**Y11 Combined Chemistry 1**

**PPE 2 - Foundation**

**For each topic, there are questions in the Revision Guide that will help you choose what to revise. The page numbers you need are listed below.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Topic** | **Questions**  Page Title | | **Support**  Pages | **☺** | **😐** | **☹** |
| A simple model of the atom | 112 | Atoms, Elements and Compounds | 96-99 |  |  |  |
| Group 7 | 112 | Groups of the Periodic Table | 107-111 |  |  |  |
| Ionic compounds | 127 | Ions and Ionic Compounds | 113-115 |  |  |  |
| Covalent compounds (Graphite) | 127 | Covalent substances | 116-119 |  |  |  |
| Metallic bonding | 127 | Metallic Bonding | 120 |  |  |  |
| Concentrations of solutions | 127 | Concentrations of Solutions | 126 |  |  |  |
| RPA – Making a salt | 137 | Acids and their reactions | 129 |  |  |  |
| pH and neutralisation | 137 | Acids and their reactions | 128-129 |  |  |  |
| Electrolysis | 137 | Electrolysis | 132-133 |  |  |  |
| RPA – Energy transfer | 137 | Exothermic and Endothermic Reactions | 135 |  |  |  |

**Exam Practice**

The following pages contain past exam questions that should attempt.

The grade for each question is indicated by:



Remember: to get Grade 4-5 you still have to be able to answer the 1-3 questions!

**Atomic structure**

**Q1.**

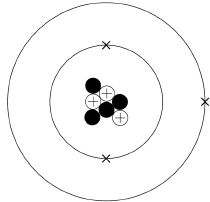
The table below shows the relative mass and charge of the particles in an atom.

|  |  |  |
| --- | --- | --- |
| **Name of particle** | **Relative mass** | **Charge** |
| proton | 1 | +1 |
| neutron |  |  |
| electron | very small |  |

(a)  Complete the table above.

**(3)**

(b)  The diagram below represents a lithium atom.



Give the number of protons, neutrons and electrons in the lithium atom shown in the diagram above.

Number of protons  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Number of neutrons  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Number of electrons  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

(c)  Scientific models of the atom have changed over time.

Draw **one** line from each description of the atomic model to the stage in the development of the atomic model.

|  |  |  |
| --- | --- | --- |
| **Description of atomic model** |  | **Stage in the development of the atomic model** |
|  | | |
|  |  | Dalton atoms |
| A ball of positive charge with electrons embedded in it |  |  |
|  |  | Neutrons discovered |
|  | | |
|  |  | Nucleus of atoms discovered |
| Spherical atoms |  |  |
|  |  | Plum pudding model |

**(2)**

**(Total 8 marks)**

**Halogens**

**Q2.**

This question is about the halogens.

(a)  Which group in the periodic table is known as the halogens?

Tick **one** box.

|  |  |
| --- | --- |
| Group 1 |  |
| Group 2 |  |
| Group 7 |  |
| Group 0 |  |

**(1)**

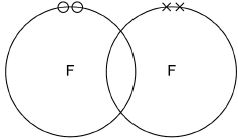
**Covalent Bonding**

(b)  A fluorine atom has 7 electrons in the outer shell.

The diagram below shows part of a dot and cross diagram to represent a molecule of fluorine (F2).

Complete the dot and cross diagram.

You should show only the electrons in the outer shells.



**(2)**

(c)  Chlorine reacts with potassium bromide solution.

Complete the word equation.

        potassium               \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

chlorine  +  bromide  ⟶ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ +

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

**(2)**

(d)  What type of reaction happens when chlorine reacts with potassium bromide solution?

Tick **one** box.

|  |  |
| --- | --- |
| decomposition |  |
| displacement |  |
| neutralisation |  |
| precipitation |  |

**(1)**



**Properties of covalent molecules**

(e)  Complete the sentence.

Choose the answer from the box.

|  |  |  |  |
| --- | --- | --- | --- |
| **an atom** | **an electron** | **a neutron** | **a proton** |

Chlorine is more reactive than bromine.

This is because chlorine gains \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ more easily.

