C.3) |  |  |  |  |
| Chromatography (C.4) |  |  |  |  |
| Structure of an atom (C.5) |  |  |  |  |
| The periodic table (C.6) |  |  |  |  |
| Types of bonding (C.7) |  |  |  |  |
| Properties of materials (C.8) |  |  |  |  |
| Describing chemical reactions, reactions of metals and gas tests (C.9) |  |  |  |  |
| Acids and Alkalis (C.10) |  |  |  |  |
| Electrolysis (C.12) |  |  |  |  |
| Electrolysis & Half equations (HT mainly) (C.13) |  |  |  |  |
| Endothermic and exothermic reactions (C.14) |  |  |  |  |
| Rates of reaction (C.17) |  |  |  |  |
| Chemical calculations, volumes and concentrations (C.19) |  |  |  |  |
| Metals and alloys (C.23) |  |  |  |  |
| Alkanes and alkenes (C.28) |  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Step 2: Exam practice**   * Practice applying your knowledge using the **past exam questions** in each section. * Self-assess these using the **mark schemes** at the back and rewrite your answers. * Assess your **progress** using a ‘red, amber, green’ system (RAG) | | | |
| **Section** | **Completed** | **SA using green pen** |  |
| 1: Knowledge |  |  |  |
| 2. Required Practicals |  |  |  |
| 3. 6 markers |  |  |  |

**Exam practice**

**Section 1: Knowledge**

**Q1.**

The halogens are elements in Group 7.

(a)  Bromine is in Group 7.

Give the number of electrons in the outer shell of a bromine atom.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(b)  Bromine reacts with hydrogen. The gas hydrogen bromide is produced.

What is the structure of hydrogen bromide?

Tick **one** box.

|  |  |
| --- | --- |
| Giant covalent |  |
| Ionic lattice |  |
| Metallic structure |  |
| Small molecule |  |

**(1)**

(c)  What is the formula for fluorine gas?

Tick **one** box.

|  |  |
| --- | --- |
| F |  |
| F2 |  |
| F2 |  |
| 2F |  |

**(1)**

A student mixes solutions of halogens with solutions of their salts.

The table below shows the student’s observations.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Potassium chloride (colourless)** | **Potassium bromide (colourless)** | **Potassium iodide (colourless)** |
| **Chlorine (colourless)** |  | Solution turns orange | Solution turns brown |
| **Bromine (orange)** | No change |  | Solution turns brown |
| **Iodine (brown)** | No change | No change |  |

(d)  Explain how the reactivity of the halogens changes going down Group 7.

Use the results in the table above.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

A company uses chlorine to produce titanium chloride from titanium dioxide.

(e)  What is the relative formula mass (*M*r) of titanium dioxide, TiO2?

Relative atomic masses (*A*r):  O = 16  Ti = 48

Tick **one** box.

|  |  |
| --- | --- |
| 64 |  |
| 80 |  |
| 128 |  |
| 768 |  |

**(1)**

(f)   The company calculates that 500 g of titanium dioxide should produce 1.2 kg of titanium chloride.

However, the company finds that 500 g of titanium dioxide only produces 900 g of titanium chloride.

Calculate the percentage yield.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Percentage yield = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ %

**(2)**

**(Total 9 marks)**

**Q2.**

This question is about the structure of the atom.

(a)  Complete the sentences.

Choose answers from the box.

Each word may be used once, more than once, or not at all.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **electron** |  | **ion** |  | **neutron** |
|  | **nucleus** |  | **proton** |  |

The centre of the atom is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .

The two types of particle in the centre of the atom are the proton

and the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .

James Chadwick proved the existence of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .

Niels Bohr suggested particles orbit the centre of the atom. This type of particle

is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .

The two types of particle with the same mass are the neutron

and the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .

**(5)**

The table below shows information about two isotopes of element **X**.

|  |  |  |
| --- | --- | --- |
|  | **Mass number** | **Percentage (%) abundance** |
| Isotope 1 | 63 | 70 |
| Isotope 2 | 65 | 30 |

(b)  Calculate the relative atomic mass (*A*r) of element **X** using the equation:



Use the table above.

Give your answer to 1 decimal place.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*A*r = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(c)  Suggest the identity of element **X**.

Use the periodic table.

Element **X** is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(d)  The radius of an atom of element **X** is 1.2 × 10−10 m

The radius of the centre of the atom is  the radius of the atom.

Calculate the radius of the centre of an atom of element **X**.

Give your answer in standard form.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Radius = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ m

**(2)**

**(Total 10 marks)**

**Q3.**

This question is about elements in Group 1.

A teacher burns sodium in oxygen.

(a)  Complete the word equation for the reaction.

sodium + oxygen ⟶ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(b)  What is the name of this type of reaction?

Tick **one** box.

|  |  |
| --- | --- |
| Decomposition |  |
| Electrolysis |  |
| Oxidation |  |
| Precipitation |  |

**(1)**

(c)  The teacher dissolves the product of the reaction in water and adds universal indicator.

The universal indicator turns purple.

What is the pH value of the solution?

Tick **one** box.



**(1)**

(d)  The solution contains a substance with the formula NaOH

Give the name of the substance.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(e)  All alkalis contain the same ion.

What is the formula of this ion?

Tick **one** box.

|  |  |
| --- | --- |
| H+ |  |
| Na+ |  |
| OH− |  |
| O2− |  |

**(1)**

(f)  A solution of NaOH had a concentration of 40 g/dm3

What mass of NaOH would there be in 250 cm3 of the solution?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Mass = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g

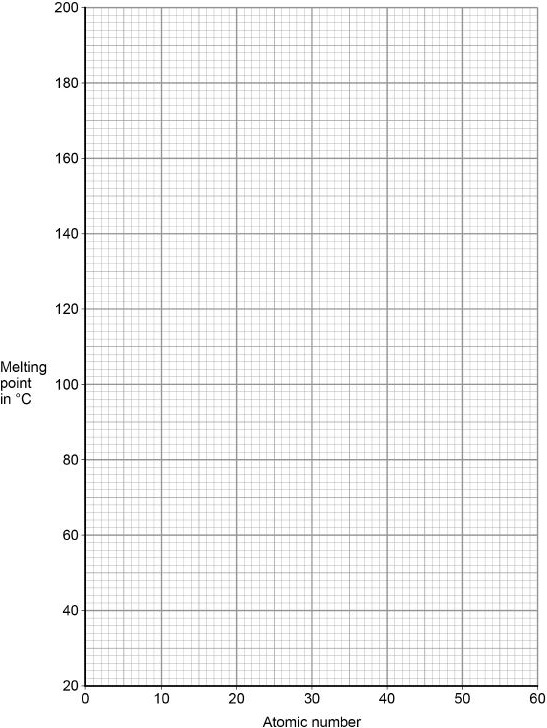
**(2)**

(g)  The melting points of the elements in Group 1 show a trend.

The table below shows the atomic numbers and melting points of the Group 1 elements.

|  |  |  |
| --- | --- | --- |
| **Element** | **Atomic number** | **Melting point in °C** |
| Lithium | 3 | 181 |
| Sodium | 11 | 98 |
| Potassium | 19 | 63 |
| Rubidium | 37 | **X** |
| Caesium | 55 | 29 |

Plot the data from the table on the graph below.



**(2)**

(h)  Predict the melting point, **X**, of rubidium, atomic number 37

Use the graph above.

Melting point = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ °C

**(1)**

**(Total 10 marks)**

**Q4.**

This question is about copper sulfate.

Blue copper sulfate turns white when it is heated.

The word equation for the reaction is:

hydrated copper sulfate ⇌ anhydrous copper sulfate + water

  blue            white

(a)  What name is given to hydrated copper sulfate in this reaction?

Tick **one** box.

|  |  |
| --- | --- |
| Catalyst |  |
| Element |  |
| Product |  |
| Reactant |  |

**(1)**

(b)  What does the symbol ⇌ mean?

Tick **one** box.

|  |  |
| --- | --- |
| Endothermic |  |
| Exothermic |  |
| Reversible |  |
| Polymerisation |  |

**(1)**

(c)  Complete the sentence.

The colour change when the water is added to anhydrous copper sulfate

is white to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .

**(1)**

A student heats 2.5 g of hydrate copper sulfate in a test tube.

0.9 g of water is given off.

The remaining solid is anhydrous copper sulfate.

(d)  Calculate the mass of anhydrous copper sulfate produced.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Mass of anhydrous copper sulfate = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g

**(2)**

(e)  Calculate the percentage of water contained in 2.5 g of hydrated copper sulfate.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

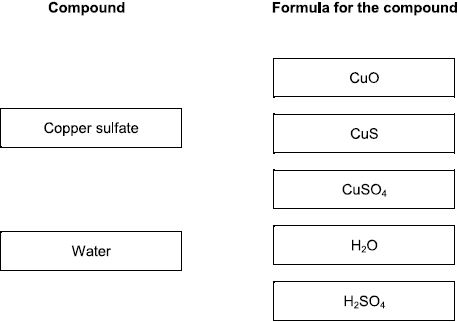
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Percentage of water = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ %

**(2)**

(f)   Draw **one** line from each compound to the formula for the compound.



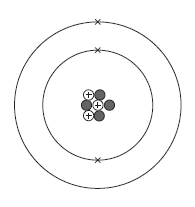
**(2)**

**(Total 8 marks)**

**Q5.**

This question is about atomic structure.

The figure below represents the structure of a lithium atom.



(a)     Name the particle in the atom that has a positive charge.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(b)     Name the particle in the atom that has the smallest mass.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(c)     Complete the sentences.

Choose the answers from the box.

|  |  |  |  |
| --- | --- | --- | --- |
| **3** | **4** | **7** | **10** |

The mass number of the lithium atom is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

The number of neutrons in the lithium atom is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**(2)**

(d)     What are lithium atoms with different numbers of neutrons called?

Tick (✔) **one** box.

|  |  |
| --- | --- |
| Compounds |  |
| Ions |  |
| Isotopes |  |
| Molecules |  |

**(1)**

(e)     Name the particle in the atom discovered by James Chadwick.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .

**(1)**

(f)      An element has two isotopes.

The table shows information about the isotopes.

|  |  |  |
| --- | --- | --- |
|  | **Mass number** | **Percentage (%) abundance** |
| **Isotope 1** | 10 | 20 |
| **Isotope 2** | 11 | 80 |

Calculate the relative atomic mass (*Ar*) of the element.

Use the equation:



Give your answer to 1 decimal place.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Relative atomic mass (*Ar*) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(g)     The radius of an atom is 0.2 nm

The radius of the nucleus is  the radius of the atom.

Calculate the radius of the nucleus.

Give your answer in standard form.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Radius = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ nm

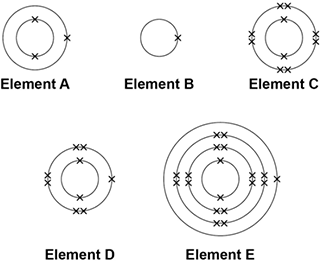
**(2)**

**(Total 10 marks)**

**Q6.**

The electronic structure of the atoms of five elements are shown in the figure below.

The letters are **not** the symbols of the elements.



Choose the element to answer the question. Each element can be used once, more than once or not at all.

Use the periodic table to help you.

(a)     Which element is hydrogen?

Tick **one** box.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **A** |  |  | **B** |  |  | **C** |  |  | **D** |  |  | **E** |  |

**(1)**

(b)     Which element is a halogen?

Tick **one** box.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **A** |  |  | **B** |  |  | **C** |  |  | **D** |  |  | **E** |  |

**(1)**

(c)     Which element is a metal in the same group of the periodic table as element **A**?

Tick **one** box.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **A** |  |  | **B** |  |  | **C** |  |  | **D** |  |  | **E** |  |

**(1)**

(d)     Which element exists as single atoms?

Tick **one** box.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **A** |  |  | **B** |  |  | **C** |  |  | **D** |  |  | **E** |  |

**(1)**

(e)     There are two isotopes of element **A**. Information about the two isotopes is shown in the table below.

|  |  |  |
| --- | --- | --- |
| Mass number of the isotope | 6 | 7 |
| Percentage abundance | 92.5 | 7.5 |

Use the information in the table above above to calculate the relative atomic mass of element **A**.

