New Document 1

Name: ______________________

Class: ______________________

Date: ______________________

Time: **148 minutes**

Marks: **146 marks**

Comments:

Q1. 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^+ ☐
- O^{2-} ☐
- OH^- ☐

(1)

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

The equation is:

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

How many elements are in the formula H_2SO_4?

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)

Q2. John Newlands arranged the known elements into a table in order of atomic weight.

Figure 1 shows part of Newlands' table.

Figure 1

Group	**1**	**2**	**3**	**4**	**5**	**6**	**7**
	H	Li	Be	B	C	N	O
	F	Na	Mg	Al	Si	P	S
	Cl	K	Ca				

(a) What are the names of the elements in Group 5 of Newlands' table?

Tick **one** box.

Calcium and sulfur ☐

Carbon and silicon ☐

Chlorine and silver ☐

Chromium and tin ☐

(1)

(b) In what order is the modern periodic table arranged?

Tick **one** box.

Atomic mass ☐

Atomic number ☐

Atomic size ☐

Atomic weight ☐

(1)

(c) Give **two** differences between Group 1 of Newlands' table and Group 1 of the periodic table.

....

....

....

....

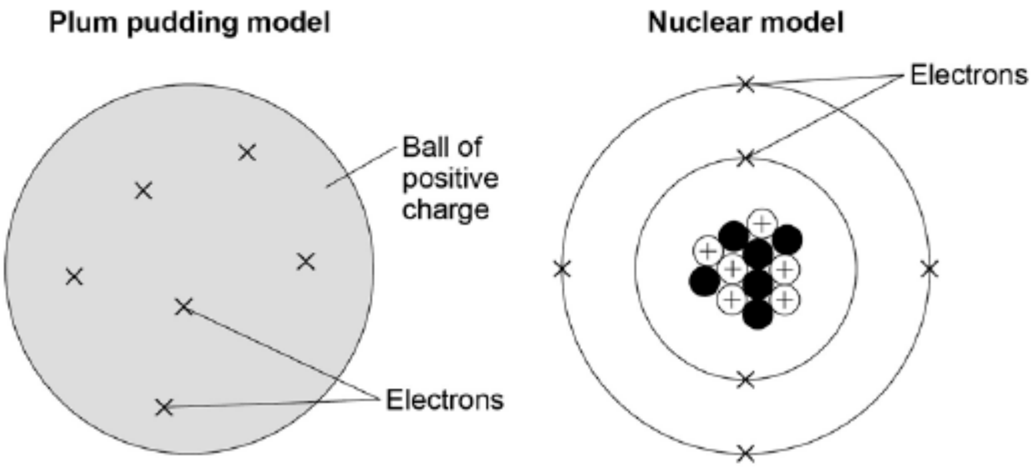
(2)

(d) In 1864, atoms were thought to be particles that could not be divided up into smaller particles.

By 1898, the electron had been discovered and the plum pudding model of an atom was proposed.

Figure 2 shows the plum pudding model of an atom of carbon and the nuclear model of an atom of carbon.

Figure 2



Compare the position of the subatomic particles in the plum pudding model with the nuclear model.

....

....

....

....

....

....

....

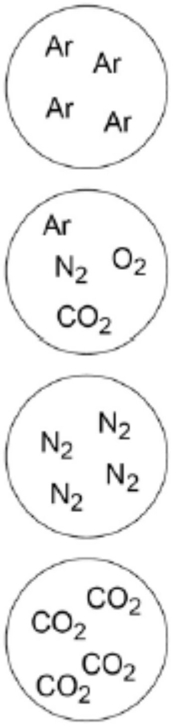
....

(4)

(e) Models are used to show the differences between elements, compounds and mixtures.

Which circle shows a model of a mixture?

Tick **one** box.



(1)

(f) **Figure 3** shows a model of carbon dioxide.

Figure 3

$O=C=O$

What does each line between the atoms in **Figure 3** represent?

Tick **one** box.

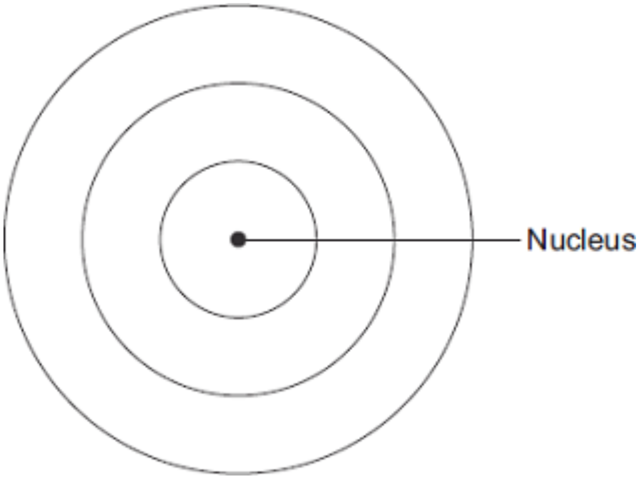
Covalent bond	☐
Intermolecular force	☐
Ionic bond	☐
Metallic bond	☐

(1)
(Total 10 marks)

Q3. Aluminium has many uses.

(a) An aluminium atom has 13 electrons.

(i) Draw the electronic structure of an aluminium atom.



(1)

(ii) Name the **two** sub-atomic particles in the nucleus of an aluminium atom.

.... and ....

(1)

(iii) Why is there no overall electrical charge on an aluminium atom?

....

....

(1)

(b) Rail tracks are made from steel.

Molten iron is used to weld rail tracks.

The reaction of aluminium with iron oxide is used to produce molten iron.

(i) Balance the chemical equation for the reaction.

$$.......Al + Fe_2O_3 \longrightarrow ....Fe + Al_2O_3$$

(1)

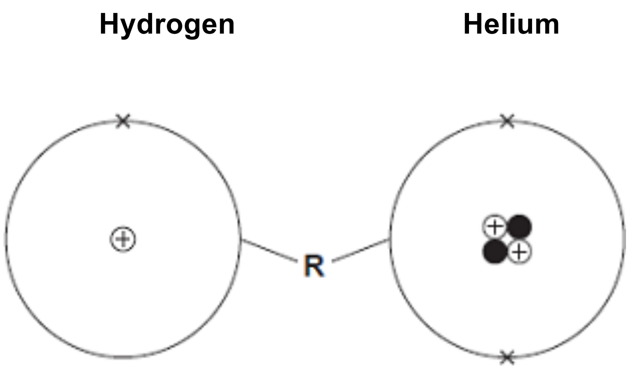
(ii) Why does aluminium react with iron oxide?

....

....