**(1)**

(f)  How does the size of a chlorine atom compare with the size of a bromine atom?

Complete the sentence.

Choose the answer from the box.

|  |  |  |
| --- | --- | --- |
| **bigger than** | **the same size as** | **smaller than** |

A chlorine atom is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a bromine atom.

**(1)**

(g)  Give a reason for your answer to part **(f)**

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

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

**(1)**

(h)  Fluorine reacts with chlorine to produce ClF3

Balance the chemical equation for the reaction.

Cl2 + \_\_\_\_\_\_\_\_F2 ⟶ 2 ClF3

**(1)**

**Properties of covalent molecules- Extended writing**

(i)   Explain why fluorine is a gas at room temperature.

Use the following words in your answer:

**energy**    **forces**    **molecules**    **weak**

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

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

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

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

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

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

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

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

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

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

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

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

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

**(3)**

**(Total 13 marks)**

**Ionic bonding and properties**

**Q3.**

The drawing shows a container of a compound called magnesium chloride.



(i)      How many elements are joined together to form magnesium chloride?

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

**(1)**

(ii)      Magnesium chloride is an ionic compound. What are the names of its ions?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ions and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ions

**(1)**

(iii)     How many **negative** ions are there in the formula for magnesium chloride?

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

**(1)**

(iv)     Complete the sentence.

          Ions are atoms, or groups of atoms, which have lost or gained

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

**(1)**

(v)     Suggest **three** properties which magnesium chloride has because it is an ionic compound.

Property 1 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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

Property 2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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

Property 3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

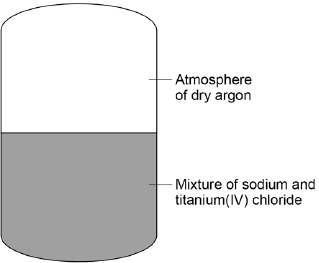
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

**(Total 7 marks)**

**Quantitative chemistry   
Q4.**

**Figure 1** shows a reactor used to produce titanium from titanium(IV) chloride.

**Figure 1  
**

The chemical equation for the reaction of titanium(IV) chloride with sodium is:

          TiCl4                    +        4Na                     Ti           +           4NaCl

titanium(IV) chloride      +      sodium             titanium      +      sodium chloride

(a)     For one reaction:

•      1615 kg titanium(IV) chloride reacted completely with 782 kg sodium

•      1989 kg sodium chloride was produced.

Calculate the mass of titanium produced from this reaction.

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

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

Mass of titanium = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ kg

**(1)**

(b)     The table below shows the solubility of sodium chloride in 100 cm3 of aqueous solution at different temperatures.

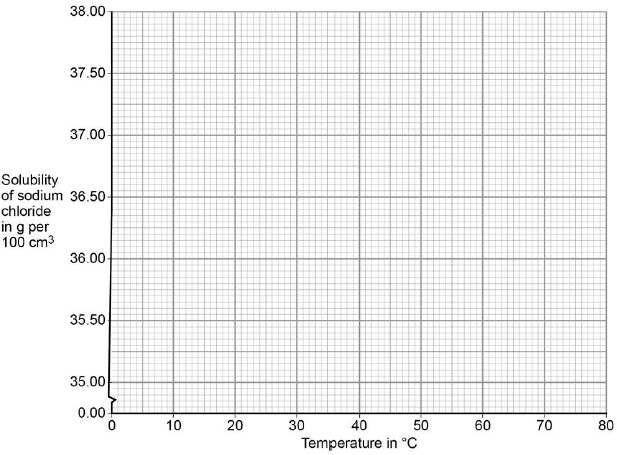
|  |  |
| --- | --- |
| **Solubility of sodium chloride in g per 100cm3** | **Temperature in °C** |
| 35.72 | 10 |
| 35.89 | 20 |
| 36.09 | 30 |
| 37.37 | 40 |
| 36.69 | 50 |
| 37.04 | 60 |

On **Figure 2**:

•      plot this data on the grid

•      draw a line of best fit.

**Figure 2**

****

**(3)**

(c)     The product sodium chloride is dissolved in water to separate it from titanium.

At 30 °C the solubility of sodium chloride is 36 kg per 100 dm3.