Give your answer to 2 decimal places.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Relative atomic mass = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

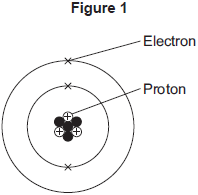
**(4)**

**(Total 8 marks)**

**Q7.**

There are eight elements in the second row (lithium to neon) of the periodic table.

(a)     **Figure 1** shows a lithium atom.



(i)      What is the mass number of the lithium atom in **Figure 1**?

|  |  |
| --- | --- |
| Tick (✔) **one** box. |  |
| 3 |  |
| 4 |  |
| 7 |  |

**(1)**

(ii)     What is the charge of an electron?

|  |  |
| --- | --- |
| Tick (✔) **one** box. |  |
| –1 |  |
| 0 |  |
| +1 |  |

**(1)**

(iii)    Protons are in the nucleus.

Which other sub-atomic particles are in the nucleus?

|  |  |
| --- | --- |
| Tick (✔) **one** box. |  |
| ions |  |
| molecules |  |
| neutrons |  |

**(1)**

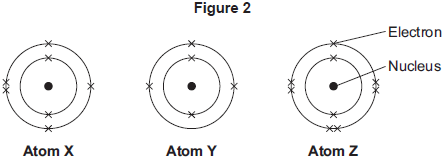
(b)     What is **always** different for atoms of different elements?

|  |  |
| --- | --- |
| Tick (✔) **one** box. |  |
| number of neutrons |  |
| number of protons |  |
| number of shells |  |

**(1)**

(c)     **Figure 2** shows the electron arrangements of three different atoms, **X**, **Y** and **Z**.

These atoms are from elements in the second row (lithium to neon) of the periodic table.

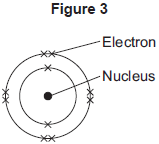


Which atom is from an element in Group 3 of the periodic table?

|  |  |
| --- | --- |
| Tick (✔) **one** box. |  |
| **Atom X** |  |
| **Atom Y** |  |
| **Atom Z** |  |

**(1)**

(d)     **Figure 3** shows the electron arrangement of a different atom from an element in the second row of the periodic table.



(i)      Give the chemical symbol of this element.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(ii)     Why is this element unreactive?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

**(Total 7 marks)**

**Q8.**

This question is about elements and the periodic table.

(a)     Use the correct answers from the box to complete the sentences.

|  |  |  |  |
| --- | --- | --- | --- |
| **atoms** | **atomic weights** | **electrons** | **proton numbers** |

Newlands’ and Mendeleev’s periodic tables show the elements in order of

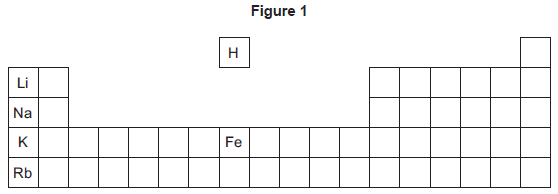
their \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .

Following the discovery of protons and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, the modern periodic

table shows the elements in order of their \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .

**(3)**

(b)     **Figure 1** shows the position of six elements in the modern periodic table.



(i)      Which **one** of these six elements has the lowest boiling point?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(ii)     Complete the sentence.

In the periodic table, rubidium (Rb) is in Group \_\_\_\_\_\_\_\_\_\_\_\_ .

**(1)**

(iii)    Which of these three elements is the most reactive?

|  |  |
| --- | --- |
| Tick (✔) **one** box. |  |
| Lithium (Li) |  |
| Sodium (Na) |  |
| Potassium (K) |  |

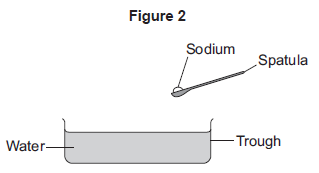
**(1)**

(iv)     Which **two** statements are correct?

|  |  |
| --- | --- |
| Tick (✔) **two** boxes. |  |
| Iron has a higher density than potassium. |  |
| Iron is softer than potassium. |  |
| Iron reacts vigorously with water. |  |
| Iron forms ions that have different charges. |  |

**(2)**

(c)     **Figure 2** shows sodium being put into water.



Describe **three** observations that can be seen when sodium is put into water.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

**(Total 11 marks)**

**Q9.**

This question is about carbon and gases in the air.

(a)     Carbon atoms have protons, neutrons and electrons.

Complete the table by writing the relative mass of a neutron and an electron.

|  |  |
| --- | --- |
| **Name of particle** | **Relative mass** |
| proton | 1 |
| neutron |  |
| electron |  |

**(2)**

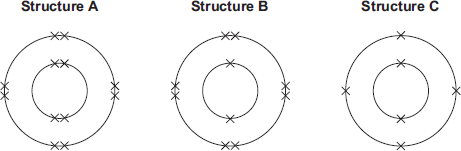
(b)     What is the total number of protons and neutrons in an atom called?

|  |  |
| --- | --- |
| Tick () **one** box. | |
| The atomic number |  |
| The mass number |  |
| One mole of the atom |  |

**(1)**

(c)     An atom of carbon has six electrons.

Which structure, **A, B** or **C**, represents the electronic structure of the carbon atom?



|  |  |
| --- | --- |
| The carbon atom is structure |  |

**(1)**

(d)     Carbon reacts with oxygen to produce carbon dioxide (CO2).

(i)      How many different elements are in one molecule of carbon dioxide?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(ii)     What is the total number of atoms in one molecule of carbon dioxide?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(e)     Sometimes carbon reacts with oxygen to produce carbon monoxide (CO).

(i)      Calculate the relative formula mass (*M*r) of carbon monoxide.

Relative atomic masses (*A*r): C = 12; O = 16

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Mr* of carbon monoxide = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(ii)     Calculate the percentage by mass of carbon in carbon monoxide.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

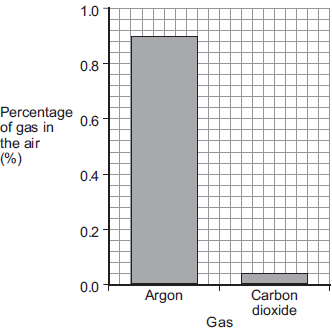
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Percentage by mass of carbon in carbon monoxide = \_\_\_\_\_%

**(1)**

(f)     Carbon dioxide is one of the gases in the air.

(i)      The graph shows the percentage of argon and the percentage of carbon dioxide in the air.



What is the percentage of argon in the air?

Percentage of argon = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ %

**(1)**

(ii)     An instrumental method is used to measure the amount of carbon dioxide in the air.

Give **one** reason for using an instrumental method.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

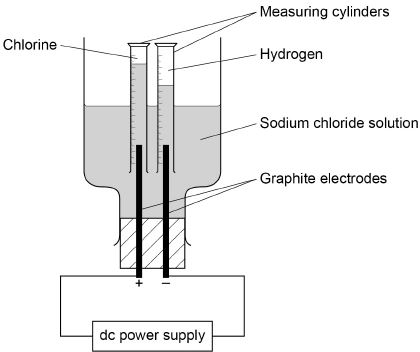
**(Total 10 marks)**

**Q10.**

A student investigated the electrolysis of sodium chloride solution.

**Figure 1** shows the apparatus.

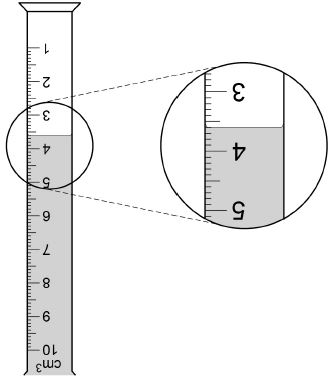
**Figure 1**

****

The student measured the volume of gas collected in each measuring cylinder every minute for 20 minutes.

(a)  **Figure 2** shows the volume of hydrogen gas collected in the measuring cylinder after 8 minutes.

**Figure 2**

****

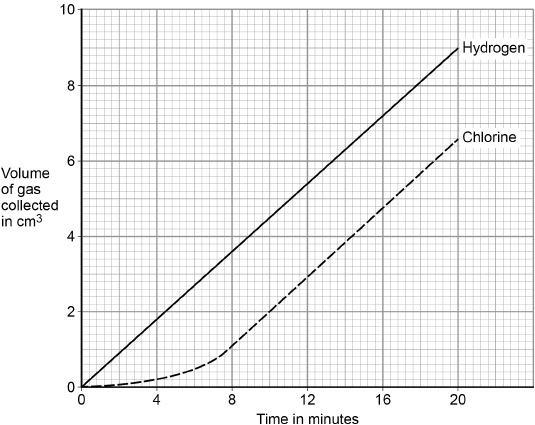
What is the volume of hydrogen gas collected?

Volume = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cm3

**(1)**

**Figure 3** shows the results of the investigation.

**Figure 3**

****

(b)  Which of the lines on **Figure 3** show that the volume of gas collected is directly proportional to the time?

Tick **one** box.

|  |  |
| --- | --- |
| Both lines |  |
| Chlorine line only |  |
| Hydrogen line only |  |
| Neither line |  |

**(1)**

(c)  Which of the lines on **Figure 3** show a positive correlation between the volume of gas collected and time?

Tick **one** box.

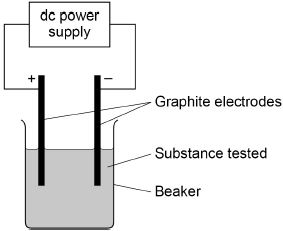
|  |  |
| --- | --- |
| Both lines |  |
| Chlorine line only |  |
| Hydrogen line only |  |
| Neither line |  |

**(1)**

A teacher demonstrates the electrolysis of different substances using graphite electrodes.

**Figure 4** shows the apparatus used.

**Figure 4**

****

(d)  Why can graphite conduct electricity?

Tick **one** box.

|  |  |
| --- | --- |
| Graphite exists in layers of atoms. |  |
| Graphite has a giant structure. |  |
| Graphite has a high melting point. |  |
| Graphite has delocalised electrons. |  |

**(1)**

(e)  The teacher demonstrates the electrolysis of:

•   molten zinc chloride

•   potassium bromide solution.

Complete the table below to predict the products.

Choose answers from the box.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **chlorine** | **bromine** | **hydrogen** | **oxygen** | **potassium** | **zinc** |

|  |  |  |
| --- | --- | --- |
| **Substance electrolysed** | **Product at cathode (negative electrode)** | **Product at anode (positive electrode)** |
| Molten zinc chloride |  |  |
| Potassium bromide solution |  |  |

**(4)**

**(Total 8 marks)**

**Q11.**

This question is about different substances and their structures.

(a)     Draw **one** line from each statement to the diagram which shows the structure.

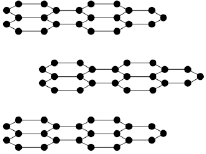
**Statement**                                                 **Structure**

****

**(4)**

(b)     **Figure 1** shows the structure of an element.

**Figure 1**

****

What is the name of this element?

|  |  |
| --- | --- |
| Tick **one** box. |  |
| Carbon |  |
| Chloride |  |
| Nitrogen |  |
| Xenon |  |

**(1)**

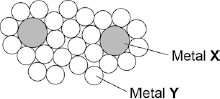
(c)     Why does this element conduct electricity?

|  |  |
| --- | --- |
| Tick **one** box. |  |
| It has delocalised electrons |  |
| It contains hexagonal rings |  |
| It has weak forces between the layers |  |
| It has ionic bonds |  |

**(1)**

(d)     **Figure 2** shows the structure of an alloy.