(1)
(Total 5 marks)

Q4. The Sun is mainly hydrogen and helium.
The diagrams show an atom of hydrogen and an atom of helium.



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

(i) The centre of each atom is called the

molecule.
nucleus.
shell.

(1)

(ii) The circle (labelled **R**) around the centre of each atom is called

a bond.
an electrical charge.
an energy level (shell).

(1)

(b) Use the diagrams in part (a) to help you to answer these questions.

Draw **one** line from each question to its correct answer.

Question	Answer
	1

Question		Answer
How many protons are there in the hydrogen atom?		
		2
How many electrons are there in the helium atom?		
		3
What is the mass number of the helium atom?		
		4

(3)

(c) The Sun is 73% hydrogen and 25% helium. The rest is other elements.

What is the percentage of other elements in the Sun?

.... %

(1)

(d) One of the other elements in the Sun is neon.
Neon is in the same group of the periodic table as helium.

Use the Chemistry Data Sheet to help you to answer these questions.

(i) How many protons are there in a neon atom?

....

(1)

(ii) Which group of the periodic table are helium and neon in?

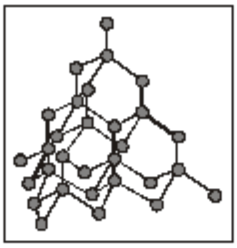
....

(1)
(Total 8 marks)

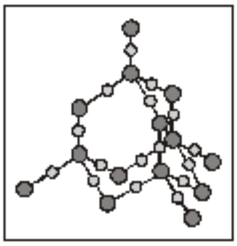
Q5. This question is about giant structures. Diamond, graphite and silicon dioxide all have giant structures.

(a) The diagrams show the structures of these three substances.

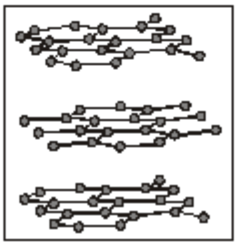
Draw a line from each structure to its name.



Silicon dioxide



Graphite



Diamond

(2)

(b) Complete the sentences using words from the box.

covalent	**four**	**hard**	**ionic**
shiny	**soft**	**three**	**two**

(i) Diamond, graphite and silicon dioxide have high melting points because all the atoms in their structures are joined by strong .... bonds.

(1)

(ii) In diamond each atom is joined to .... other atoms.

(1)

(iii) Diamond can be used to make cutting tools because it has a rigid structure which makes it very ....

(1)

(iv) In graphite each atom is joined to .... other atoms.

(1)

(v) Graphite can be used to make pencils because it has a structure which makes it

....

(1)

(c) When a diamond is heated to a high temperature and then placed in pure oxygen it burns. Carbon dioxide is the only product.

Name the element in diamond. ....

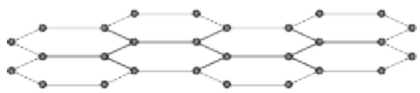
(1)
(Total 8 marks)

Q6. Read the information

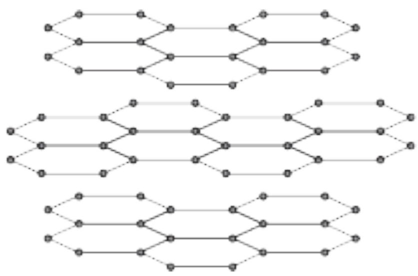
Graphene

Scientists have made a new substance called graphene.
The bonding and structure of graphene are similar to graphite.

Graphene is made of a single layer of the same atoms as graphite.



Graphene



Graphite

Use the information above and your knowledge of graphite to answer the questions.

(a) This part of the question is about graphene.

Choose the correct answer to complete each sentence.

(i)

ionic	**covalent**	**metallic**

The bonds between the atoms in graphene are ....

(1)

(ii)

chromium	**carbon**	**chlorine**

Graphene is made of .... atoms.

(1)

(iii)

2	3	4

In graphene each atom bonds to .... other atoms.

(1)

(b) This part of the question is about graphite.

Graphite is used in pencils.

Explain why. Use the diagrams to help you.

....

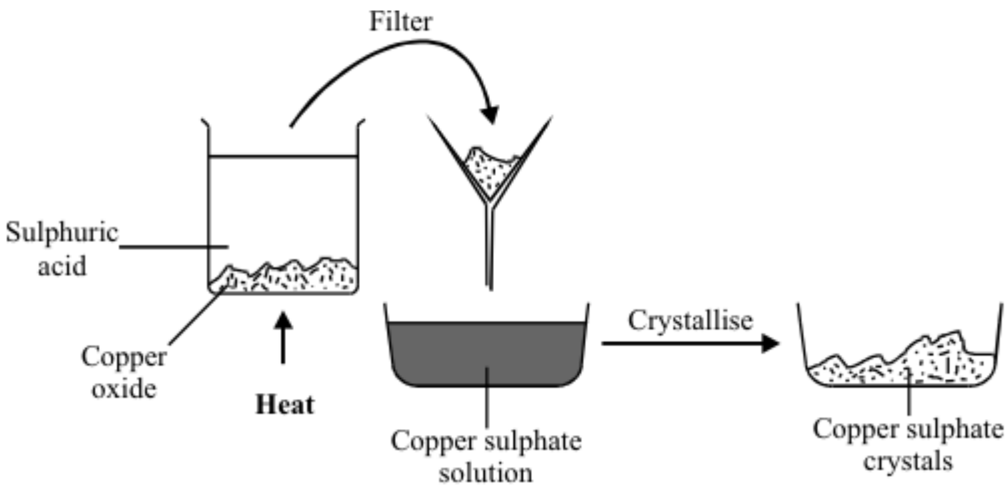
....

....

....

(2)
(Total 5 marks)

Q7. (a) The diagram shows one way of making crystals of copper sulphate.



(i) Why was the solution filtered?

....

(1)

(ii) How could you make the crystals form faster from the copper sulphate solution?

....

(1)

(iii) The chemical equation is shown for this reaction.

$$CuO(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + H_2O(l)$$

In the chemical equation what does (aq) mean?

....

(1)

(b) Blue copper sulphate crystals go white when warmed. How could you use the white copper sulphate as a test for water?

