Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
CHEMISTRY

F

Foundation Tier — Paper 1F

Specimen 2018 (set 2) — Time allowed: 1 hour 45 minutes

Materials

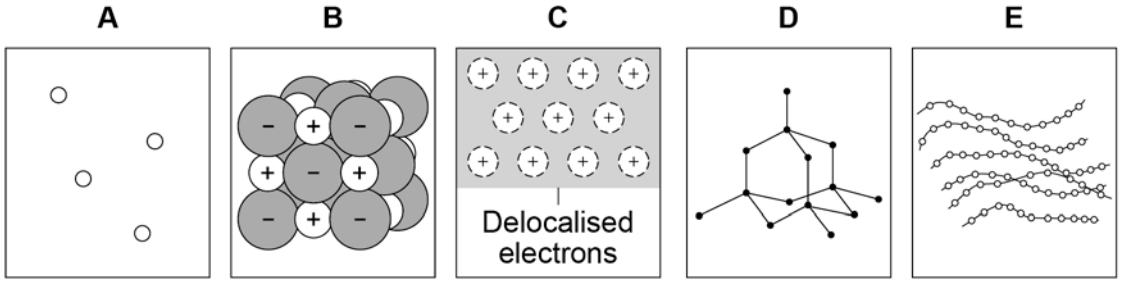
For this paper you must have:
- a ruler
- a scientific calculator
- the periodic table (enclosed).

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

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

0 1 **Figure 1** shows the structure of five substances.

Figure 1



0 1 . 1 Which diagram shows a gas?

[1 mark]

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

0 1 . 2 Which diagram shows the structure of diamond?

[1 mark]

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

0 1 . 3 Which diagram shows a metallic structure?

[1 mark]

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

0 1 . 4 Which diagram shows a polymer?

[1 mark]

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

A chlorine atom has 7 electrons in the outer shell.

Two chlorine atoms covalently bond to form a chlorine molecule, Cl_2

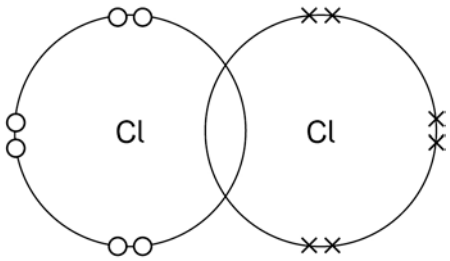
0 1 . 5 **Figure 2** is a dot and cross diagram showing the outer shells and some electrons in a chlorine molecule.

Complete the dot and cross diagram.

Show only the electrons in the outer shell.

[1 mark]

Figure 2



Question 1 continues on the next page

0 1 . 6 What is the reason for chlorine's low boiling point?

[1 mark]

Tick **one** box.

Strong covalent bonds ☐

Strong forces between molecules ☐

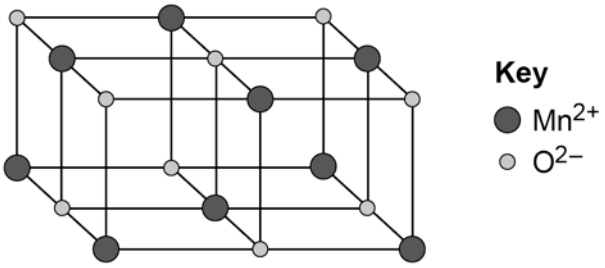
Weak covalent bonds ☐

Weak forces between molecules ☐

Figure 3 represents the structure of manganese oxide.

Manganese oxide is an ionic compound.

Figure 3



0 1 . 7 Determine the empirical formula of manganese oxide.

Use **Figure 3**.

[1 mark]

Empirical formula = _____

0 1 . 8 Why does manganese oxide conduct electricity as a liquid?

[1 mark]

Tick **one** box.