**Figure 2**

****

Explain why this alloy is harder than the pure metal **Y**.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(e)     What percentage of the atoms in the alloys are atoms of **X**?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(f)     What type of substance is an alloy?

|  |  |
| --- | --- |
| Tick **one** box. |  |
| Compound |  |
| Element |  |
| Mixture |  |

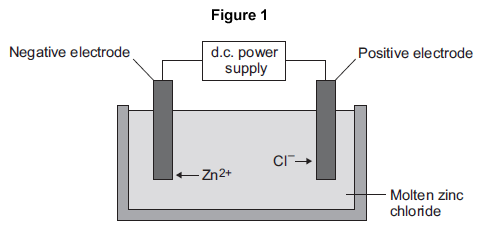
**(1)**

**(Total 11 marks)**

**Q12.**

This question is about zinc.

**Figure 1** shows the electrolysis of molten zinc chloride.



(a)     Zinc chloride is an ionic substance.

Complete the sentence.

When zinc chloride is molten, it will conduct \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .

**(1)**

(b)     Zinc ions move towards the negative electrode where they gain electrons to produce zinc.

(i)      Name the product formed at the positive electrode.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(ii)     Explain why zinc ions move towards the negative electrode.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

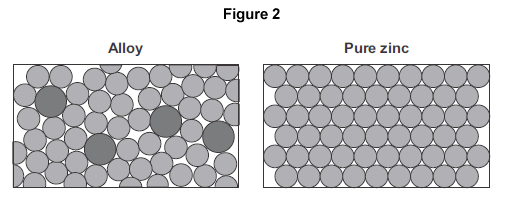
(iii)    What type of reaction occurs when the zinc ions gain electrons?

|  |  |
| --- | --- |
| Tick (✔) **one** box. |  |
| Neutralisation |  |
| Oxidation |  |
| Reduction |  |

**(1)**

(c)     Zinc is mixed with copper to make an alloy.

(i)      **Figure 2** shows the particles in the alloy and in pure zinc.



Use **Figure 2** to explain why the alloy is harder than pure zinc.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(ii)     Alloys can be bent. Some alloys return to their original shape when heated.

What name is used for these alloys?

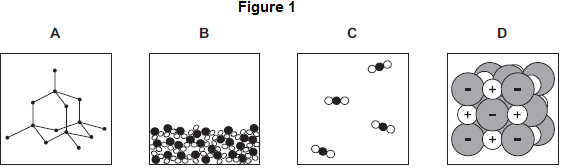
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

**(Total 8 marks)**

**Q13.**

The structures of four substances, **A**, **B**, **C** and **D**, are represented in **Figure 1**.



(a)     Use the correct letter, **A**, **B**, **C** or **D**, to answer each question.

|  |  |  |
| --- | --- | --- |
| (i) | Which substance is a gas? |  |

**(1)**

|  |  |  |
| --- | --- | --- |
| (ii) | Which substance is a liquid? |  |

**(1)**

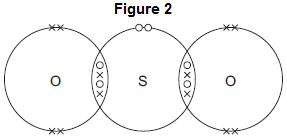
|  |  |  |
| --- | --- | --- |
| (iii) | Which substance is an element? |  |

**(1)**

|  |  |  |
| --- | --- | --- |
| (iv) | Which substance is made of ions? |  |

**(1)**

(b)     **Figure 2** shows the bonding in substance **C**.



(i)      What is the formula of substance **C**?

Draw a ring around the correct answer.

|  |  |  |
| --- | --- | --- |
| **SO2** | **SO2** | **S2O** |

**(1)**

(ii)     Use the correct answer from the box to complete the sentence.

|  |  |  |
| --- | --- | --- |
| **delocalised** | **shared** | **transferred** |

When a sulfur atom and an oxygen atom bond to produce substance **C**,

electrons are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(iii)    What is the type of bonding in substance **C**?

Draw a ring around the correct answer.

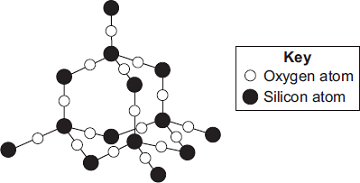
|  |  |  |
| --- | --- | --- |
| **covalent** | **ionic** | **metallic** |

**(1)**

**(Total 7 marks)**

**Q14.**

The diagram shows a small part of the structure of silicon dioxide.



(a)     Use the diagram above to answer the question.

Draw a ring around the correct answer to complete each sentence.

|  |  |  |
| --- | --- | --- |
|  | two |  |
| In silicon dioxide, each silicon atom is bonded with | three | oxygen atoms. |
|  | four |  |

|  |  |
| --- | --- |
|  | ionic. |
| The bonds in silicon dioxide are | covalent. |
|  | metallic. |

**(2)**

(b)  


© Oleksiy Mark/iStock

Silicon dioxide is used as the inside layer of furnaces.

Suggest why.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(c)     Nanowires can be made from silicon dioxide.

Draw a ring around the correct answer to complete the sentence.

|  |  |
| --- | --- |
|  | brittle. |
| The word ‘nano’ means the wires are very | thick. |
|  | thin. |

**(1)**

**(Total 4 marks)**

**Q15.**

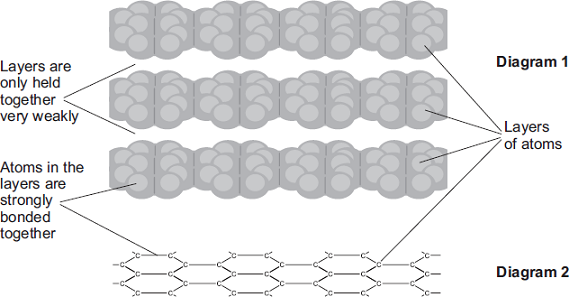
The picture shows a student filling in a multiple choice answer sheet using a pencil.



© Cihan Ta?k?n/iStock

The pencil contains graphite. Graphite rubs off the pencil onto the paper.

Diagrams **1** and **2** show how the atoms are arranged in graphite.



(a)     Use the diagrams to help you explain why graphite can rub off the pencil onto the paper.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(b)     Draw a ring around the type of bond which holds the atoms together in each layer.

|  |  |  |
| --- | --- | --- |
| **covalent** | **ionic** | **metallic** |

**(1)**

**(Total 3 marks)**

**Q16.**

A student investigated the temperature change in displacement reactions between metals and copper sulfate solution.

This is the method used.

1.   Measure 50 cm3 of the copper sulfate solution into a polystyrene cup.

2.   Record the starting temperature of the copper sulfate solution.

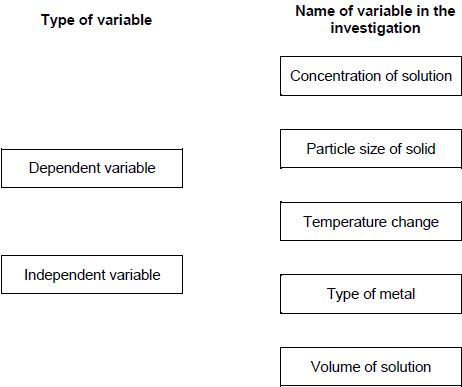
3.   Add the metal and stir the solution.

4.   Record the highest temperature the mixture reaches.

5.   Calculate the temperature increase for the reaction.

6.   Repeat steps 1-5 with different metals.

(a)  Draw **one** line from each type of variable to the name of the variable in the investigation.



**(2)**

(b)  The student used a polystyrene cup and not a glass beaker.

Why did this make the investigation more accurate?

Tick **one** box.

|  |  |
| --- | --- |
| Glass is breakable |  |
| Glass is transparent |  |
| Polystyrene is a better insulator |  |
| Polystyrene is less dense |  |

**(1)**

The table below shows the student’s results.

|  |  |
| --- | --- |
| **Metal** | **Temperature increase in °C** |
| Magnesium | 38 |
| Nickel | 8 |
| Zinc | 16 |

(c)  Complete **Figure 1**.

Use data from the table above.

**Figure 1**

****

**(2)**

(d)  The student concluded that the reactions between the metals and copper sulfate solution are endothermic.

Give **one** reason why this conclusion is **not** correct.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(e)  The temperature increase depends on the reactivity of the metal.

Write the metals magnesium, nickel and zinc in order of reactivity.

Use the table above.

Most reactive \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

       \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Less reactive \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(f)  **Y** is an unknown metal.

Describe a method to find the position of **Y** in the reactivity series in Question **(e)**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

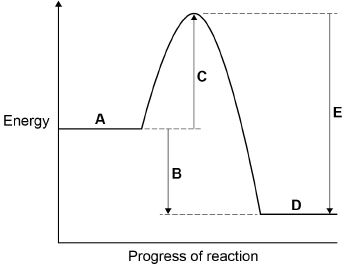
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

**Figure 2** shows the reaction profile for the reaction between zinc and copper sulfate solution.

**Figure 2**

****

(g)  Which letter represents the products of the reaction?

Tick **one** box.



**(1)**

(h)  Which letter represents the activation energy?

Tick **one** box.



**(1)**

**(Total 12 marks)**

**Q17.**

A student investigated the reactivity of three different metals.

This is the method used.

1.       Place 1 g of metal powder in a test tube.

2.       Add 10 cm3 of metal sulfate.

3.       Wait 1 minute and observe.

4.       Repeat using the other metals and metal sulfates.

The student placed a tick in the table below if there was a reaction and a cross if there was no reaction.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Zinc** | **Copper** | **Magnesium** |
| **Copper sulfate** |  |  |  |
| **Magnesium sulfate** |  |  |  |
| **Zinc sulfate** |  |  |  |

(a)     What is the dependent variable in the investigation?

|  |  |
| --- | --- |
| Tick **one** box. |  |
| Time taken |  |
| Type of metal |  |
| Volume of metal sulfate |  |
| Whether there was a reaction or not |  |

**(1)**

(b)     Give **one** observation the student could make that shows there is a reaction between zinc and copper sulfate.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(c)     The student used measuring instruments to measure some of the variables.

Draw **one** line from each variable to the measuring instrument used to measure the variable.

|  |  |  |
| --- | --- | --- |
| **Variable** |  | **Measuring instrument** |
|  |  | Balance |
|  |  |  |
|  |  | Measuring cylinder |
| Mass of metal powder |  |  |
|  |  | Ruler |
|  |  |  |
|  |  | Burette |
| Volume of metal sulfate |  |  |
|  |  | Theromometer |
|  |  |  |
|  |  | Test tube |

**(2)**

(d)     Use the results shown in table above to place zinc, copper and magnesium in order of reactivity.

Most reactive         \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

                       \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Least reactive        \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(e)     Suggest **one** reason why the student should **not** use sodium in this investigation.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(f)     Which metal is found in the Earth as the metal itself?

|  |  |
| --- | --- |
| Tick **one** box. |  |
| Calcium |  |
| Gold |  |
| Lithium |  |
| Potassium |  |

**(1)**

(g)     Iron is found in the Earth as iron oxide (Fe2O3).

Iron oxide is reduced to produce iron.

Balance the equation for the reaction.

\_\_\_Fe2O3      +     \_\_\_C      →     \_\_\_Fe      +      \_\_\_CO2

**(1)**

(h)     Name the element used to reduce iron oxide.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(i)     What is meant by reduction?

|  |  |
| --- | --- |
| Tick **one** box. |  |
| Gain of iron |  |
| Gain of oxide |  |
| Loss of iron |  |
| Loss of oxygen |  |

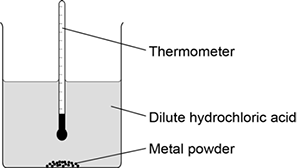
**(1)**

**(Total 10 marks)**

**Q18.**

A student investigated the reactivity of different metals.

The student used the apparatus shown in the figure below.



The student used four different metals.

The student measured the temperature rise for each metal three times.

The student’s results are shown in the table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Metal** | **Temperature rise in °C** | | | **Mean temperature rise in °C** |
| Test 1 | Test 2 | Test 3 |
| **Calcium** | 17.8 | 16.9 | 17.5 |  |
| **Iron** | 6.2 | 6.0 | 6.1 | 6.1 |
| **Magnesium** | 12.5 | 4.2 | 12.3 | 12.4 |
| **Zinc** | 7.8 | 8.0 | 7.6 | 7.8 |

(a)     Give **two** variables the student should control so that the investigation is a fair test.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(b)     One of the results for magnesium is anomalous.