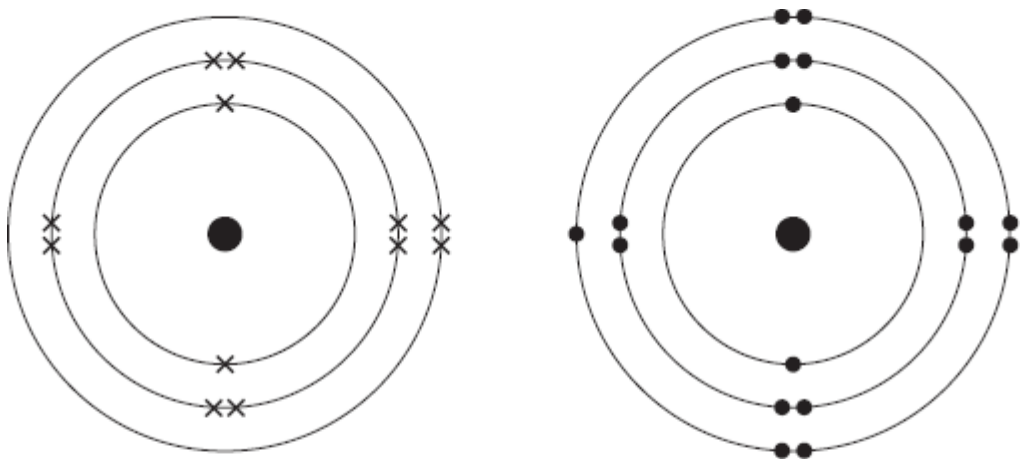
....

....

....

(2)
(Total 5 marks)

Q8.(a) The diagram shows an atom of magnesium and an atom of chlorine.



Magnesium **Chlorine**

Describe, in terms of electrons, how magnesium atoms and chlorine atoms change into ions to produce magnesium chloride ($MgCl_2$).

....

....

....

....

....

....

....

....

(4)

(b) Calculate the relative formula mass (M_r) of magnesium chloride ($MgCl_2$).

Relative atomic masses (A_r): magnesium = 24; chlorine = 35.5

....

....

....

Relative formula mass (M_r) = ...

(2)

(Total 6 marks)

Q9. Calcium oxide (quicklime) is made by heating calcium carbonate (limestone).

calcium carbonate	→	calcium oxide	+	carbon dioxide
100 g		?		44 g

(a) 44 grams of carbon dioxide is produced when 100 grams of calcium carbonate is heated.

Calculate the mass of calcium oxide produced when 100 grams of calcium carbonate is heated.

....

mass .... g

(1)

(b) What mass of carbon dioxide could be made from 100 tonnes of calcium carbonate?

mass .... tonnes

(1)
(Total 2 marks)

Q10. 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 ☐

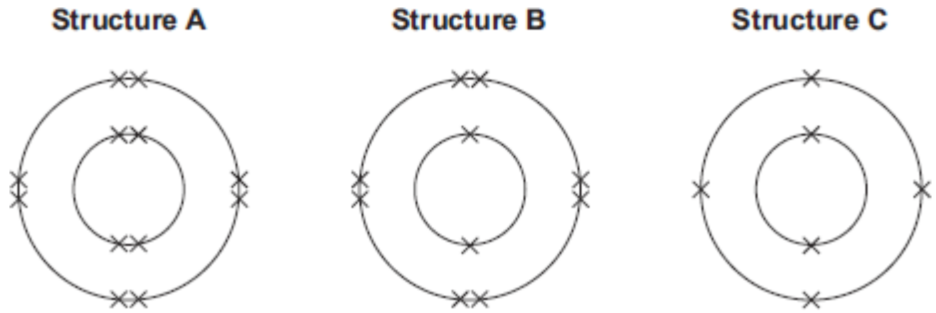
The mass number ☐

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 (CO_2).

(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

....

....

M_r of carbon monoxide = ...

(1)

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

....

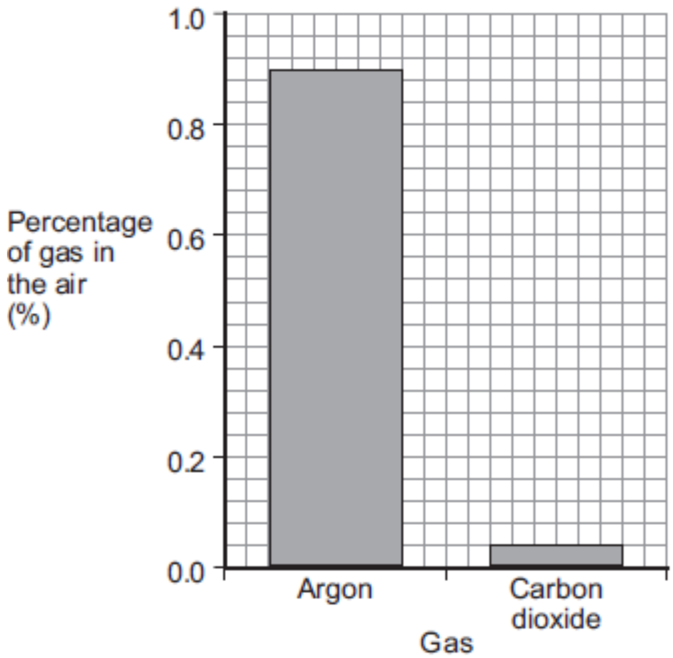
....

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.

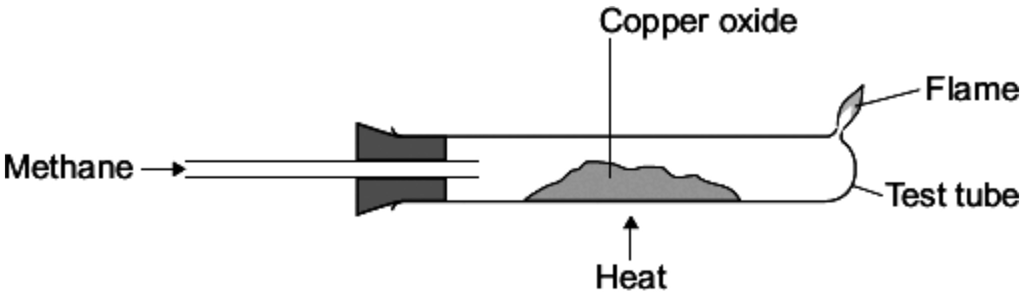
Give **one** reason for using an instrumental method.

....

....

(1)
(Total 10 marks)

Q11. An experiment was done on the reaction of copper oxide (CuO) with methane (CH_4).



(a) The equation for this reaction is shown below.

$$4CuO(s) + CH_4(g) \rightarrow 4Cu(s) + 2H_2O(g) + CO_2(g)$$

The water and carbon dioxide produced escapes from the test tube.

Use information from the equation to explain why.

....

(1)

(b) (i) Calculate the relative formula mass (M_r) of copper oxide (CuO).

Relative atomic masses (A_r): O = 16; Cu = 64.

....

....

....

Relative formula mass (M_r) = ...

(2)

(ii) Calculate the percentage of copper in copper oxide.