Atoms move around in the liquid ☐

Electrons move around in the liquid ☐

Ions move around in the liquid ☐

Molecules move around in the liquid ☐

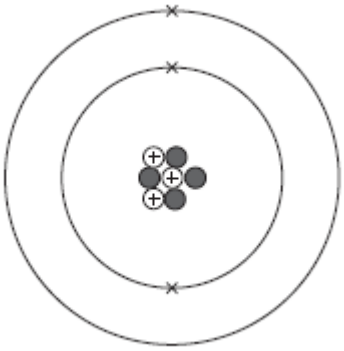
8

Turn over for the next question

0 2 This question is about atomic structure.

Figure 4 represents the structure of a lithium atom.

Figure 4



0 2 . 1 Name the particle in the atom that has a positive charge.

[1 mark]

_____

0 2 . 2 Name the particle in the atom that has the smallest mass.

[1 mark]

_____

0 2 . 3 Complete the sentences.

Choose the answers from the box.

[2 marks]

3	**4**	**7**	**10**

The mass number of the lithium atom is _____ .

The number of neutrons in the lithium atom is _____ .

0 2 . 4 What are lithium atoms with different numbers of neutrons called?

[1 mark]

Tick **one** box.

- Compounds ☐
- Ions ☐
- Isotopes ☐
- Molecules ☐

0 2 . 5 Name the particle in the atom discovered by James Chadwick.

[1 mark]

_____

Question 2 continues on the next page

0 2 . 6 An element has two isotopes.

Table 1 shows information about the isotopes.

Table 1

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

Calculate the relative atomic mass (A_r) of the element.

Use the equation:

$$A_r = \frac{\text{(mass number} \times \text{percentage) of isotope 1} + \text{(mass number} \times \text{percentage) of isotope 2}}{100}$$

Give your answer to 1 decimal place.

[2 marks]

Relative atomic mass (A_r) = _____

0 2 . 7 The radius of an atom is 0.2 nm

The radius of the nucleus is $\frac{1}{10\,000}$ the radius of the atom.

Calculate the radius of the nucleus.

Give your answer in standard form.

[2 marks]

Radius = _____ nm

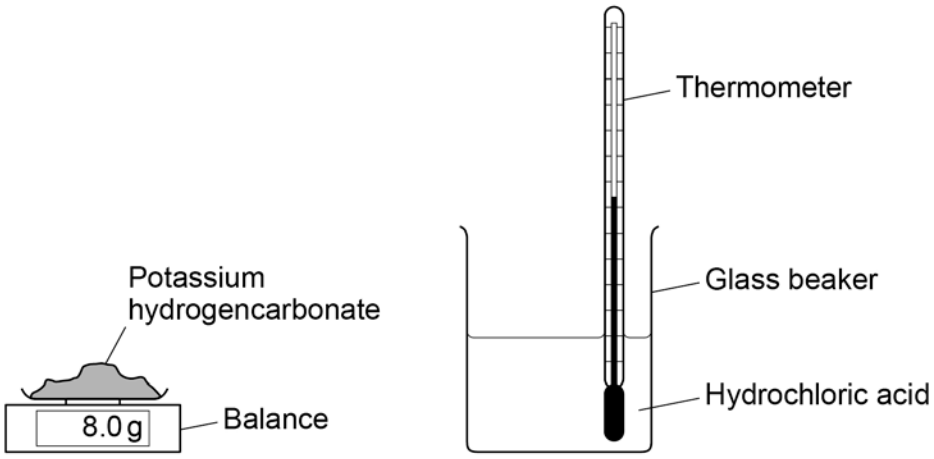
10

Turn over for the next question

0 3 A student investigated the energy change occurring in the endothermic reaction between potassium hydrogencarbonate and hydrochloric acid.

Figure 5 shows the apparatus used.

Figure 5



This is the method used.

1. Measure 50 cm^3 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.

0 3 . 1 Which is the most suitable apparatus to use to measure 50 cm^3 of hydrochloric acid?

[1 mark]

Tick **one** box.

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

0 3 . 2 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 marks]

Question 3 continues on the next page

0 3 . 3 Which **two** variables should the student keep the same to make this a fair test?