Which result is anomalous?

Suggest **one** reason why this anomalous result was obtained.

Result \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Reason \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(c)     Calculate the mean temperature rise for calcium.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Mean temperature rise = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ °C

**(1)**

(d)     The temperature rose when the metals were added to sulfuric acid.

Give **one** other observation that might be made when the metal was added to sulfuric acid.

How would this observation be different for the different metals?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(e)     Aluminium is more reactive than iron and zinc but less reactive than calcium and magnesium.

Predict the temperature rise when aluminium is reacted with dilute hydrochloric acid.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Temperature rise = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ °C

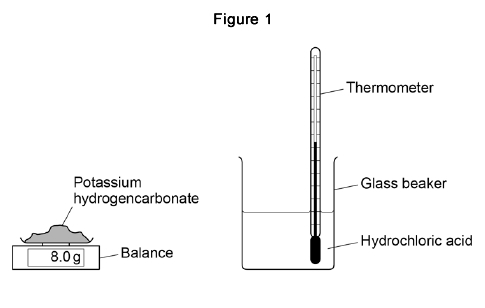
**(1)**

**(Total 8 marks)**

**Q19.**

A student investigated the energy change occurring in the endothermic reaction between potassium hydrogencarbonate and hydrochloric acid.

**Figure 1** shows the apparatus used.



This is the method used.

1. Measure 50 cm3 hydrochloric acid into a glass beaker.

2. Measure 1.0 g of potassium hydrogencarbonate.

3. Add the potassium hydrogencarbonate to the hydrochloric acid.

4. Stir until all the potassium hydrogencarbonate has reacted.

5. Record the lowest temperature reached.

6. Repeat steps 1‒5 two more times.

7. Repeat steps 1‒6 with different masses of potassium hydrogencarbonate.

(a)     Which is the most suitable apparatus to use to measure 50 cm3 of hydrochloric acid?

Tick (✔) **one** box.

|  |  |
| --- | --- |
| Balance |  |
| Conical flask |  |
| Gas syringe |  |
| Measuring cylinder |  |

**(1)**

(b)     The student used a glass beaker for the reaction.

Suggest **one** change to the apparatus that would improve the accuracy of the results.

Give a reason for your answer.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(c)     Which **two** variables should the student keep the same to make this a fair test?

Tick **two** boxes.

|  |  |
| --- | --- |
| Mass of potassium hydrogencarbonate |  |
| Same balance |  |
| Same thermometer |  |
| Starting temperature of hydrochloric acid |  |
| Volume of hydrochloric acid |  |

**(2)**

(d)     **Figure 2** shows part of the thermometer used to measure the temperature.



What is the temperature reading on the thermometer?

Temperature = \_\_\_\_\_\_\_\_\_\_\_ °C

**(1)**

The table shows a set of results.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Test 1** | **Test 2** | **Test 3** |
| **Lowest temperature in °C** | 16.1 | 15.8 | 15.9 |

(e)     What is the range of the lowest temperature?

From \_\_\_\_\_\_\_\_\_ °C to \_\_\_\_\_\_\_\_\_ °C

**(1)**

(f)      Calculate the mean lowest temperature.

Use the table above.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Mean lowest temperature = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ °C

**(2)**

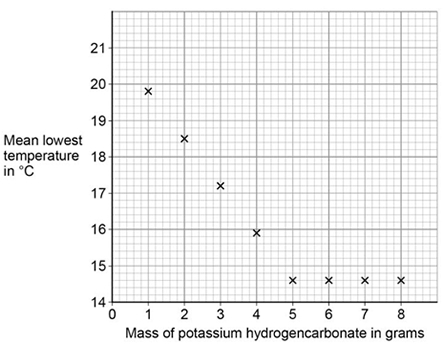
(g)     How do the results show that the reaction is endothermic?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

The graph shows the student’s results.



(h)     Draw **two** straight lines of best fit on the graph above.

**(2)**

(i)      Describe how the lowest temperature changes as the mass of potassium hydrogencarbonate added increases.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

**(Total 15 marks)**

**Q20.**

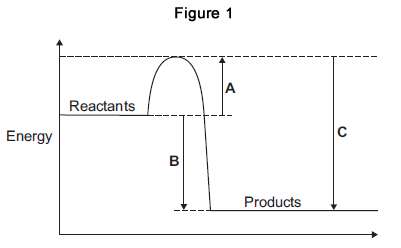
This question is about energy changes in chemical reactions.

(a)     Complete the word equation for the combustion of hydrogen.

hydrogen          +          oxygen          →          \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(b)     **Figure 1** shows a simple energy level diagram.



(i)      Which arrow, **A**, **B** or **C**, shows the activation energy?

|  |  |
| --- | --- |
| Tick (✔) **one** box. |  |
| **A** |  |
| **B** |  |
| **C** |  |

**(1)**

(ii)     What type of reaction is shown by the energy level diagram in **Figure 1**?

Give a reason for your answer.

Type of reaction \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Reason \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(iii)    For a reaction, the value of **A** is 1370 kJ and **C** is 3230 kJ.

Calculate the value of **B**.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

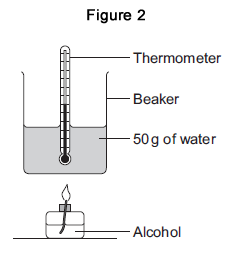
**B** = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ kJ

**(1)**

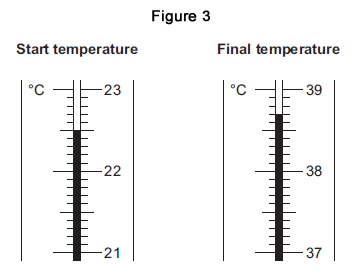
(c)     Alcohols are used as fuels.

A group of students investigated the amount of energy released when different alcohols are burned.

The students used the apparatus shown in **Figure 2**.



(i)      **Figure 3** shows the start temperature and the final temperature of the water.



Write the start temperature and the final temperature of the water in **Table 1**.

Work out the increase in temperature to complete **Table 1**.

|  |  |
| --- | --- |
| **Table 1** | |
| Start temperature of the water in °C |  |
| Final temperature of the water in °C |  |
| Increase in temperature in °C |  |

**(3)**

(ii)     The students worked out the heat energy released by burning 1 g of each alcohol.

The students used the equation:

                Heat energy released = m × 4.2 × increase in temperature

Look at **Figure 2**. What is the value of m?

m = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g

**(1)**

(iii)     **Table 2** shows the students’ results.

|  |  |  |
| --- | --- | --- |
| **Table 2** | | |
| **Name of alcohol** | **Number of carbon atoms in one molecule of alcohol** | **Heat energy released when 1 g of alcohol is burned in kJ** |
| Methanol | 1 | 11.4 |
| Ethanol | 2 | 13.5 |
| Propanol | 3 | 20.1 |
| Butanol | 4 | 16.8 |
| Pentanol | 5 | 17.2 |

Which value of heat energy released is anomalous?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(iv)     Look at **Table 2**.

What is the relationship between the number of carbon atoms in one molecule of alcohol and the heat energy released when 1 g of the alcohol is burned?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(v)     The value in a data book for the amount of heat energy released when 1 g of butanol is burned completely is 36.2 kJ.

Suggest two reasons why the students’ result for butanol is lower than the data book value.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

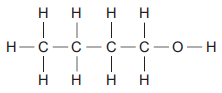
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(vi)     The displayed structure of butanol is:



What is the functional group of the alcohol?

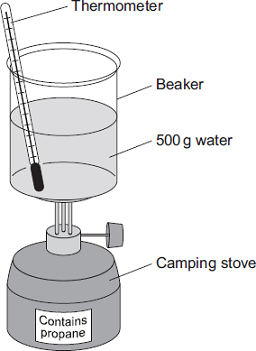
|  |  |
| --- | --- |
| Tick (✔) **one** box. |  |
| –– C –– C |  |
| –– C –– H |  |
| –– O –– H |  |

**(1)**

**(Total 14 marks)**

**Q21.**

A camping stove uses propane gas.



(a)     A student did an experiment to find the energy released when propane is burned.

The student:

•        put 500 g water into a beaker

•        measured the temperature of the water

•        heated the water by burning propane for 1 minute

•        measured the temperature of the water again.

The student found the temperature change was 20 °C.

The student can calculate the energy released, in joules (J), using the equation:

energy released (J) = mass of water (g) × 4.2 × temperature change (°C)

(i)      Use the student’s result to calculate the energy released in joules (J).

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Energy released = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ J

**(2)**

(ii)     State **two** safety precautions that the student should take during the experiment.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

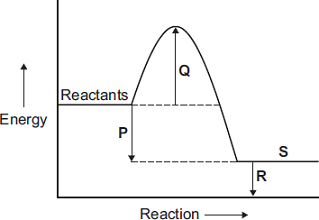
**(2)**

(iii)    Tick () **two** boxes which describe how the student could make his result more accurate.

|  |  |
| --- | --- |
|  | **Tick ()** |
| Stir the water before measuring the temperature. |  |
| Heat the water until it boils. |  |
| Place a lid on the beaker. |  |
| Use a larger beaker for the water. |  |

**(2)**

(b)     The change in energy when propane is burned can be shown in an energy level diagram.



Draw **one** line from each description to the correct letter.

|  |  |  |
| --- | --- | --- |
| **Description** |  | **Letter** |
|  |  | **P** |
| products |  |  |
|  |  | **Q** |
| activation energy |  |  |
|  |  | **R** |
| energy released by the reaction |  |  |
|  |  | **S** |

**(3)**

(c)     Propane and hydrogen are both used as fuels.

Some information about propane and hydrogen is given in the table.

|  |  |  |
| --- | --- | --- |
| **Fuel** | **Resource** | **Products formed when fuel burned** |
| propane | crude oil | carbon dioxide and water |
| hydrogen | water | water |

Use the information in the table to suggest **two** disadvantages that propane has as a fuel compared to hydrogen.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

**(Total 11 marks)**

**Q22.**

Hydrogen peroxide decomposes slowly to give water and oxygen.

The reaction is *exothermic*.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 2H2O2 | → | 2H2O | + | O2 |

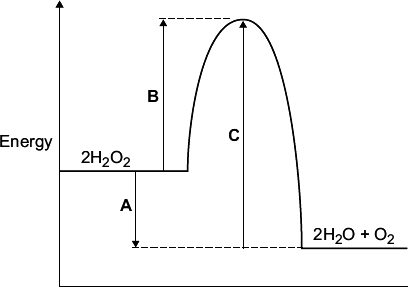
(a)     In an *exothermic* reaction, energy is given out.

Draw a ring around the correct answer to complete the sentence.

|  |  |
| --- | --- |
|  | goes down. |
| In an *exothermic* reaction, the temperature | goes up. |
|  | stays the same. |

**(1)**

(b)     The energy level diagram for this reaction is shown below.



The energy changes, **A**, **B** and **C**, are shown on the diagram.

Use the diagram to help you answer these questions.

|  |  |  |
| --- | --- | --- |
| (i) | Which energy change, **A**, **B** or **C**, is the activation energy? |  |

**(1)**

|  |  |  |
| --- | --- | --- |
| (ii) | Which energy change, **A**, **B** or **C**, shows that this reaction is exothermic? |  |

**(1)**

(iii)    Hydrogen peroxide decomposes quickly when a small amount of manganese(IV) oxide is added.

Draw a ring around the correct answer to complete each sentence.

Hydrogen peroxide decomposes quickly because

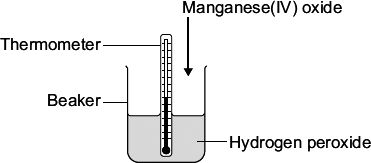
|  |  |
| --- | --- |
|  | a catalyst. |
| manganese(IV) oxide is | an element. |
|  | a solid. |

|  |  |
| --- | --- |
|  | activation energy. |
| The manganese(IV) oxide has lowered the | boiling point. |
|  | temperature. |

**(2)**

(c)     A student did an experiment to find the amount of energy produced when hydrogen peroxide solution is decomposed using manganese(IV) oxide.