....

....

....

Percentage of copper = ... %

(2)

(iii) Calculate the mass of copper that could be made from 4.0 g of copper oxide.

....

....

Mass of copper = ... g

(1)

(c) The experiment was done three times.
The mass of copper oxide used and the mass of copper made was measured each time.
The results are shown in the table.

	Experiment		
	1	**2**	**3**
Mass of copper oxide used in g	4.0	4.0	4.0
Mass of copper made in g	3.3	3.5	3.2

(i) Calculate the mean mass of copper made in these experiments.

....

....

Mean mass of copper made = ... g

(1)

(ii) Suggest how the results of these experiments could be made more precise.

....

....

(1)

(iii) The three experiments gave slightly different results for the mass of copper made.
This was caused by experimental error.

Suggest **two** causes of experimental error in these experiments.

1 ....

....

2 ....

....

(2)

(Total 10 marks)

Q12. Potassium reacts violently with cold water.

It forms an alkaline solution of potassium hydroxide and hydrogen.

potassium + water → potassium hydroxide + hydrogen

(a) In what physical state is hydrogen given off?

Choose your answer from the words in the box.

gas	liquid	solid	solution

....

(1)

(b) (i) What type of substance will neutralise potassium hydroxide solution?

....

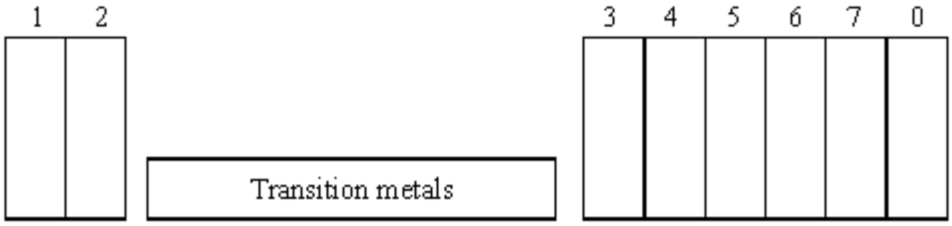
(1)

(ii) What is the pH of the neutral solution?

....

(1)

(c) In the Periodic Table there are eight main groups.



What is the number of the group that has potassium in it?

....

(1)

(d) Sodium is in the same group as potassium.

(i) How does sodium react with cold water and what is formed?

....

....

(2)

(ii) How can you prove that an alkaline solution is formed when sodium reacts with water?

....

....

(2)

(e) Lithium reacts more slowly with cold water than sodium.

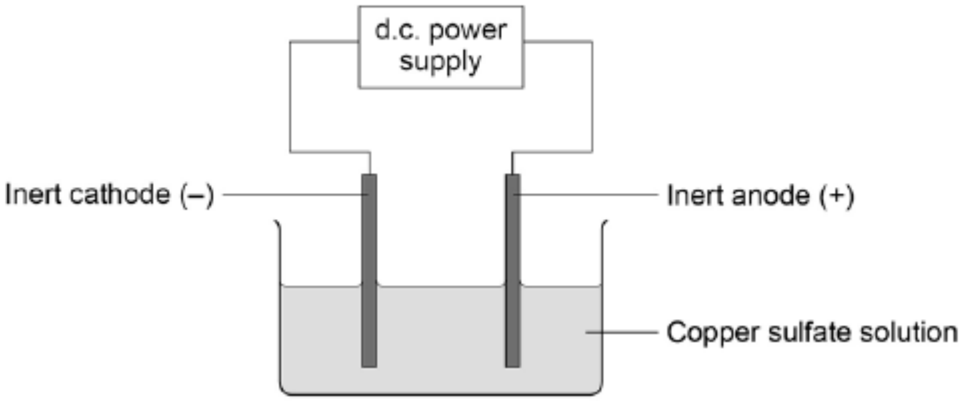
State **two** ways the reaction can be made to go faster.

....

....

(2)
(Total 10 marks)

Q13. The figure below shows an apparatus to produce elements from a solution of an ionic compound.



(a) What is the name of the process in the figure?

Tick **one** box.

Combustion ☐

Crystallisation ☐

Distillation ☐

Electrolysis ☐

(1)

(b) The table below shows the products formed from three experiments using different compounds and the apparatus shown in the figure above.

Compound	**State**	**Product at cathode**	**Product at anode**
Copper chloride	Molten	Copper	Chlorine
Copper chloride	Aqueous solution	Copper	Chlorine
Potassium bromide	Molten	Potassium	Bromine

Use the table above to name the products formed at each electrode if using an aqueous solution of potassium bromide.

At cathode .... At anode ....

....
(2)

(c) Explain why copper is formed at the cathode during the electrolysis of its salts.

....

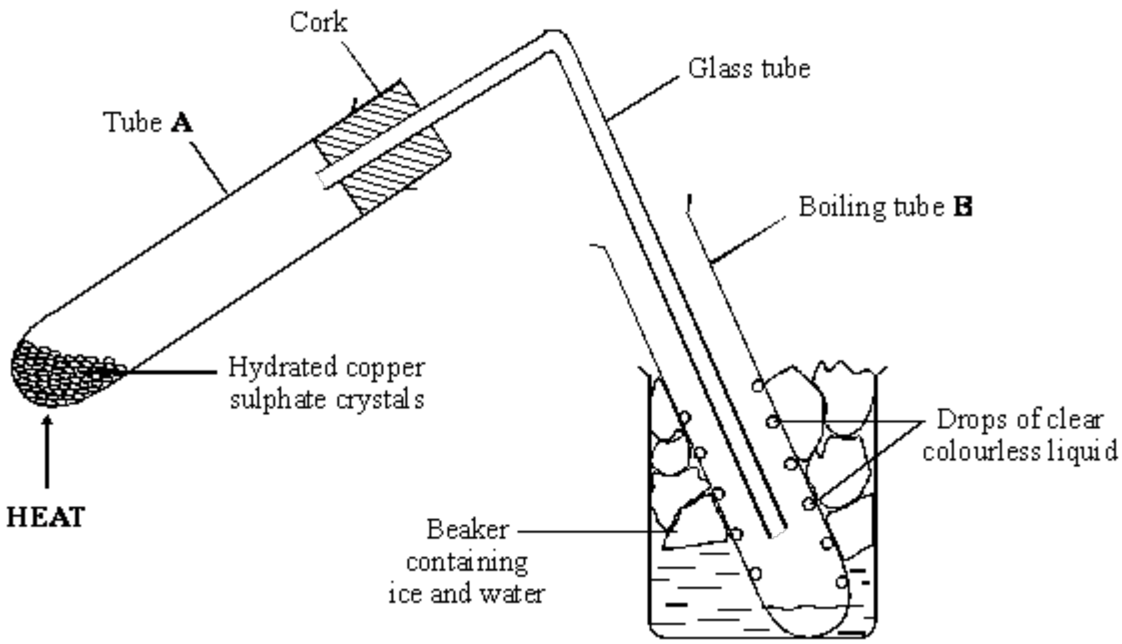
....