[2 marks]

Tick **two** boxes.

Mass of potassium hydrogencarbonate ☐

Same balance ☐

Same thermometer ☐

Starting temperature of hydrochloric acid ☐

Volume of hydrochloric acid ☐

0 3 . 4 **Figure 6** shows part of the thermometer used to measure the temperature.

Figure 6

What is the temperature reading on the thermometer?

[1 mark]

Temperature = _____ °C

Table 2 shows a set of results.

Table 2

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

0 3 . 5 What is the range of the lowest temperature?

[1 mark]

From _____ °C to _____ °C

0 3 . 6 Calculate the mean lowest temperature.

Use **Table 2**.

[2 marks]

_____

_____

_____

Mean lowest temperature = _____ °C

0 3 . 7 How do the results show that the reaction is endothermic?

[1 mark]

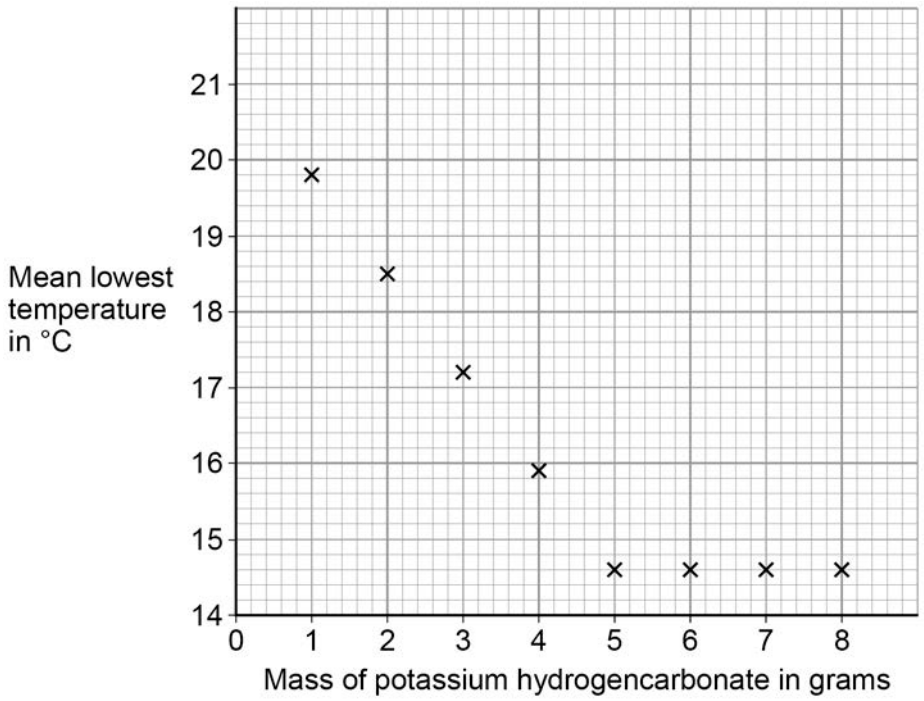
_____

_____

Question 3 continues on the next page

Figure 7 shows the student's results.

Figure 7



0 3 . 8 Draw **two** straight lines of best fit on **Figure 7**.

[2 marks]

0 3 . 9 Describe how the lowest temperature changes as the mass of potassium hydrogencarbonate added increases.

[3 marks]

15

Turn over for the next question

0 4 A student investigated the voltage produced by simple cells.

Figure 8 shows the apparatus used.

Figure 8

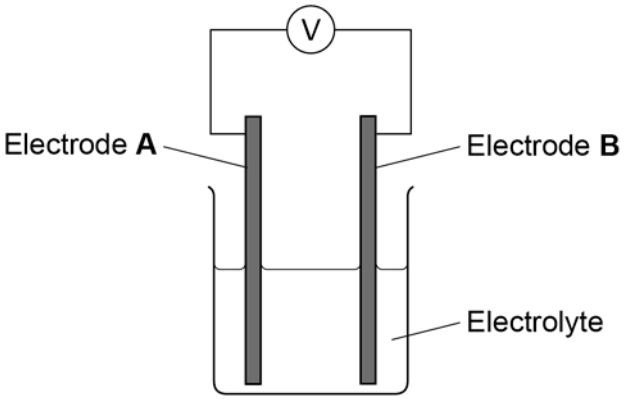


Table 3 shows the voltage produced with different metal electrodes.