The apparatus the student used is shown in the diagram.



The student first measured the temperature of the hydrogen peroxide. Then the student added the manganese(IV) oxide, stirred the mixture and recorded the highest temperature.

(i)      Suggest why the student stirred the mixture before recording the highest temperature.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(ii)     The biggest error in this experiment is heat loss.

Suggest how the student could change the apparatus so that less heat is lost.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

**(Total 7 marks)**

Section 2: Required Practicals

**Q23.**

Some students investigated the energy changes occurring in the reaction between potassium hydrogencarbonate and hydrochloric acid.

The equation for the reaction is:

KHCO3(s) + HCl(aq) ⟶ KCl(aq) + CO2(g) + H2O(l)

This is the method used.

1. Measure 50 cm3 hydrochloric acid into a glass beaker.

2. Measure the temperature of the hydrochloric acid.

3. Measure a given mass of potassium hydrogencarbonate.

4. Add the potassium hydrogencarbonate to the hydrochloric acid.

5. Stir until all the potassium hydrogencarbonate has reacted.

6. Record the lowest temperature reached.

7. Repeat three more times, using the same mass of potassium hydrogencarbonate.

Each student used a different mass of potassium hydrogencarbonate.

(a)     The method described will not give very accurate results.

Suggest **one** change to the apparatus that would improve the accuracy of the results.

Give a reason for your answer.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(b)     The students controlled the volume of the hydrochloric acid.

Give **one** other control variable the students should use.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(c)     The table shows one student’s results.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Trial 1** | **Trial 2** | **Trial 3** | **Trial 4** |
| **Initial temperature in °C** | 21.2 | 21.1 | 21.0 | 21.1 |
| **Final temperature in °C** | 15.6 | 15.4 | 15.6 | 16.6 |
| **Temperature decrease in °C** | 5.6 | 5.7 | 5.4 | 4.5 |

Calculate the mean temperature decrease for the results shown in the table above.

Ignore any anomalous results.

Give your answer to 1 decimal place.

Give the uncertainty in your answer.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

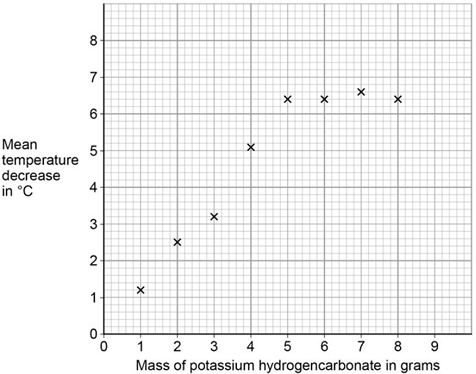
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Mean = \_\_\_\_\_\_\_\_\_\_ °C ± \_\_\_\_\_\_\_\_\_\_ °C

**(3)**

The graph below shows the students’ results.



(d)     Draw **two** intersecting straight lines of best fit on the graph above.

**(2)**

(e)     Explain why the graph has this shape.

Use data from the graph.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

(f)      Suggest a possible reason for the anomalous points.

Do **not** include errors in measuring.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

**(Total 12 marks)**

**Q24.**

Soluble salts are formed by reacting metal oxides with acids.

(a)  Give **one** other type of substance that can react with an acid to form a soluble salt.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(b)  Calcium nitrate contains the ions Ca2+ and NO3−

Give the formula of calcium nitrate.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(c)  Describe a method to make pure, dry crystals of magnesium sulfate from a metal oxide and a dilute acid.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(6)**

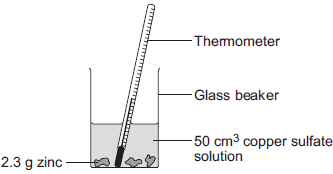
**(Total 8 marks)**

**Q25.**

A student investigated the temperature change when zinc reacts with copper sulfate solution.

The student used a different concentration of copper sulfate solution for each experiment.

The student used the apparatus shown below.



The student:

•        measured 50 cm3 copper sulfate solution into a glass beaker

•        measured the temperature of the copper sulfate solution

•        added 2.3 g zinc

•        measured the highest temperature

•        repeated the experiment using copper sulfate solution with different concentrations.

The equation for the reaction is:

Zn(s)     +                 CuSO4(aq)                    Cu(s)       +              ZnSO4(aq)

zinc       +      copper sulfate solution        copper      +    zinc sulfate solution

(a)     The thermometer reading changes during the reaction.

Give **one** other change the student could **see** during the reaction.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(b)     Suggest **one** improvement the student could make to the apparatus.

Give a reason why this improves the investigation.

Improvement \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Reason \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(c)     **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

The student’s results are shown in the table below.

|  |  |  |
| --- | --- | --- |
| **Experiment number** | **Concentration of copper sulfate in moles per dm3** | **Increase in temperature in °C** |
| 1 | 0.1 | 5 |
| 2 | 0.2 | 10 |
| 3 | 0.3 | 12 |
| 4 | 0.4 | 20 |
| 5 | 0.5 | 25 |
| 6 | 0.6 | 30 |
| 7 | 0.7 | 35 |
| 8 | 0.8 | 35 |
| 9 | 0.9 | 35 |
| 10 | 1.0 | 35 |

Describe **and** explain the trends shown in the student’s results.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(6)**

**(Total 9 marks)**

**Q26.**

A student makes a hypothesis:

‘When different salt solutions are electrolysed with inert electrodes, the product at the negative electrode is always a metal’.

(a)     Describe how you would test this hypothesis in the laboratory.

You should:

•   draw a labelled diagram of the apparatus

•   give the independent variable

•   describe what you would see at the negative electrode if the hypothesis is true.

Diagram

Independent variable \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Observation \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(5)**

(b)     The student’s hypothesis is only partially correct.

Explain why the product at the negative electrode is not always a metal.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(c)     Predict the product at the positive electrode in the electrolysis of:

•   sodium chloride solution

•   copper sulfate solution.

Sodium chloride solution \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Copper sulfate solution \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

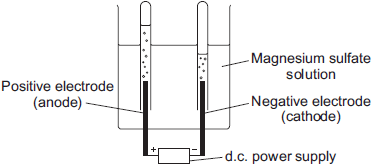
**(2)**

**(Total 9 marks)**

**Q27.**

**Diagram 1** shows the apparatus used to electrolyse magnesium sulfate solution.

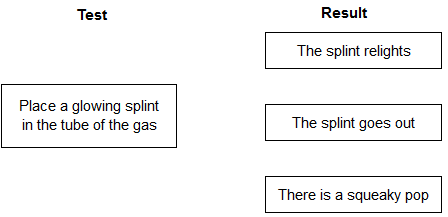
**Diagram 1**

****

Gases were given off at both electrodes.

(a)     The gas collected at the anode was oxygen.

Draw **one** line from the test for oxygen to the correct result.



**(1)**

(b)     (i)      The gas collected at the cathode was hydrogen.

Describe how to test the gas to show that it is hydrogen.

Test \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Result \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(ii)     Why is hydrogen, and **not** magnesium, produced at the cathode?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(c)     A student wanted to use electrolysis to silver plate a metal spoon.

(i)      Give **one** reason why metal spoons are sometimes silver plated.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

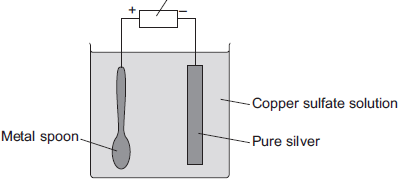
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(ii)     **Diagram 2** shows the apparatus the student used. The student did **not** set the apparatus up correctly.

**Diagram 2**

d.c. power  
supply



The student found that the metal spoon eroded and a thin layer of copper formed on the pure silver electrode.

Suggest **two** changes that the student must make to his apparatus to be able to silver plate the metal spoon. Give a reason for each change.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(4)**

(iii)    Why is it difficult to electroplate plastic spoons?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

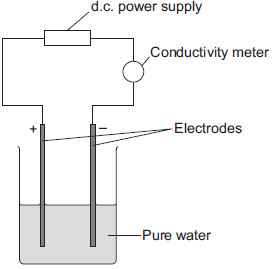
**(1)**

**(Total 10 marks)**

**Q28.**

A student investigated the conductivity of different concentrations of sodium chloride solution.  
The student set the apparatus up as shown in **Figure 1**.

**Figure 1**

****

The student measured the conductivity of the pure water with a conductivity meter.

The reading on the conductivity meter was zero.

(a)     The student:

•        added sodium chloride solution one drop at a time   
•        stirred the solution   
•        recorded the reading on the conductivity meter.

The student’s results are shown in the table below.

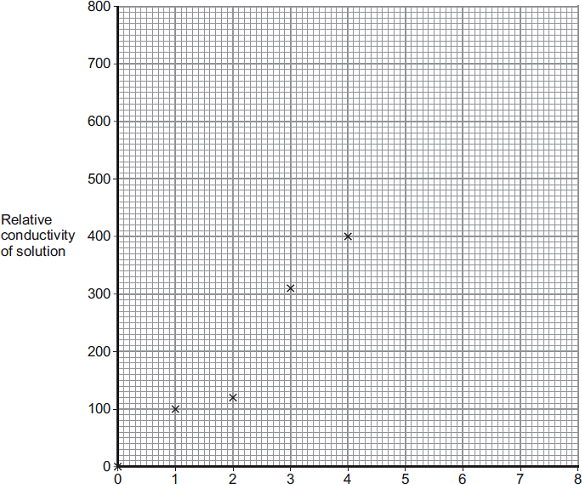
|  |  |
| --- | --- |
| **Number of drops of sodium chloride solution added** | **Relative conductivity of solution** |
| 0 | 0 |
| 1 | 100 |
| 2 | 120 |
| 3 | 310 |
| 4 | 400 |
| 5 | 510 |
| 6 | 590 |
| 7 | 710 |
| 8 | 800 |

(i)      The student plotted the results on the grid shown in **Figure 2**.

Plot the four remaining results.

Draw a line of best fit, ignoring the anomalous result.

**Figure 2**

****                            Number of drops of sodium chloride added

**(3)**

(ii)     One of the points is anomalous.

Suggest **one** error that the student may have made to cause the anomalous result.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(iii)    The student wanted to compare the conductivity of sodium chloride solution with the conductivity of potassium chloride solution.

State **one** variable he should keep constant when measuring the conductivity of the two solutions.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(b)     (i)      Explain, in terms of bonding, why pure water does **not** conduct electricity.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(ii)     Explain why sodium chloride solution conducts electricity.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(iii)    After he had added sodium chloride solution, the student noticed bubbles of gas at the negative electrode.

Complete the sentence.

The gas produced at the negative electrode is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

**(Total 10 marks)**

Section 3: 6 Mark Questions

**Q29.**

This question is about Group 7 elements.

Chlorine is more reactive than iodine.

(a)  Name the products formed when chlorine solution reacts with potassium iodide solution.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(b)  Explain why chlorine is more reactive than iodine.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

(c)  Chlorine reacts with hydrogen to form hydrogen chloride.

Explain why hydrogen chloride is a gas at room temperature.

Answer in terms of structure and bonding.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

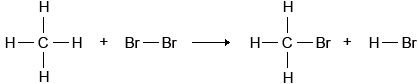
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

(d)  Bromine reacts with methane in sunlight.

The diagram below shows the displayed formulae for the reaction of bromine with methane.



The table below shows the bond energies and the overall energy change in the reaction.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **C—H** | **Br—Br** | **C—Br** | **H—Br** | **Overall energy change** |
| **Energy in kJ/mol** | 412 | 193 | **X** | 366 | −51 |

Calculate the bond energy **X** for the C—Br bond.

Use the diagram and the table above.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Bond energy **X** = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ kJ/mol

**(4)**

**(Total 11 marks)**

**Q30.**

This question is about some compounds of iodine.

(a)     Lead iodide can be made by mixing a solution containing lead ions with a solution containing iodide ions.

Lead iodide is formed as a precipitate.