....

....

....
(2)
(Total 5 marks)

Q14. The diagram shows the apparatus for an experiment. Hydrated copper sulphate crystals were heated. They became anhydrous copper sulphate.



(a) Name a suitable piece of equipment to heat tube **A**.

....
(1)

(b) Use words from the box to complete the **two** spaces in the table. You may use each word once or not at all.

black	blue	orange	red	purple	white

Name	**Colour**
Hydrated copper sulphate crystals	....
Anhydrous copper sulphate	....

(2)

(c) What is the purpose of the ice and water in the beaker?

....

....

(1)

(d) Drops of a clear, colourless liquid formed on the inside of tube **B**.

(i) Name the liquid.

....

(1)

(ii) Explain how the liquid came to be inside tube **B**.

....

....

....

(2)

(e) Anhydrous copper sulphate can be turned into hydrated copper sulphate. What would you need to add? Apart from the change in colour, what could you observe?

....

....

....

(2)

(f) Copper sulphate can be made from black copper oxide by reacting it with an acid. Name the acid.

....

(1)
(Total 10 marks)

Q15. Hydrogen peroxide decomposes to give water and oxygen.

$2H_2O_2 \rightarrow 2H_2O + O_2$

The reaction is *exothermic*.

(a) Explain, in terms of bond breaking and bond making, why the decomposition of hydrogen peroxide is *exothermic*.

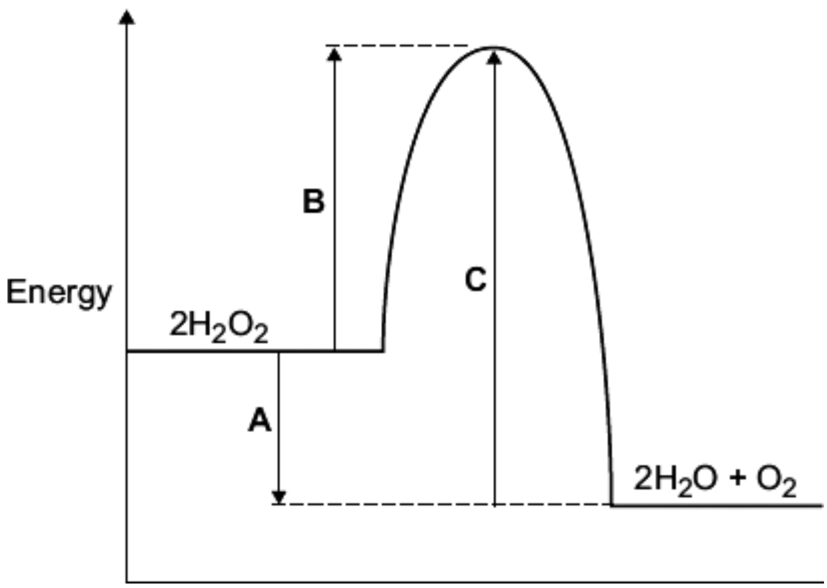
....

....

....

(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) How do you know that this reaction is *exothermic*?

....

....

....

(1)

(ii) The decomposition of hydrogen peroxide is slow.
What does this suggest about energy change **B**?

....

....

....

(1)

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

Explain why.

....

....

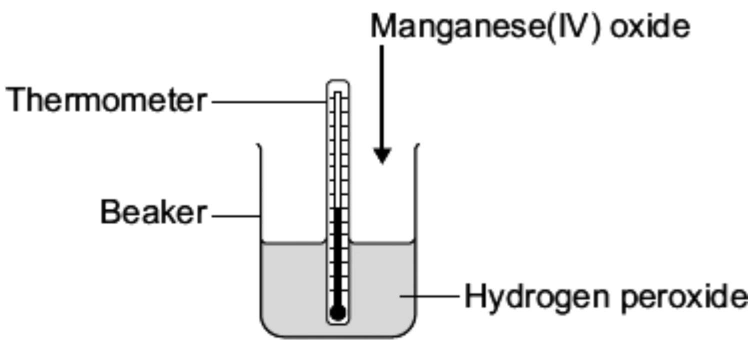
....

....

(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 and recorded the highest temperature.

The temperature rise was smaller than expected.

Suggest why.

....

....

....

....

....

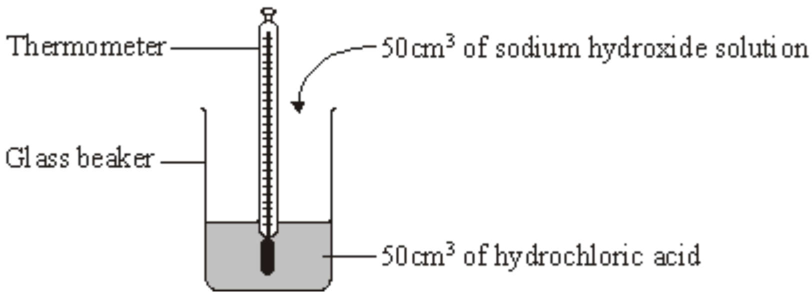
(2)
(Total 7 marks)

Q16. Read the information about energy changes and then answer the questions.

A student did an experiment to find the energy change when hydrochloric acid reacts with sodium hydroxide. The equation which represents the reaction is:

$HCl + NaOH \rightarrow NaCl + H_2O$

The student used the apparatus shown in the diagram.



The student placed 50 cm^3 of hydrochloric acid in a glass beaker and measured the temperature.

The student then quickly added 50 cm3 of sodium hydroxide solution and stirred the mixture with the thermometer. The highest temperature was recorded.

The student repeated the experiment, and calculated the temperature change each time.

	Experiment 1	Experiment 2	Experiment 3	Experiment 4
Initial temperature in °C	19.0	22.0	19.2	19.0
Highest temperature in °C	26.2	29.0	26.0	23.5
Temperature change in °C	7.2	7.0	6.8	4.5

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

Suggest how the apparatus could be modified to reduce heat loss.

....

.... **(1)**

(b) Suggest why it is important to stir the chemicals thoroughly.

.... **(1)**

(c) Which **one** of these experiments was probably carried out on a different day to the others?

Explain your answer.

....

.... **(1)**

(d) Suggest why experiment 4 should **not** be used to calculate the average temperature change.

....