Table 3

Electrode A	Electrode B	Voltage in V
Copper	Copper	0.00
Copper	Iron	0.78
Copper	Magnesium	2.71
Copper	Tin	0.48
Copper	Zinc	1.10

0 4 . 1 List the metals in **Table 3** in order of reactivity.

[2 marks]

Most reactive _____

_____

_____

_____

Least reactive Copper

0 4 . 2 Batteries consist of cells.

Describe how a 6.0 V battery can be made from cells of voltage 1.5 V

[2 marks]

0 4 . 3 Why do non-rechargeable cells stop producing electricity?

[2 marks]

0 4 . 4 Complete the word equation for the reaction in a hydrogen fuel cell.

[1 mark]

hydrogen + _____ → water

0 4 . 5 Give **two** reasons why using a hydrogen fuel cell is seen as non-polluting.

Use the equation in Question **04.4**

[2 marks]

1 _____

2 _____

9

0 5 This question is about metal oxides.

When sodium is heated in oxygen, sodium oxide is produced.

0 5 . 1 Balance the equation for the reaction.

[1 mark]

$$\_\_\_\_\_\ Na + O_2 \rightarrow 2\ Na_2O$$

0 5 . 2 Why is this an oxidation reaction?

[1 mark]

0 5 . 3 Sodium oxide is added to water and shaken.

Universal indicator is added.

The pH of the solution is 14

What is the colour of the universal indicator?

[1 mark]

Tick **one** box.

- Green ☐
- Purple ☐
- Red ☐
- Yellow ☐

0 5 . 4 Aluminium oxide reacts with hydrochloric acid to produce a salt.

What is the name of the salt produced?

[1 mark]

Tick **one** box.

Aluminium chloride ☐

Aluminium nitrate ☐

Aluminium sulfate ☐

Aluminium sulfide ☐

Question 5 continues on the next page

A student investigates the solubility of four metal oxides and four non-metal oxides in water.

The student tests the pH of the solutions formed.

Table 4 shows the student's results.

Table 4

Type of oxide	Oxide	Solubility in water	pH of solution
Metal oxides	Sodium oxide	Soluble	14
	Calcium oxide	Soluble	10
	Magnesium oxide	Slightly soluble	9
	Zinc oxide	Insoluble	No solution formed
Non-metal oxides	Carbon dioxide	Soluble	5
	Sulfur dioxide	Soluble	2
	Phosphorus oxide	Soluble	1
	Silicon dioxide	Insoluble	No solution formed

The student makes two conclusions.

Conclusion 1: 'All metal oxides produce alkaline solutions.'

Conclusion 2: 'All non-metal oxides produce acidic solutions.'

0 5 . 5 Explain why the student's conclusions are only **partly** correct.

Use information from **Table 4**.

[4 marks]

0 5 . 6 Give an improved conclusion for metal oxides.

Use **Table 4**.

[2 marks]

10

Turn over for the next question

0 6 This question is about metal compounds.