Pb2+(aq)     +     2l–(aq)    →     Pbl2(s)

(i)     The table below gives information about the solubility of some compounds.

|  |  |
| --- | --- |
| **Soluble compounds** | **Insoluble compounds** |
| all sodium and potassium salts |  |
| all nitrates |  |
| most chlorides, bromides and iodides | silver and lead chlorides, bromides and iodides |

Use the table to help you name:

a soluble compound which contains lead ions \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

a soluble compound which contains iodide ions \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(ii)     Suggest a method of separating the lead iodide from the solution.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(b)     Magnesium iodide can be made by reacting magnesium with iodine.

Mg     +     I2     →     MgI2

Magnesium iodide is an ionic compound. It contains magnesium ions (Mg2+) and iodide ions (I-).

Describe, in terms of electrons, what happens when magnesium reacts with iodine.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

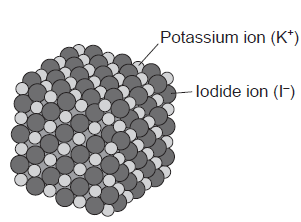
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(4)**

(c)     The diagram shows the structure of potassium iodide.



Explain why a high temperature is needed to melt potassium iodide.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

**(Total 9 marks)**

**Q31.**

This question is about elements and the periodic table.

(a)     Newlands and Mendeleev both produced early versions of the periodic table.

(i)      Complete the sentence.

In their periodic tables, Newlands and Mendeleev arranged the elements in

order of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .

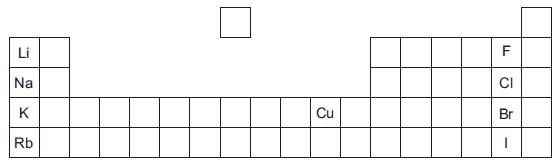
**(1)**

(ii)     Name the particle that allowed the elements to be arranged in order of their atomic number in the modern periodic table.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(b)     The diagram below shows the position of nine elements in the modern periodic table.



(i)      Which **one** of the nine elements shown in the diagram above has the lowest boiling point?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(ii)     Copper and potassium have different melting points and boiling points.

Give **one other** difference between the properties of copper and potassium.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(iii)    Explain why the reactivity of the elements increases going down Group 1 from lithium to rubidium but decreases going down Group 7 from fluorine to iodine.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

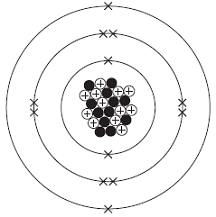
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(4)**

**(Total 8 marks)**

**Q32.**

The diagram represents a magnesium atom.



(a)     Use words from the box to answer these questions.

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

(i)      What is the name of the central part of the atom? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(ii)     What is the name of the particle with no charge? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(iii)    What is the name of the particle with a negative charge? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(b)     Use the diagram above to help you answer these questions.

(i)      Draw a ring around the atomic (proton) number of this magnesium atom.

|  |  |  |
| --- | --- | --- |
| **12** | **24** | **36** |

**(1)**

(ii)     Draw a ring around the mass number of this magnesium atom.

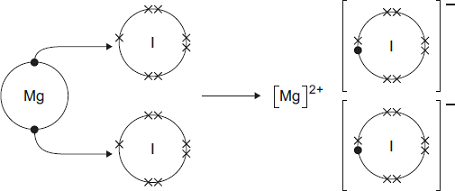
|  |  |  |
| --- | --- | --- |
| **12** | **24** | **36** |

**(1)**

(c)     The diagram shows how magnesium and iodine atoms form magnesium iodide.

Only the outer electrons are shown.

The dots (●) and crosses (×) are used to represent electrons.



**Use the diagram** to help you to answer this question.

Describe, as fully as you can, what happens when magnesium reacts with iodine to make magnesium iodide.

To gain full marks you should use the words atom, electron and ion in your answer.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(4)**

**(Total 9 marks)**

**Q33.**

The article gives some information about graphene.

|  |
| --- |
| Nanotunes!    Carbon can be made into nano-thin, strong sheets called graphene.  A graphene sheet is a single layer of graphite.  Graphene conducts electricity and is used in loudspeakers.  The picture shows the structure of graphene.                                                                  © 7immy/iStock |

(a)     Use the picture and your knowledge of bonding in graphite to:

(i)      explain why graphene is strong;

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

(ii)     explain why graphene can conduct electricity.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(b)     Graphite is made up of layers of graphene.

Explain why graphite is a lubricant.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

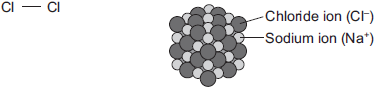
**(Total 7 marks)**

**Q34.**

**In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Explain why chlorine (Cl2) is a gas at room temperature, but sodium chloride (NaCl) is a solid at room temperature.

**Chlorine**                        **Sodium chloride**

****

Include a description of the bonding and structure of chlorine and sodium chloride in your answer.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Extra space \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(Total 6 marks)**

**Q35.**

Graphite and diamond are different forms of the element carbon.  
Graphite and diamond have different properties.

The structures of graphite and diamond are shown below.

|  |  |
| --- | --- |
|  |  |
| **Graphite** | **Diamond** |

(a)     Graphite is softer than diamond.

Explain why.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(4)**

(b)     Graphite conducts electricity, but diamond does not.

Explain why.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

**(Total 7 marks)**

Section 1: Knowledge Mark Scheme

**Q1.**

(a)  7

**1**

(b)  small molecule

**1**

(c)  F2

**1**

(d)  the reactivity decreases (going down Group 7)

*allow the reactivity decreases from chlorine to iodine*

**1**

(because) chlorine displaces bromine and iodine

*allow (because) chlorine has two reactions*

*allow (because) neither bromine nor iodine can displace chlorine*

**1**

(and) bromine displaces iodine **or** iodine does not react

*allow (and) bromine has one reaction*

***or*** *iodine has no reactions*

*allow (and) iodine cannot displace bromine*

**1**

(e)  80

**1**

(f)  (1.2 kg =) 1200 (g)

**or** (900 g =) 0.9 (kg)

**1**

****

**or**

****

*allow an answer correctly calculated from:*

**

***or***

******

**1**

*an answer of 75 (%) scores* ***2*** *marks*

**[9]**

**Q2.**

(a)  nucleus

**1**

neutron

**1**

neutron

**1**

electron

**1**

proton

**1**

*must be in this order*

(b)  

**1**

= 63.6

**1**

*an answer of 63.6 scores* ***2*** *marks*

(c)  copper / Cu

*allow ecf from answer to question* ***(b)***

**1**

(d)  

**or**

1.2 × 10−10 × 1 × 10−4

**1**

= 1.2 × 10−14 (m)

**1**

*an answer of 1.2 × 10−14 (m) scores* ***2*** *marks*

*a correct answer not in standard form scores* ***1*** *mark*

**[10]**

**Q3.**

(a)  sodium oxide

*allow Na2O*

**1**

(b)  oxidation

**1**

(c)  13

**1**

(d)  sodium hydroxide

**1**

(e)  OH−

**1**

(f)  

or 0.25 (dm3)

**1**

**or**

****

or 0.04 (g)



**1**

*an answer of 10 (g) scores* ***2*** *marks*

(g)  all points correct

*allow a tolerance of ±½ a small square*

*allow* ***1*** *mark for 3 points correct*

*ignore any attempt at a line of best fit*

**2**

(h)  39 °C

*allow any value from 34 to 46 (°C)*

**1**

**[10]**

**Q4.**

(a)  reactant

**1**

(b)  reversible

**1**

(c)  blue

*allow shades of blue, e.g. pale blue*

**1**

(d)  1.6 (g)

**1**

(e)  

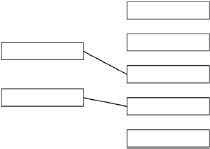
**1**

= 36 (%)

**1**

*an answer of 36 (%) scores* ***2*** *marks*

(f)



*copper sulfate − CuSO4*

**1**

*water − H2O*

**1**

**[8]**

**Q5.**

(a)     proton

**1**

(b)     electron

**1**

(c)     7

**1**

4

**1**

*in this order only*

(d)     isotopes

**1**

(e)     neutron

**1**

(f)      

**1**

= 10.8

**1**

*an answer of 10.8 scores* ***2*** *marks*

(g)      

**1**

= 2 × 10−5 (nm)

*allow 0.00002 (nm)*

**1**

*an answer of 2 × 10−5 (nm) scores 2 marks*

**[10]**

**Q6.**

(a)     **B**

**1**

(b)     **D**

**1**

(c)     **E**

**1**

(d)     **C**

**1**

(e)     92.5 × 6 **and**

7× 7.5

**1**

****

**1**

6.075

**1**

6.08

**1**

*allow 6.08 with no working shown for* ***4*** *marks*

**[8]**

**Q7.**

(a)     (i)      7

**1**

(ii)     –1

**1**

(iii)     neutrons

**1**

(b)    number of protons

**1**

(c)    atom **Y**

**1**

(d)     (i)      Ne

*allow neon*

**1**

(ii)     has a full outer shell

*allow in Group 0*

*allow a noble gas*

**or**

full outer energy level

*allow the shells are full*

**or**

has 8 electrons in its outer shell

*ignore in Group 8*

**1**

**[7]**

**Q8.**

(a)     atomic weights

*must be in this order*

**1**

electrons

**1**

proton numbers

**1**

(b)     (i)      H/hydrogen

*allow H2 or h*

**1**

(ii)     one / 1

*allow alkali metals*

**1**

(iii)    Potassium (K)

**1**

(iv)    Iron has a higher density than potassium

**1**

Iron forms ions that have different charges

**1**

(c)     any **three** from:

•        melts

•        fizzes / bubbles / effervesces

*allow gas produced*

•        sodium floats

•        size of the sodium decreases

*allow dissolves / disappears*

•        sodium moves

*allow two marks for moves around on the surface of the water*

**3**

**[11]**

**Q9.**

(a)     1

*must be in this order*

**1**

very small

*accept negligible, 1 / 2000*

*allow zero*

**1**

(b)     The mass number

**1**

(c)     C

**1**

(d)     (i)      2

**1**

(ii)     3

**1**

(e)     (i)      28

**1**

(ii)     42.9

*accept ecf from (e)(i)*

*accept 42 - 43*

**1**

(f)    (i)      0.9

**1**

(ii)     any **one** from:

•        accurate

•        sensitive

•        rapid

•        small sample.