Calculate the minimum volume of water in dm3, at 30 °C, needed to dissolve 1989 kg sodium chloride.

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

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

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

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

Volume of water = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ dm3

**(2)**

(d)     Calculate the percentage by mass of titanium in titanium(IV) chloride (TiCl4).

Give your answer to 3 significant figures.

Relative atomic masses (*A*r): Cl = 35.5; Ti = 48

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

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

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

Percentage of titanium by mass = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ %

**(3)**

(e)     Suggest why the reaction is done in an atmosphere of dry argon instead of air containing water vapour.

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

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

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

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

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

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

**(3)**

**Properties of metals**

(f)     Explain why titanium conducts electricity.

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

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

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

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

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

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

**(3)**

**(Total 15 marks)**

**pH and neutralisation**

**Q5.**

The pH scale is a measure of the acidity or alkalinity of a solution.

(a)     Draw one line from each solution to the pH value of the solution.

|  |  |  |
| --- | --- | --- |
| **Solution** |  | **pH value of the solution** |

|  |  |  |
| --- | --- | --- |
|  |  | 5 |
|  |  |  |
| Acid |  | 7 |
|  |  |  |
|  |  | 9 |
|  |  |  |
| Neutral |  | 11 |
|  |  |  |
|  |  | 13 |

**(2)**

(b)     Which ion in aqueous solution causes acidity?

Tick **one** box.

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

**(1)**

(c)     When sulfuric acid is added to sodium hydroxide a reaction occurs to produce two products.

The equation is:

             H2SO4  +  2NaOH     Na2SO4  +  2H2O

How many elements are in the formula H2SO4?

Tick **one** box.

|  |  |
| --- | --- |
| 3 |  |
| 4 |  |
| 6 |  |
| 7 |  |

**(1)**

(d)     What is this type of reaction?

Tick **one** box.

|  |  |
| --- | --- |
| Decomposition |  |
| Displacement |  |
| Neutralisation |  |
| Reduction |  |

**(1)**

(e)     Name the salt produced.

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

**(1)**

(f)     Describe how an indicator can be used to show when all the sodium hydroxide has reacted with sulfuric acid.

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

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

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

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

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

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

**(3)**

**(Total 9 marks)**

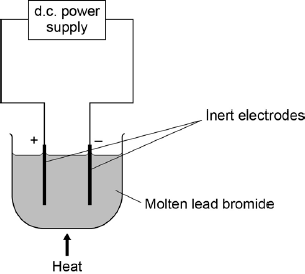
**Electrolysis**

**Q6.**

This question is about the electrolysis of two compounds.

**Figure 1** shows the electrolysis of molten lead bromide.

**Figure 1**

****

(a)     The electrolyte contains lead ions (Pb2+) and bromide ions (Br–).

Complete the sentences.

Use words from the box.

|  |
| --- |
| **atoms           bromide           bromine           ions** |
| **lead                  molecules              oxygen** |

At the positive electrode the gas produced is\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

At the negative electrode lead \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

gain electrons and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .

**(3)**

(b)     A student measured the volumes of each gas produced during the electrolysis of water.  
The table below shows the student’s results.

|  |  |  |
| --- | --- | --- |
| **Time in minutes** | **Volume of gas produced in cm3** | |
| **Hydrogen** | **Oxygen** |
| 0 | 0 | 0 |
| 2 | 11.2 | 5.4 |
| 4 | 20.1 | 11.4 |
| 6 | 32.5 | 17.6 |
| 8 | 40.0 | 23.7 |
| 10 | 60.9 | 30.0 |

The student plotted a graph of the results for oxygen. **Figure 2** shows the graph.

The student did not put a scale on the *y* axis.