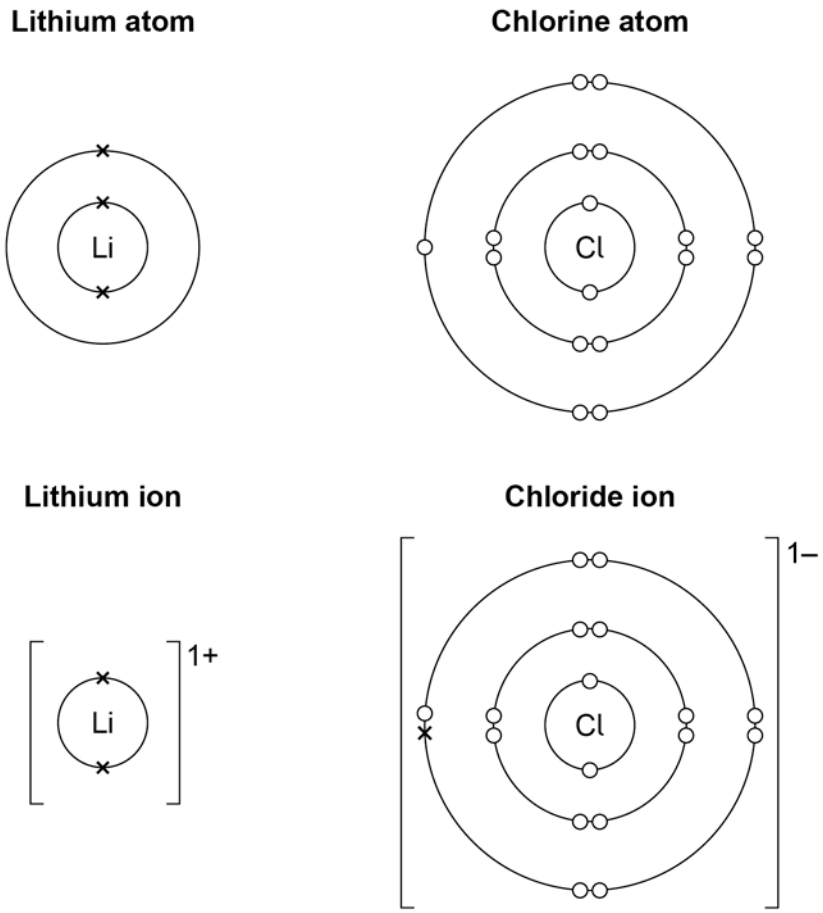
0 6 . 1 Lithium reacts with chlorine to produce lithium chloride.

When lithium atoms and chlorine atoms react to produce lithium chloride, lithium ions and chloride ions are formed.

Figure 9 shows the electronic structures of the atoms and ions.

The symbols **o** and **x** are used to represent electrons.

Figure 9



Describe what happens when a lithium atom reacts with a chlorine atom.

Answer in terms of electrons.

[4 marks]

Question 6 continues on the next page

Zinc sulfate can be made by two methods.

The equations for the two methods are:

Method 1: $ZnO + H_2SO_4 \rightarrow ZnSO_4 + H_2O$

Method 2: $ZnCO_3 + H_2SO_4 \rightarrow ZnSO_4 + H_2O + CO_2$

0 6 . 2 Calculate the percentage atom economy for making zinc sulfate in **Method 1**.

Use the equation:

percentage atom economy =

$$\frac{\text{relative formula mass of } ZnSO_4}{\text{relative formula mass of } ZnO + \text{relative formula mass of } H_2SO_4} \times 100$$

Give your answer to 3 significant figures.

[3 marks]

Relative formula masses (M_r): ZnO = 81 H_2SO_4 = 98 $ZnSO_4$ = 161

Percentage atom economy = _____ %

0 6 . 3 **Method 1** gives a higher percentage atom economy for making zinc sulfate than **Method 2**.

Give a reason why it is important to use a reaction with a high atom economy.

[1 mark]

0 6 . 4 A student uses 50 cm^3 of a zinc sulfate solution of 80 g/dm^3

What mass of zinc sulfate is dissolved in 50 cm^3 of this zinc sulfate solution?