**1**

**[10]**

**Q10.**

(a)  3.6 (cm3)

**1**

(b)  hydrogen line only

**1**

(c)  both lines

**1**

(d)  graphite has delocalised electrons

**1**

(e)  **cathode**    **anode**

zinc (1)     chlorine (1)

*do* ***not*** *accept chloride*

*allow* ***1*** *mark if chlorine and zinc the wrong way around*

**1+1**

hydrogen (1)  bromine (1)

*do* ***not*** *accept bromide*

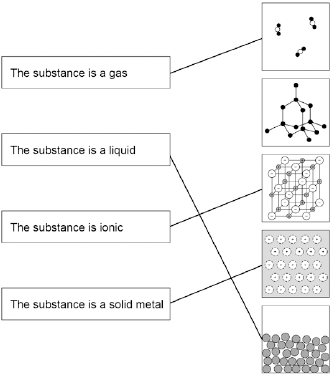
*allow* ***1*** *mark if bromine and hydrogen the wrong way around*

**1+1**

**[8]**

**Q11.**

(a)               **Statement**                                   **Structure**

****

more than one line drawn from a variable negates the mark

**4**

(b)     Carbon

**1**

(c)     It has delocalised electrons

**1**

(d)     the atoms / particles / ions are different sizes

*do* ***not*** *accept molecules*

**1**

so there are no rows / layers to slide

*accept the layers are disrupted*

**1**

(e)    

**1**

7.4%

**1**

*allow 7.4% with no working shown for* ***2*** *marks*

(f)     Mixture

**1**

**[11]**

**Q12.**

(a)     electricity

*allow an electric current*

**1**

(b)     (i)      chlorine/Cl2

*do* ***not*** *accept chloride*

**1**

(ii)     (zinc ions are) positive

*ignore to gain electrons*

**1**

and (opposite charges) attract

**1**

(iii)     reduction

**1**

(c)     (i)      in alloy:

*accept converse*

different sized atoms/particles

**or**

no layers/rows

*accept layers distorted*

**1**

so cannot slide

**1**

(ii)      shape memory (alloys)

*accept smart*

**1**

**[8]**

**Q13.**

(a)     (i)      C

**1**

(ii)     B

**1**

(iii)    A

**1**

(iv)    D

**1**

(b)     (i)      SO2

**1**

(ii)     shared

**1**

(iii)    covalent

**1**

**[7]**

**Q14.**

(a)    four

**1**

covalent

**1**

(b)     because it has a high melting point

*accept it won’t melt*

*accept it won’t decompose or react*

*allow withstand high temperatures*

*ignore boiling point*

**1**

(c)     thin

**1**

**[4]**

**Q15.**

(a)    layers

which have weak forces / attractions / bonds between them

*second mark must be linked to layers*

**1**

**or**

which can slide over each other **or** separate

*ignore references to rubbing*

**1**

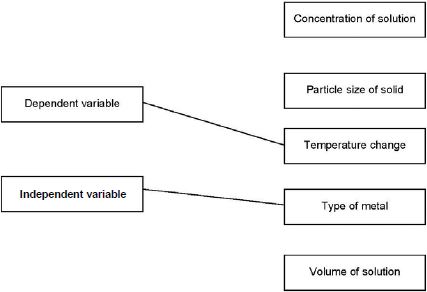
(b)     covalent

**1**

**[3]**

**Q16.**

(a)



*allow* ***one*** *mark if answers are reversed*

**1**

**1**

(b)  polystyrene is a better insulator

**1**

(c)  both bars labelled

**1**

both bars correctly plotted

*allow tolerance of ±½ small square*

*ignore width and spacing of bars*

*if no other mark scored, allow* ***1*** *mark for any one bar correctly plotted and labelled*

**1**

(d)  temperature increases

*allow (because) energy / ‘heat’ is transferred to the surroundings*

**or**

temperature does not decrease

*energy / ‘heat’ is not taken in from the surroundings*

*allow the energy of the products is less than the energy of the reactants*

**1**

(e)  (most reactive)

magnesium

(zinc)

nickel

*this order only*

**1**

(f)  suitable method described

**1**

the observations / measurements required to place in order

**1**

an indication of how results would be used to place the unknown metal in the reactivity series

**1**

**approaches that could be used:**

**approach 1:**

add the unknown metal to copper sulfate solution (1)

measure temperature change (1)

place the metals in order of temperature change (1)

**approach 2:**

add the metal to salt solutions of the other metals

**or**

heat the metal with oxides of the other metals (1)

measure temperature change (only if salt solutions used)

**or**

observe whether a chemical change occurs (1)

compare temperature change or whether there is a reaction to place in correct order (1)

**approach 3:**

add all of the metals to an acid (1)

measure temperature change or means of comparing rate of reaction (1)

place the metals in order of temperature change or rate of reaction (1)

**approach 4:**

set up electrochemical cells with the unknown metal as one electrode and each of the other metals as the other electrode (1)

measure the voltage of the cell (1)

place the metals in order of voltage (1)

(g)  D

**1**

(h)  C

**1**

**[12]**

**Q17.**

(a)     Whether there was a reaction or not

**1**

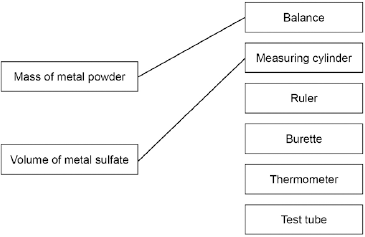
(b)     brown / orange / dark deposit on zinc

**or**

blue solution turns colourless / paler

**1**

(c)               **Variable**                                   **Measuring instrument**



more than one line drawn from a variable negates the mark

**2**

(d)     (Most reactive)        **Magnesium**

**Zinc**

(Least reactive)       **Copper**

*must all be correct*

**1**

(e)     would not be safe **or**

too reactive

*allow too dangerous*

**1**

(f)     Gold

**1**

(g)     2Fe2O3   +   3C   →   4Fe   +   3CO2

*allow multiples*

**1**

(h)     carbon

**1**

(i)     Loss of oxygen

**1**

**[10]**

**Q18.**

(a)     any **two** from:

•        concentration / volume of dilute hydrochloric acid

•        mass of metal powder

•        surface area of metal powder

•        stirring (of any) / rate of stirring

*allow reacted for the same length of time*

**2**

(b)     4.2 °C

*allow Magnesium Test 2*

**1**

and any **one** from:

•        lower mass of magnesium added

•        surface area of magnesium too low

•        magnesium coated in magnesium oxide (so took a while to start reacting)

•        not stirred

•        not stirred as quickly as the other metals

•        not reacted for as long a time as the other metals

*allow reason for break in circuit*

**1**

(c)     17.4(°C)

**1**

(d)     bubbles of gas

**1**

more (bubbles) seen with calcium than other metals

*allow any correct comparison between two metals*

**1**

(e)     any value between 7.9 °C and 12.3 °C

**1**

**[8]**

**Q19.**

(a)     measuring cylinder

**1**

(b)     use a polystyrene cup

*allow insulate the beaker and / or use a lid*

**1**

better insulator

**or**

reduces energy transfer from the surroundings

**1**

(c)     starting temperature of hydrochloric acid

**1**

volume of hydrochloric acid

**1**

(d)     21.4 (°C)

**1**

(e)     15.8 (°C) to 16.1 (°C)

*allow 16.1 (°C) to 15.8 (°C)*

**1**

(f)      

=15.9 (°C)

*an answer of 15.9(333..) (°C) scores* ***2*** *marks*

**1**

*allow 15.9(333..) (°C)*

**1**

(g)      temperature decreases

**1**

(h)      straight line from (1.0, 19.8) to (5.0, 14.6)

*ignore continuation of line in either direction*

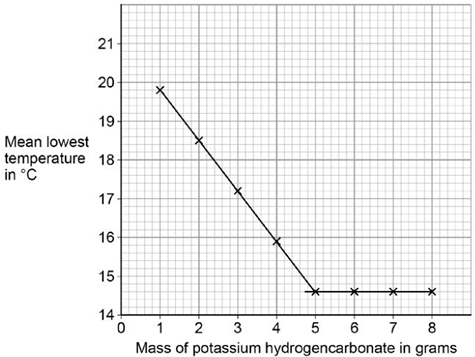
**1**

horizontal straight line from (5.0, 14.6 to 8.0, 14.6)

*ignore continuation of line in either direction*

**1**

the answer below scores **2** marks



(i)       (lowest) temperature decreases

**1**

to 14.6 °C

**or**

until 5 g added

**1**

then no change to temperature (after 5 g solid added)

**or**

then temperature remains at 14.6 °C (after 5 g solid added)

**1**

**[15]**

**Q20.**

(a)     water / H2O

*allow steam or hydrogen oxide*

**1**

(b)     (i)      A

**1**

(ii)     exothermic

**1**

products (energy) lower than reactants (energy)

**1**

(iii)     1860 (kJ)

**1**

(c)     (i)      22.5

**1**

38.7

**1**

16.2

*allow ecf for correct subtraction*

**1**

(ii)     50 (g)

**1**

(iii)    20.1 (kJ)

*allow propanol*

*ignore 3*

**1**

(iv)    as the number of carbon atoms (in one molecule of alcohol) increases the heat energy given out increases (when the alcohol is burned)

**1**

(v)     any **two** from:

•        no lid

•        no insulation

•        no draught shield

*Allow heat / energy loss to surroundings for any one of these marks*

•        incomplete combustion

•        inaccurate measurement

•        no repeats (to calculate a mean)

**2**

(iv)    -O-H

**1**

**[14]**

**Q21.**

(a)     (i)      42 000

*correct answer gains* ***2*** *marks with or without working  
allow 42 kJ*

*if answer incorrect : correct substitution 500 x 4.2 x 20 gains* ***1****mark*

**2**

(ii)     any **two** from:

•        eye protection

•        lab coat

•        heat-proof mat

•        (heat-proof) gloves

•        (long) hair tied back

•        stand up

•        secure the beaker

**2**

(iii)    Stir the water before measuring the temperature.

**1**

Place a lid on the beaker.

**1**

(b)     the products → S

**1**

the activation energy → Q

**1**

the energy released by the reaction → P

**1**

(c)     carbon dioxide produced

*it = propane*

*allow converse arguments*

*allow greenhouse gas / global warming / atmospheric pollution*

(crude oil / propane) non-renewable

**1**

*allow crude oil running out*

**1**

**[11]**

**Q22.**

(a)     goes up

**1**

(b)     (i)      B

**1**

(ii)     A

**1**

(iii)    a catalyst

**1**

activation energy

**1**

(c)     (i)      eg (ensures) complete reaction

*allow spread heat / energy*

**or** even heating

*allow mixes properly or mix them together or to get correct temperature*

*ignore dissolves*

**1**

(ii)     lid (on beaker)

*accept cover beaker*

**or**

insulate (beaker) / use a plastic cup

**1**

**[7]**

Section 2: Required Practicals Mark Scheme

**Q23.**

(a)     use a polystyrene cup instead of a (glass) beaker

*allow insulate the beaker*

*allow use a lid*

**1**

minimises energy transfer from the surroundings

**or**

for better insulation

**1**

(b)     concentration of hydrochloric acid

**1**

(c)     

**1**

= 5.6 (°C)

**1**

± 0.2

**1**

(d)     straight line from origin to (5.0, 6.4)

*must not deviate to anomalous point*

**1**

horizontal line from (5.0, 6.4) to (8.0, 6.4)

*must not deviate to anomalous point*

**1**

(e)     as mass (of potassium hydrogencarbonate) increases, temperature decrease / change increases

**1**

*until 5 g (to 8 g) (of potassium hydrogencarbonate has been added)*

*allow ecf from lines of best fit*

**1**

(because) the reaction has finished

**or**

(because) all the acid has reacted

**or**

(because) no more solid can react

**or**

(because) the solid is in excess

**1**

(f)      not stirred correctly

**1**

**[12]**

**Q24.**

(a)  any **one** from:

•   metal

•   (metal) hydroxide

*allow ammonium hydroxide*

•   (metal) carbonate

*allow ammonium carbonate*

•   alkali

*allow soluble base*

*allow ammonia*

**1**

*allow named example*

*allow correct formula*

*ignore base*

(b)  Ca(NO3)2

*allow Ca2+(NO3−)2*

**1**

(c)  **Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

**5−6**

**Level 2:** The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.

**3−4**

**Level 1:** The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

**1−2**

**No relevant content**

**0**

**Indicative content**

•   use magnesium oxide and sulfuric acid

•   add sulfuric acid to a beaker

•   warm sulfuric acid

•   add magnesium oxide

•   stir

•   continue adding until magnesium oxide is in excess

•   filter

•   using a filter paper and funnel

•   to remove excess magnesium oxide

•   heat solution in an evaporating basin

•   to crystallisation point

•   leave to crystallise

•   pat dry with filter paper

credit may be given for diagrams

**[8]**

**Q25.**

(a)     any **one** from:

•        solution becomes colourless or colour fades

•        zinc becomes bronze / copper coloured

*allow copper (forms) or a solid (forms)*

•        zinc gets smaller

*allow zinc dissolves*

•        bubbles or fizzing.

*ignore precipitate*

**1**

(b)     improvement:

use a plastic / polystyrene cup or add a lid

*accept use lagging / insulation*

**1**

reason - must be linked

reduce / stop heat loss

**OR**

improvement:

use a digital thermometer

*allow use a data logger*

reason - must be linked

more accurate or easy to read or stores data

*allow more precise or more sensitive*

*ignore more reliable*

*ignore improvements to method, eg take more readings*

**1**

(c)     Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking Guidance and apply a ‘best–fit’ approach to the marking.