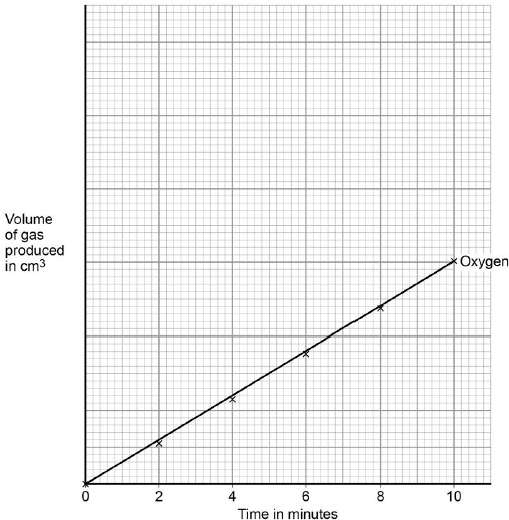
On the graph in **Figure 2**:

•        complete the scale for the *y* axis

•        plot the results for hydrogen

•        include a line of best fit.

**Figure 2**

****

**(3)**

(c)     Use the graph to calculate the mean volume of oxygen produced per second.

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

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

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

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

Mean volume of oxygen produced = \_\_\_\_\_\_\_\_\_\_ cm3 / s

**(3)**

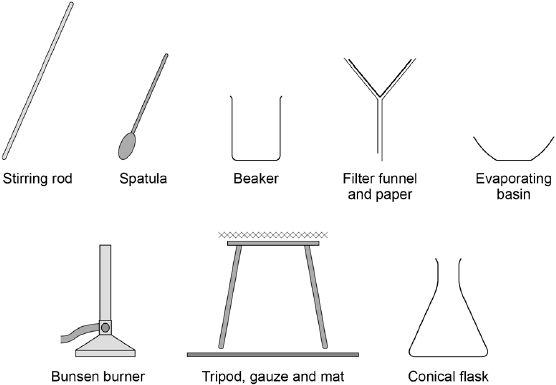
**(Total 9 marks)**

**Required Practical Activity- Making a salt**

**Q7.**

This question is about making copper salts.

The figure below shows the apparatus given to a student.



Outline a safe plan the student could use to make pure, dry, crystals of the soluble salt copper sulfate from the insoluble metal oxide and dilute acid.

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

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

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

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

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

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

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

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

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

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

**(Total 6 marks)**

**Required practical activity- Energy transfer**

**Q8.**

Some students investigated the reactivity of four unknown metals, **W**, **X**, **Y** and **Z**.

The letters are not the symbols of these elements.

The students used metal salt solutions of copper nitrate, magnesium sulfate and zinc chloride.

This is the method used.

1.      Pour a solution of a metal salt into a glass beaker.

2.      Measure the temperature of the solution.

3.      Add 1 g of metal to the solution.

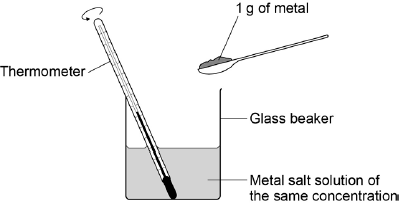
4.      Measure the temperature of the solution.

5.      Calculate the temperature increase.

The students did the experiment using each salt solution with each metal.

**Figure 1** shows the apparatus the students used.

**Figure 1**

****

The table below shows the students’ results.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Temperature increase in °C** | | | |
| **Solution** | **Metal W** | **Metal X** | **Metal Y** | **Metal Z** |
| Copper nitrate | 46 | 10 | 29 | No change |
| Magnesium sulfate | No change | No change | No change | No change |
| Zinc chloride | 15 | No change | No change | No change |

(a)     Which metal is **least** reactive?

Tick **one** box.

|  |  |
| --- | --- |
| Metal W |  |
| Metal X |  |
| Metal Y |  |
| Metal Z |  |

**(1)**

(b)     How do the results show that magnesium is **more** reactive than the metals **W**, **X**, **Y** and **Z**?

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

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

**(1)**

(c)     How do the results show that the reaction between metal **Y** and copper nitrate solution is exothermic?

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

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

**(1)**

(d)     One student said that the investigation was not valid (a fair test).

Write a plan for the investigation that includes improvements to the method and apparatus.

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

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

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

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

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

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

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

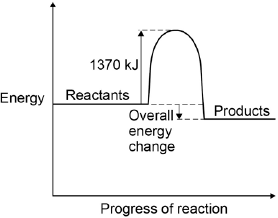
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(4)**

**Reaction profiles**

(e)     **Figure 2** shows the reaction profile of an exothermic reaction.