[2 marks]

Mass = _____ g

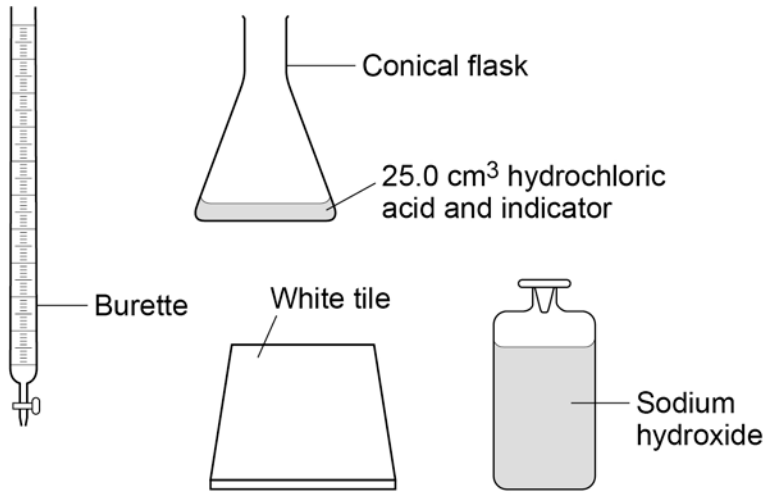
10

Turn over for the next question

0 7 Sodium hydroxide reacts with hydrochloric acid.

Figure 10 shows apparatus that can be used to find the volume of sodium hydroxide reacting with 25.0 cm^3 hydrochloric acid.

Figure 10



0 7 . 1 Describe a method to find the exact volume of sodium hydroxide that reacts with 25.0 cm^3 of hydrochloric acid.

[6 marks]

The reaction produces a solution of sodium chloride.

A student wants to obtain sodium chloride crystals from the sodium chloride solution.

This is the method used.

1. Add solid charcoal to the sodium chloride solution to remove the indicator colour.
2. Remove the solid charcoal.
3. Evaporate the solution to dryness over a Bunsen burner.

0 7 . 2 Charcoal is not soluble in water.

Suggest a method the student could use to remove the solid charcoal in **Step 2**.

[1 mark]

0 7 . 3 The student obtains a powdery white solid.

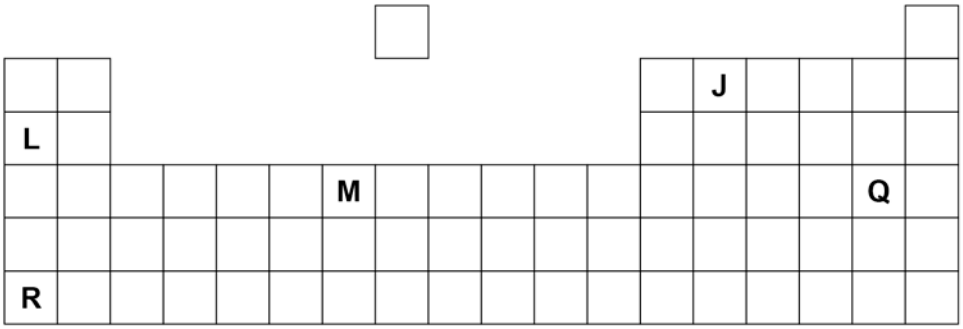
Suggest how the student could improve **Step 3** of the method to obtain larger crystals instead of powder.

[1 mark]

8

0 8 **Figure 11** shows an outline of the modern periodic table.

Figure 11



J, **L**, **M**, **Q** and **R** represent elements in the periodic table.

0 8 . 1 Which element has four electrons in its outer shell?

[1 mark]

Tick **one** box.

J ☐ **L** ☐ **M** ☐ **Q** ☐ **R** ☐

0 8 . 2 Which **two** elements in **Figure 11** are in the same period?

[1 mark]

_____ and _____

0 8 . 3 Which element reacts with potassium to form an ionic compound?

[1 mark]

Tick **one** box.

J ☐ **L** ☐ **M** ☐ **Q** ☐ **R** ☐

0 8 . 4 Which element forms ions with different charges?

[1 mark]

Tick **one** box.

J ☐ **L** ☐ **M** ☐ **Q** ☐ **R** ☐

0 8 . 5 Which element has three electron shells?

[1 mark]

Tick **one** box.