.... **(1)**

(e) Calculate the average temperature change from the first three experiments.

....

Answer = ... °C

(1)

(f) Use the following equation to calculate the energy change for this reaction.

energy change in joules = 100 × 4.2 × average temperature change

....

Answer = ... J

(1)

(g) Which **one** of these energy level diagrams, **A** or **B**, represents the energy change for this reaction?

Explain why.

Diagram A

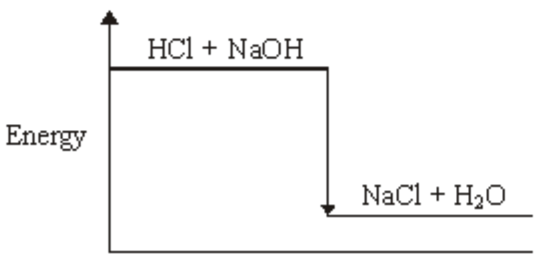
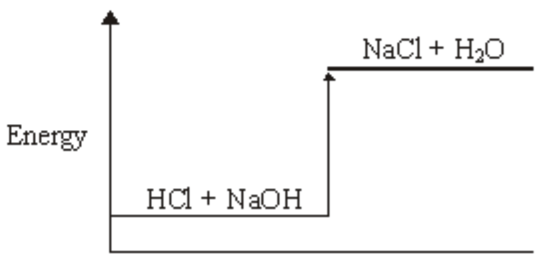


Diagram B



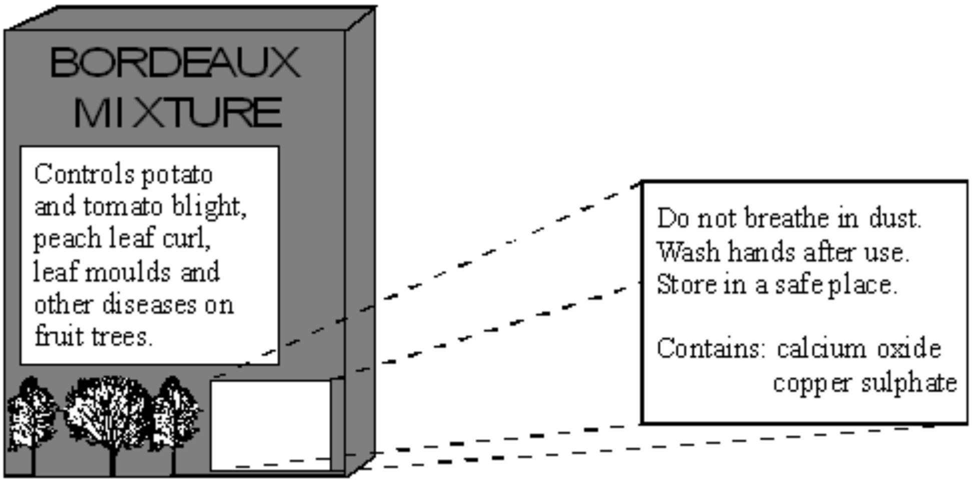
....

....

(1)
(Total 7 marks)

Q17. Bordeaux Mixture controls some fungal infections on plants.

A student wanted to make some Bordeaux Mixture.



(a) The student knew that calcium oxide could be made by heating limestone. Limestone contains calcium carbonate, $CaCO_3$.

(i) Write the word equation for this reaction.

.... **(1)**

(ii) What type of reaction is this?

.... **(1)**

(b) The student knew that copper sulphate, $CuSO_4$, could be made by the following general reaction.

acid + base → salt + water

(i) What type of reaction is this?

.... **(1)**

(ii) The base used is copper oxide. Name and give the chemical formula of the acid used.

Name ....

Chemical formula .... **(2)**

(c) The student wrote about how the copper sulphate was made.

"Some of the acid was warmed. Copper oxide was added. The mixture was stirred. More copper oxide was added until no more would react. The mixture was then filtered."

(i) Why was the acid warmed?

....

.... **(1)**

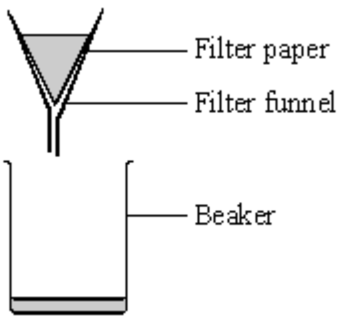
(ii) Copper oxide was added until no more would react. Explain why.

....

....

.... **(2)**

(iii) The filtration apparatus is shown.



Describe and explain what happens as the mixture is filtered.

....

....

....

....

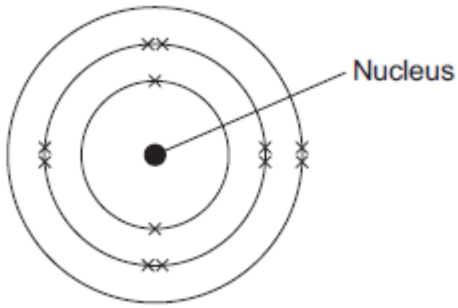
....

.... **(2)**

(Total 10 marks)

Q18. This question is about magnesium.

(a) (i) The electronic structure of a magnesium atom is shown below.



Use the correct answer from the box to complete each sentence.

electrons	**neutrons**	**protons**	**shells**

The nucleus contains protons and ....

The particles with the smallest relative mass that move around the nucleus are called ....

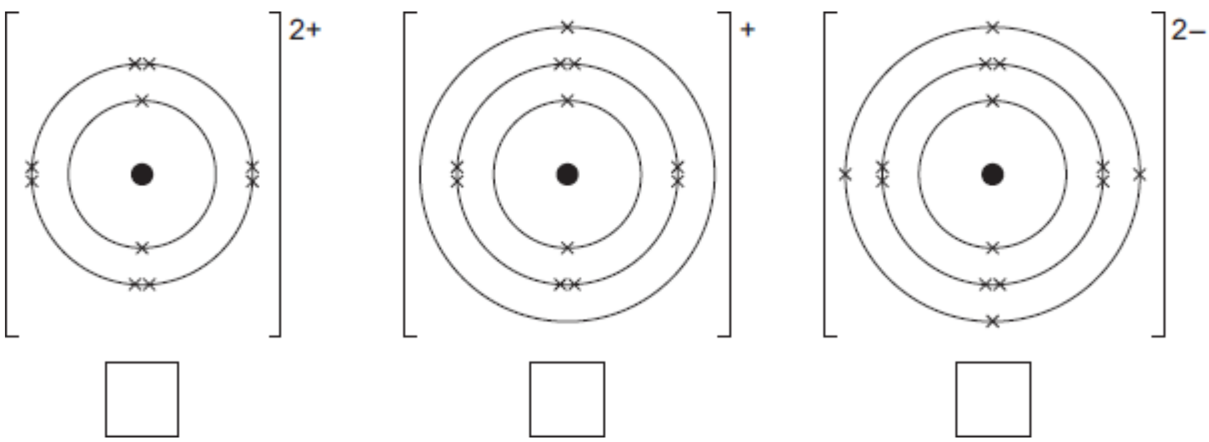
Atoms of magnesium are neutral because they contain the same number of electrons and ....