**0 marks**No relevant content

**Level 1 (1−2 marks)**There is a statement about the results.

**Level 2 (3−4 marks)**There are statements about the results. These statements may be linked or may include data.

**Level 3 (5−6 marks)**There are statements about the results with at least one link and an attempt at an explanation.

Examples of chemistry points made in the response:

**Description:**

**Statements**

Concentration of copper sulfate increases

Temperature change increases

There is an anomalous result

The temperature change levels off

Reaction is exothermic

**Linked Statements**

Temperature change increases as concentration of copper sulfate increases

The temperature change increases, and then remains constant

After experiment 7 the temperature change remains constant

**Statements including data**

The trend changes at experiment 7

Experiment 3 is anomalous

**Attempted Explanation**

Temperature change increases because rate increases

Temperature change levels off because the reaction is complete

**Explanation**

As more copper sulfate reacts, more heat energy is given off

Once copper sulfate is in excess, no further heat energy produced

**6**

**[9]**

**Q26.**

(a)     **(diagram)**

complete circuit with power supply

**1**

test solution in beaker or other appropriate apparatus

**1**

electrodes

*allow carbon, platinum or inert electrodes*

**1**

**(independent variable)**

salt solutions (with different metal ions)

**1**

**(observation)**

solid / metal deposit on the negative electrode

**1**

(b)     (sometimes) hydrogen is produced

**1**

(because) the metal is more reactive than hydrogen

**1**

(c)     chlorine

**1**

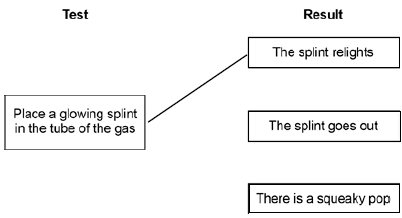
oxygen

**1**

**[9]**

**Q27.**

(a)



*more than one line from test negates the mark*

**1**

(b)     (i)      place a lighted splint at the mouth of the tube

**1**

there is a squeaky pop

*dependent on correct test*

**1**

(ii)     hydrogen is less reactive than magnesium

*accept converse*

*accept magnesium is too reactive*

**1**

(c)     (i)      any **one** from:

•        to improve appearance or make it look nice

•        to prevent corrosion

•        to make it more durable

•        cheaper than solid silver

**1**

(ii)     solution must be silver nitrate **or** contain silver ions

**1**

otherwise copper will be deposited **or** silver will not be deposited

**1**

spoon must be the negative electrode / cathode

**1**

because silver ions have a positive charge **or** go to negative electrode **or** are discharged at the negative electrode.

**1**

(iii)    because (plastic is an) insulator **or** does not conduct electricity

*accept does not contain mobile electrons*

**1**

**[10]**

**Q28.**

(a)     (i)      points correctly plotted ( ± ½ small square)

*four points =* ***2*** *marks*

*three points =* ***1*** *mark*

**Max 2**

straight line of best fit using full range of points from 0,0

**1**

(ii)     any **one** from:

*must explain why the point is below the line*

•        the solution may not have been properly stirred

•        the electrodes may have been a larger distance apart

•        the drop of sodium chloride may have been a smaller volume / smaller

*allow not enough sodium chloride added*

*allow smaller amount of sodium chloride*

*do* ***not*** *allow too few drops added*

*ignore the student may have misread the conductivity meter*

**1**

(iii)    any **one** from:

•        the volume of pure water

*allow amount*

•        the concentration (of the solutions added)

•        the volume (of the drops) of solution added

*ignore number of drops*

•        the distance between the electrodes

•        the same electrodes **or** electrodes made of the same material

•        same depth **or** surface area of electrodes in the water

•        constant power supply

*ignore current*

•        stirred

**1**

(b)     (i)      because (pure) water is covalent / molecular (simple) **or** contains molecules

**1**

therefore (pure) water has no free / mobile electrons **or** ions

*molecules do not have a charge* ***or*** *molecules do not contain ions gains* ***2*** *marks*

**1**

(ii)     because there are ions in sodium chloride

*allow Na+ and / or Cl–(ions)* ***or*** *ionic bonding.*

*Ignore particles other than ions for MP1.*

**1**

which can move **or** carry the current / charge

*MP2 must be linked to ions only.*

**1**

(iii)    Hydrogen

*allow H2 / H*

**1**

**[10]**

Section 3: 6 Mark Questions Mark Scheme

**Q29.**

(a)  potassium chloride **and** iodine

*either order*

*allow KCl for potassium chloride and I2 for iodine*

**1**

(b)  (chlorine’s) outer electrons / shell closer to the nucleus

*allow chlorine has fewer shells*

*allow chlorine atom is smaller than iodine atom*

*ignore chlorine has fewer outer shells*

**1**

(so) the chlorine nucleus has greater attraction for outer electrons / shell

*allow chlorine has less shielding*

*do* ***not*** *accept incorrect types of attraction*

**1**

(so) chlorine gains an electron more easily

**1**

***max 2*** *marks can be awarded if the answer refers to chloride / iodide instead of chlorine / iodine*

*allow converse statements*

*allow energy levels for shells throughout*

(c)  hydrogen chloride is made of small molecules

*allow hydrogen chloride is simple molecular*

**1**

(so hydrogen chloride) has weak intermolecular forces\*

**1**

(intermolecular forces) require little energy to overcome\*

**1**

*\*do* ***not*** *accept reference to bonds breaking unless applied to intermolecular bonds*

(d)  (bonds broken = 4(412) + 193 =)1841

**1**

(bonds formed = 3(412) + 366 + **X** =) 1602 + **X**

**1**

−51 = 1841 − (1602 + **X**)

*allow use of incorrectly calculated values of bonds broken and / or bonds formed from steps 1 and 2 for steps 3 and 4*

**1**

(**X** =) 290 (kJ/mol)

*allow a correctly calculated answer from use of −51 = bonds formed − bonds broken*

**1**

**OR**

alternative method ignoring the 3 unchanged C−H bonds

(412 + 193 =) 605 (1)

366 + **X** (1)

−51 = 605 − (366 + **X**) (1)

(**X** =) 290 (kJ/mol) (1)

*an answer of 290 (kJ/mol) scores* ***4*** *marks*

*an answer of 188 (kJ/mol) scores* ***3*** *marks*

*an incorrect answer for one step does* ***not*** *prevent allocation of marks for subsequent steps*

**[11]**

**Q30.**

(a)      (i)     lead nitrate

*accept Pb(NO3)2*

*do* ***not*** *accept nitride*

**1**

sodium iodide / potassium iodide

*accept NaI / KI*

*accept other correct soluble iodides*

*do* ***not*** *accept sodium iodine / potassium iodine*

**1**

(ii)     filter / filtration / filtering

*accept decant / decanting etc.*

*accept centrifugation*

*ignore evaporation* ***or*** *heating if after filtration*

**1**

(b)     *metallic / sharing / covalent* ***or*** *molecule = max* ***3***

magnesium loses **2** electrons

*all three underlined ideas must be present*

*two underlined ideas =* ***1*** *mark*

*eg magnesium loses electrons*

***or***

*magnesium gains 2 electrons*

***or***

*magnesium loses 2 ions*

*nb magnesium* ***ion*** *loses 2 electrons =* ***1*** *mark*

*2 errors =* ***0*** *marks*

*eg magnesium gains electrons*

*all four underlined ideas must be present*

**2**

iodine gains **1 / an** electron

*three underlined ideas =* ***1*** *mark*

*eg iodine gains electron(s)*

***or***

*iodine loses 1 / an electron*

***or***

*iodine gains 1 / an ion*

***or***

*iodide (ion) gains 1 / an electron*

*2 errors =* ***0*** *marks*

**2**

(c)     any **two** from:

*mention of molecules / intermolecular / covalent / atoms = max* ***1***

•        forces (of attraction) / bonds are strong **or** lot of energy needed to break bonds

•        oppositely charged ions attract **or** electrostatic attraction between ions

•        giant structure **or** lattice

*allow many bonds*

*ignore ionic bonding unqualified*

**2**

**[9]**

**Q31.**

(a)     (i)      atomic weights

*allow atomic masses*

**1**

(ii)     proton

*allow proton number*

**1**

(b)     (i)      F/fluorine

*allow F2*

**1**

(ii)     any **one** from:

•        copper has a higher density

•        copper is stronger

•        copper is harder

•        copper is less reactive

*allow named property*

*ignore colour, conductivity, melting point and boiling point*

*allow converse for potassium*

**1**

(iii)    relative distance from nucleus

*allow more / fewer energy levels / shells or larger / smaller atom*

**1**

relative attraction to nucleus

*allow more / less shielding*

**1**

relative ease of gain or loss of electron

**1**

opposite explanation of ease of gain or loss of electron for other group

**1**

*max 3 marks if ‘outer’ not mentioned*

**[8]**

**Q32.**

(a)     (i)      nucleus

**1**

(ii)     neutron

**1**

(iii)    electron

**1**

(b)     (i)      12

**1**

(ii)     24

**1**

(c)     any **four** from:

*sharing / covalent / metallic = max* ***3***

•         magnesium (atom) reacts with **two** iodine (atoms)

•         magnesium (atom) loses electrons

•         **2** electrons (from each atom)

•         Iodine (atom) gains electron(s)

•         **1** electron or an electron (to each atom)

•         iodide ion formed

*allow iodine ion*

•         iodide has negative charge / is a negative ion / particle

*allow iodine  
ignore I2–*

•         magnesium ion formed

•         magnesium has positive charge

•         oppositely charged ions attract

•         a giant structure / lattice is formed

*allow* ***1*** *mark for unqualified reference to ion formation or ionic bonding*

**4**

**[9]**

**Q33.**

(a)     (i)      giant lattice

*allow each carbon atom is joined to three others*

**1**

atoms in graphene are covalently bonded

*max.* ***2*** *marks if any reference to wrong type of bonding*

**1**

and covalent bonds are strong **or** need a lot of energy to be broken

*allow difficult to break*

**1**

(ii)     because graphene has delocalised electrons

*allow each carbon atom has one free electron*

**1**

which can move throughout the structure

*do* ***not*** *accept just electrons can move.*

**1**

(b)     because there are weak forces between molecules

*allow no bonds between the layers*

**1**

so layers / molecules can slip / slide.

**1**

**[7]**

**Q34.**

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response.

**0 marks**

No relevant content

**Level 1 (1–2 marks)**

*There is a statement about the bonding and / or structure* ***or*** *melting / boiling point of chlorine* ***or*** *sodium chloride.*

**Level 2 (3–4 marks)**

*There are statements about the bonding and / or structure of chlorine* ***or*** *sodium chloride.*

**Level 3 (5–6 marks)**

*There are statements about the bonding and / or structure of chlorine* ***and*** *sodium chloride.*

*There is an explanation of why chlorine is a gas* ***or*** *sodium chloride is a solid.*

**Examples of chemistry points made in response:**

**Chlorine:**

covalent bonds between atoms

forming (simple) molecules

*no / weak attraction / bonds between molecules*

low boiling point

**Sodium chloride:**

*ionic bonds* ***or*** *electrostatic attraction*

strong bonds

in all directions

between oppositely charged ions

forming giant lattice

*large amounts of energy needed to break bonds*

*high melting point*

**[6]**

**Q35.**

(a)     **Graphite:**

because the layers (of carbon atoms) in graphite can move / slide

*it = graphite*

**1**

this is because there are only weak intermolecular forces **or** weak forces between layers

*accept Van der Waals’ forces allow no covalent bonds between layers*

**1**

**Diamond:**

however, in diamond, each carbon atom is (strongly / covalently) bonded to 4 others

*allow diamond has three dimensional / tetrahedral structure*

**1**

so no carbon / atoms able to move / slide

*allow so no layers to slide* ***or*** *so diamond is rigid*

**1**

(b)     because graphite has delocalised electrons / sea of electrons

*allow free / mobile / roaming electrons*

**1**

which can carry charge / current **or** move through the structure

**1**

however, diamond has no delocalised electrons

*accept however, diamond has all (outer) electrons used in bonding*

**1**

**[7]**