J ☐ **L** ☐ **M** ☐ **Q** ☐ **R** ☐

Question 8 continues on the next page

In the 1860s scientists were trying to organise elements.

Figure 12 shows the table published by John Newlands in 1865.

The elements are arranged in order of their atomic weights.

Figure 12

H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co, Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce, La	Zr	Di, Mo	Ro, Ru
Pd	Ag	Cd	U	Sn	Sb	Te

Figure 13 shows the periodic table published by Dmitri Mendeleev in 1869.

Figure 13

H							
Li	Be	B	C	N	O	F	
Na	Mg	Al	Si	P	S	Cl	
K Cu	Ca Zn	? ?	Ti ?	V As	Cr Se	Mn Br	Fe Co Ni
Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	? I	Ru Rh Pd

0 8 . 6 Mendeleev's table became accepted by other scientists whereas Newlands' table was not.

Evaluate Newlands' and Mendeleev's tables.

You should include:

- a comparison of the tables
- reasons why Mendeleev's table was more acceptable.

Use **Figure 12** and **Figure 13** and your own knowledge.

[6 marks]

11

0 9 A student investigated the law of conservation of mass.

The law of conservation of mass states that the mass of the products is equal to the mass of the reactants.

This is the method used.

1. Pour lead nitrate solution into a beaker labelled **A**.
2. Pour potassium chromate solution into a beaker labelled **B**.
3. Measure the mass of both beakers and contents.
4. Pour the solution from beaker **B** into beaker **A**.
5. Measure the mass of both beakers and contents again.

When lead nitrate solution and potassium chromate solution are mixed, a reaction takes place.

This is the equation for the reaction:

$$Pb(NO_3)_2(aq) + K_2CrO_4(aq) \rightarrow PbCrO_4(s) + 2\,KNO_3(aq)$$

0 9 . 1 What would the student see when the reaction takes place?

[1 mark]

0 9 . 2 **Table 5** shows the student's results.

Table 5

	Mass in g
Beaker **A** and contents before mixing	128.71
Beaker **B** and contents before mixing	128.97
Beaker **A** and contents after mixing	154.10
Beaker **B** after mixing	103.58

Show that the law of conservation of mass is true.

Use the data from **Table 5**.

[2 marks]

0 9 . 3 What is the resolution of the balance used to obtain the results in **Table 5**?

[1 mark]

Tick **one** box.

0.01 g ☐ 0.1g ☐ 1 g ☐ 100 g ☐

Question 9 continues on the next page

0 9 . 4 Calculate the relative formula mass (M_r) of lead nitrate $Pb(NO_3)_2$

[2 marks]

Relative atomic masses (A_r): N = 14 O = 16 Pb = 207

Relative formula mass = _____

0 9 . 5 The formula of potassium chromate is K_2CrO_4

The charge on the potassium ion is +1

What is the formula of the chromate ion?

[1 mark]

Tick **one** box.

CrO_4^{+} ☐

CrO_4^{2+} ☐

CrO_4^{-} ☐

CrO_4^{2-} ☐

0 9 . 6 Another student also tests the law of conservation of mass using the same method.

The student uses a different reaction.

This is the equation for the reaction.

$$Na_2CO_3(aq) + 2\,HCl(aq) \rightarrow 2\,NaCl(aq) + CO_2(g) + H_2O(l)$$

Explain why this student's results would **not** appear to support the law of conservation of mass.

[3 marks]

10

Turn over for the next question

1 0 A student makes a hypothesis:

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

1 0 . 1 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.

[5 marks]

Diagram

Independent variable _____

_____

Observation _____

_____

1 0 . 2 The student's hypothesis is only partially correct.

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

[2 marks]

1 0 . 3 Predict the product at the **positive** electrode in the electrolysis of:

- sodium chloride solution
- copper sulfate solution.

[2 marks]

Sodium chloride solution _____

Copper sulfate solution _____

9

END OF QUESTIONS

There are no questions printed on this page

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