**Figure 2**

****

What does the energy value of 1370 kJ represent?

Tick **one** box.

|  |  |
| --- | --- |
| Activation energy |  |
| Products energy |  |
| Reactants energy |  |
| Released energy |  |

**(1)**

(f)     The overall energy change is 386 kJ.

What percentage of 1370 kJ is this?

Give your answer to two significant figures.

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

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

**(2)**

**(Total 10 marks)**

Mark schemes

**Q1.**

(a)

|  |  |  |  |
| --- | --- | --- | --- |
| **name of particle** | **relative mass** | **charge** |  |
| proton | (1) | (+1) |  |
| neutron | 1 | 0 | **1 + 1** |
| electron | (very small) | −1 | **1** |

*allow words instead of numbers*

*allow neutral* ***or*** *no charge for the neutron*

(b)  (protons) 3

**1**

(neutrons) 4

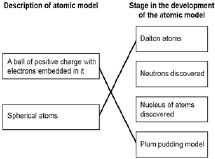
**1**

(electrons) 3

**1**

*allow words instead of numbers*

(c)



**1**

**1**

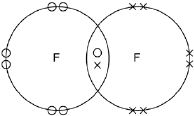
**[8]**

**Q2.**

(a)  group 7

**1**

(b)



*one shared pair anywhere in overlap between two circles* ***or*** *on intersection*

*6 other electrons on each atom*

*allow dots* ***or*** *crosses* ***or*** *mixture for all marks*

*ignore any inner shell electrons*

**1**

**1**

(c)  bromine

**1**

potassium chloride

**1**

*either order*

*allow correct chemical formulae*

(d)  displacement

**1**

(e)  (an) electron

**1**

(f)  smaller than

**1**

(g)  (chlorine has) fewer levels / shells (of electrons)

*allow converse for bromine*

*allow (chlorine has) fewer electrons*

*allow Cl has 3 levels / shells and Br has 4 levels / shells*

*ignore atomic number*

***or*** *mass number*

***or*** *number of protons*

**1**

*mark independent of answer to part* ***(f)***

(h)  3

*allow multiples*

**1**

(i)   there are weak forces

*do* ***not*** *accept weak bonds*

**1**

between molecules

**1**

*allow weak intermolecular forces for the first* ***2*** *marks*

which require little energy to overcome / break

*allow does not need much energy to boil*

**1**

**[13]**

**Q3.**

(i)      two

*or 2*

**1**

(ii)      magnesium **and** chloride

*either order*

***not*** *positive / negative*

*do not credit’chlorine’*

*accept Mg++* ***and*** *Cl-*

*do not credit just Mg and Cl–*

*accept cation(s)* ***and*** *anion(s)*

**1**

(iii)     2

**1**

(iv)     electrons

*accept charges*

**1**

(v)     any **three** from

•        (is a) giant structure/lattice structure

•        crystalline / hard

*accept just 'crystals(s)’*

•        high melting point / solid

•        high boiling point

•        conductor (of electricity) when dissolved **in** water

***or*** *conductor (of electricity) when ions are free to move*

•        conductor (of electricity) when molten

•        soluble in water

**3**

**[7]**

**Q4.**

(a)     408 kg

**1**

(b)     all points correct

*± ½ small square*

**2**

*allow* ***1*** *mark if 5 points correct*

best fit line

**1**

(c)    

**1**

5525 dm3

**1**

(d)     relative formula mass of TiCl4 is 190

**1**

25.26 %

**1**

Answer given to 3 significant figures = 25.3 %

**1**

*25.23% with or without working gains* ***3*** *marks*

(e)     argon is unreactive

**1**

water (vapour) would react with sodium

*allow water (vapour) would react with titanium(IV) chloride*

**1**

and air contains oxygen that would react with reactants

*allow and air contains oxygen that would react with products*

**1**

(f)     (titanium conducts electricity) because electrons in the outer shell of the metal atoms are delocalised

**1**

and so electrons are free to move

*allow the delocalised electrons in the metal carry electrical charge through the metal*