(3)

(ii) A magnesium atom reacts to produce a magnesium ion.

Which diagram shows a magnesium ion?

Tick (✓) **one** box.



(1)

(b) Magnesium and dilute hydrochloric acid react to produce magnesium chloride solution and hydrogen.

$$Mg(s) + 2\ HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g)$$

(i) State **two** observations that could be made during the reaction.

1 ....

....

2 ....

....

(2)

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

Describe a method for making pure crystals of magnesium chloride from magnesium and dilute hydrochloric acid.

In your method you should name the apparatus you will use.

You do **not** need to mention safety.

....

....

....

....

....

....

....

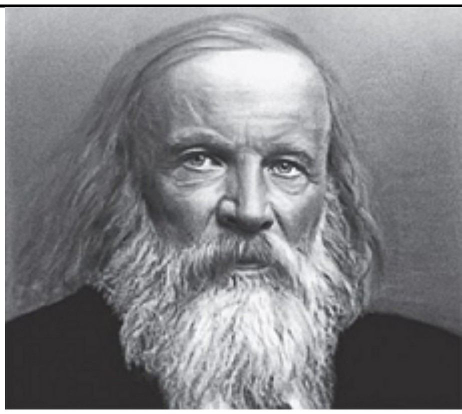
....

....

....

(6)
(Total 12 marks)

Q19. Use the periodic table on the Data Sheet and the information below to help you answer these questions.



Mendeleev was one of the first chemists who classified elements in a systematic way based on atomic weight. He suggested his version of the periodic table in 1869.

He put the elements in order of their atomic weights but reversed the order for some pairs of elements. Then he arranged them in a table so that chemically similar elements were in columns known as Groups. He also left gaps and made predictions.

Part of Mendeleev's table is shown below.

Group 1	**Group 2**	**Group 3**	**Group 4**	**Group 5**	**Group 6**	**Group 7**
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
Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	# I

The gaps Mendeleev left are shown by #.

(a) Which group of elements in the modern periodic table is missing from Mendeleev's table?

....

(1)

(b) Mendeleev reversed the order for some pairs of elements. For example, he put tellurium (Te, atomic weight 128) before iodine (I, atomic weight 127), as shown in his table.

Why did he do this?

....

....

(1)

(c) In 1869 many chemists did **not** agree with Mendeleev's periodic table.

Suggest **three** reasons why.

....

....

....

....

....

....

....

(3)

(d) In the 20th century, the arrangement of elements in the periodic table was explained in terms of atomic structure.

Describe the links between atomic structure and the periodic table.

....

....

....

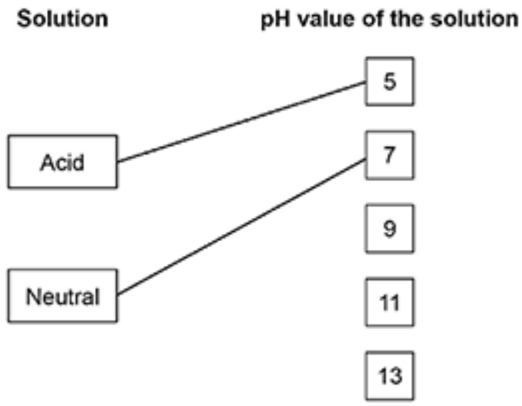
....

....

....

(2)
(Total 7 marks)

M1.(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]

M2.(a) Carbon and silicon

1

(b) Atomic number

1

(c) Hydrogen / fluorine / chlorine are not in Group 1 of the periodic table
or
Hydrogen and fluorine / chlorine are not in the same group of the periodic table

1

Lithium / sodium / potassium are in Group 1 of the periodic table

1

(d) plum pudding model has a single ball of positive charge and nuclear model has positive charges in the centre / nucleus

1

plum pudding model has electrons in random positions and nuclear model has electrons
in fixed positions

1

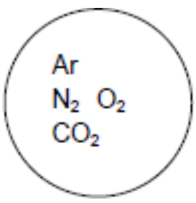
plum pudding model has no nucleus and the nuclear model has a nucleus

1

plum pudding model has no neutrons and the nuclear model has neutrons in the nucleus

1

(e)



1

(f) Covalent bond

1

[10]

M3.(a) (i) 2.8.3

any sensible symbol can be used to represent an electron

1

(ii) proton(s) **and** neutron(s)

both needed for the mark

1

(iii) number of protons is equal to number of electrons

allow positive and negative charges cancel out

allow same amount of protons and electrons

1

(b) (i) **2** Al + Fe_2O_3 → **2** Fe + Al_2O_3

equation must be balanced

1

(ii) aluminium is more reactive (than iron)

it = aluminium

accept converse

accept aluminium displaces iron

accept aluminium is higher in the reactivity series (than iron)

1

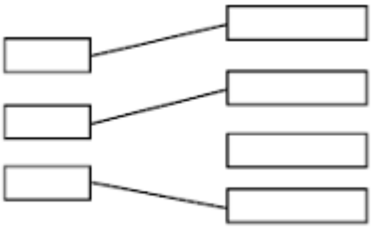
[5]

M4.(a) (i) nucleus

1

(ii) an energy level (shell)

1



(b)

3

(c) 2 / two(%)

1

(d) (i) 10 / ten

1

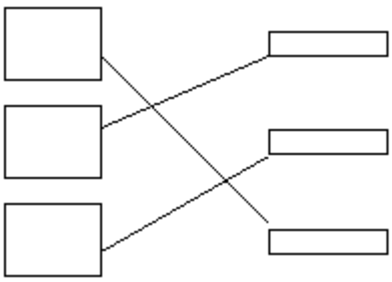
(ii) (group) 0

accept noble gasesignore (group) 8

1

[8]

M5. (a)



*all three lines correct gains **2** marks*

*one or two correct gains **1** mark*

if there are more than 3 lines then lose mark for each extra line

2

(b) (i) covalent

1

(ii) four

1

(iii) hard

1

(iv) three

1

(v) soft

1

(c) carbon

accept C

1

[8]

M6. (a) (i) covalent

*two different answers indicated gains **0** marks*

1

(ii) carbon

*two different answers indicated gains **0** marks*

1

(iii) 3

*two different answers indicated gains **0** marks*

1

(b) layers can slide / slip

1

because there are no bonds between layers

accept because weak forces / bonds between layers

or so (pieces of) graphite rubs / breaks off

or graphite left on the paper

1

[5]

M7. (a) (i) to remove or separate copper oxide

accept to remove or separate
unreacted or excess base
accept to remove or separate insoluble solids

1

(ii) heat (the solution)

accept heat the water
accept evaporate the water
***rapid** cooling/cool to lower temperature*
accept boil the water or solution
***not** increase surface area, put in*
draught
***not** increase the temperature*

1

(iii) aqueous

accept in water
accept solution
***not** soluble in water*

1

(b) add water/liquid/solution

1

colour changes to blue

1

[5]

M8.(a) magnesium <u>loses electrons</u>

there are four ideas here that need to be linked in two pairs.