**1**

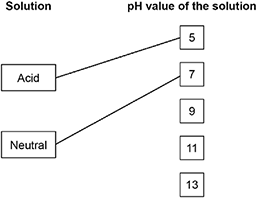
through the whole structure

**1**

**[15]**

**Q5.**

(a)



*extra lines from solution negate the mark*

**2**

(b)     H+

**1**

(c)     3

**1**

(d)     Neutralisation

**1**

(e)     sodium sulfate

**1**

(f)     Add indicator to sodium hydroxide solution

*allow add indicator to sulfuric acid*

**1**

Add sulfuric acid (gradually)

*allow add sodium hydroxide solution (gradually)*

**1**

*allow pH probe*

until indicator just changes (colour)

**or** until universal indicator turns green or shows pH7

**1**

**[9]**

**Q6.**

(a)     bromine

**1**

ions

**1**

atoms

**1**

(b)     correct scale on y axis

**1**

points correctly plotted using the scale

*± ½ small square*

**1**

best-fit line drawn

**1**

(c)     value for oxygen divided by corresponding time

**1**

× 60

**1**

= 0.05 (cm3 / s)

*allow 0.05 with no working shown for* ***3*** *marks*

**1**

**[9]**

**Q7.**

**Level 3 (5–6 marks):**

A coherent method is described with relevant detail, which demonstrates a broad  
understanding of the relevant scientific techniques, procedures and safety precautions. The  
steps in the method are logically ordered with the dependent and control variables correctly identified. The method would lead to the production of valid results.

**Level 2 (3–4 marks):**

The bulk of a method is described with mostly relevant detail, which demonstrates a  
reasonable understanding of the relevant scientific techniques, procedures and safety precautions. The method may not be in a completely logical sequence and may be missing  
some detail.

**Level 1 (1–2 marks):**

Simple statements are made which demonstrate some understanding of some of the relevant scientific techniques, procedures and safety precautions. The response may lack a logical structure and would not lead to the production of valid results.

**0 marks:**

No relevant content

**Indicative content**

Named chemicals

•        copper oxide

•        sulfuric acid

•        copper sulfate

Correct use of apparatus

•        stirring rod

•        spatula

•        beaker

•        filter funnel and filter paper

•        evaporating basin

•        Bunsen burner

•        tripod and gauze

•        bench mat

•        conical flask

Method

•        add (excess) copper oxide to sulfuric acid

•        heat the mixture

•        filter the mixture

•        method to evaporate some of the water from the filtrate eg using a water bath or evaporating to half volume

•        leave solution (to cool and) to form crystals

•        remove and dry crystals

Safety

•        wearing of safety glasses / goggles

•        care with use of sulfuric acid as corrosive

•        warming not boiling mixture of copper oxide and sulfuric acid

•        hold beaker containing warm mixture with tongs whilst filtering

**[6]**

**Q8.**

(a)     **Z**

**1**

(b)     magnesium sulfate does not react with any of the metals

*allow there is no change / increase in temperature with any of the metals*

**1**

(c)     temperature increase

**1**

(d)     **Level 2 (3–4 marks):**

A detailed and coherent plan covering all the steps. The steps include the improvements and are set out in a logical manner.

**Level 1 (1–2 marks):**

Simple statements of improvements to the apparatus or steps are made but they may  
not be set out in a logical manner.

**0 marks:**

No relevant content

**Indicative content**

Simple statements

•        stir the solution

•        use the same amount of each solution

•        use the same concentration of solution

•        put insulation or a lid on the beaker

•        measure how high temperature goes

Coherent statements in a logical order

•        pour a fixed, measured volume of the metal salt solution into a plastic / polystyrene cup

•        measure and record the temperature of the solution

•        stir and add 1 g of metal to the solution

•        (put a lid on the cup)

•        measure and record the temperature after a set time or measure and record  
the greatest / highest temperature

•        calculate and record the temperature increase

•        (repeat each individual experiment at least two more times and calculate the mean temperature increase)

**4**

(e)     Activation energy

**1**

(f)      386 (kJ) / 1370 × 100

**1**

28 %

**1**

**[10]**