1

<u>two electrons</u>

1

chlorine gains electrons

*magnesium loses electrons and chlorine gains electrons scores **2** marks.*

1

two atoms of chlorine

magnesium loses two electrons and two chlorines each gain one electron will score full marks.

1

(b) 95

*correct answer with or without working gains **2** marks*

*if answer incorrect, allow 24 + 35.5 + 35.5 for **1** mark*

2

[6]

M9. (a) 56g

for 1 mark

1

(b) 44 tonnes

for 1 mark

1

[2]

M10.(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]

M11. (a) because they are gases

ignore vapours / evaporate / (g)

allow it is a gas

1

(b) (i) 80 / 79.5

correct answer with or without working = ***2*** *marks*

ignore units

if no answer ***or*** *incorrect answer then evidence of 64 / 63.5 + 16 gains* ***1*** *mark*

2

(ii) 80 / 79.87 / 79.9 / 79.375 / 79.38 / 79.4

correct answer with or without working = ***2*** *marks*

if no answer ***or*** *incorrect answer* *then*

evidence of $\frac{64}{80}$ ***or*** $\frac{63.5}{79.5}$ *(x100) gains **1** mark*

accept (ecf)

$\frac{64 or 63.5}{answer(b)(i)}(\times 100)$ *for **2** marks if correctly calculated*

if incorrectly calculated

evidence of $\frac{64 or 63.5}{answer(b)(i)}(\times 100)$

*gains **1** mark*

2

(iii) 3.2

*correct answer with or without working = **1** mark*

allow (ecf)

*4 x ((b)(ii)/100) for **1** mark if correctly calculated*

1

(c) (i) 3.3

accept 3.33…….. or $3\frac{1}{3}$ *or 3.3 · or 3.3 ʳ*

1

(ii) measure to more decimal places

***or** use a more sensitive balance / apparatus*

allow use smaller scale (division)

***or** use a smaller unit*

ignore accurate / repeat

1

*(iii) any **two** from:*

- *ignore systematic / human / apparatus / zero / measurement / random / weighing / reading errors unless qualified*
- *different balances used **or** faulty balance*
  ignore dirty apparatus
- *reading / using the balance incorrectly **or** recording error*
  accept incorrect weighing of copper / copper oxide
- *spilling copper oxide / copper*

allow some copper left in tube

- *copper oxide impure*
  allow impure copper (produced)
- *not all of the copper oxide was reduced / converted to copper* ***or*** *not enough / different amounts of methane used*
  accept not all copper oxide (fully) reacted
- *heated for different times*
- *heated at different temperatures*
  accept Bunsen burner / flame at different temperatures
- *some of the copper made is oxidised / forms copper oxide*
- *some of the copper oxide / copper blown out / escapes (from tube)*
  ignore some copper oxide / copper lost
- *some water still in the test tube*

2

[10]

M12. (a) gas

1

(b) (i) acid

ignore any reference to a particular kind of acid

1

(ii) 7

1

(c) 1

credit potassium ***or*** *K written into Group 1*

1

(d) (i) reacts rapidly **or** quickly **or** fast

credit melts ***or*** *fizzes* ***or*** *dissolves* ***or*** *violently* ***or*** *less violently (than K)*

1

sodium hydroxide **or** hydrogen

credit NAOH ***or*** *H2*

1

(ii) *add universal indicator*

credit add indicator ***or*** *litmus* ***or*** *use pH paper*

1

turns blue ***or*** *purple*

credit 'it goes purple' providing something has been added to the water

1

(e) *any two from*

heat ***or*** *warm*

cut it up ***or*** *have smaller pieces or larger surface area*

do not accept more lithium ***or*** *less water*

stir

2

[10]

M13.*(a)* *electrolysis*

1

(b) *Cathode – hydrogen*

1

Anode – bromine

1

(c) *copper ions are positive*

1

so the copper ions are attracted to the negative cathode

allow so the copper ions gain electrons from the cathode to form copper atoms

1

[5]

M14. *(a)* *Bunsen (burner)*

accept spirit burner do not credit candle

1

(b) *blue*

1

white

credit (1) if both colours correct but answers are reversed

1

to cool the tube (B)

accept answers which anticipate part (d) e.g. 'to condense the water vapour' or gases ***or*** *vapours*

1

(d) *(i)* *water*

do not credit 'condensation'

1

(ii) *(Water) vapour from the crystals (from tube A)*

accept steam ***or*** *steam from tube A*

1

condenses ***or*** *cools*

accept turns to (liquid) water

1

(e) *add water*

gets hot ***or*** *hotter* ***or*** *warm* ***or*** *warmer turns into solution dissolves*

or the temperature rises or there is an exothermic reaction accept steams ***or*** *hisses ignore any reference to colour(s)*

2

(f) *sulphuric acid*

accept H_2S0_4 only if correct in every detail

1

[10]

M15. *(a) energy released from making (new) bonds is greater than the energy needed to break (existing) bonds*

accept the energy needed to break (existing) bonds is less than the energy released in making (new) bonds

*do **not** accept energy needed to make bonds*

1

(b) (i) energy / heat of products less than energy of reactants

accept products are lower than reactants

***or** reactants higher than products*

accept more energy / heat given out than taken in

***or** less energy / heat taken in than given out*

accept energy / heat is given out / lost (to the surroundings)

allow produce heat

ignore produce energy

accept ΔH is negative

***or** energy change / **A** is negative*

or B** is less than **C

1

*(ii) **B** is (very) high / large*

*it = **B***

*ignore energy change **C** is high*

1

(iii) it = MnO_2

(MnO_2) catalyst (is added)

accept it is a catalyst

***or** reaction catalysed (by MnO_2)*

*do **not** accept MgO / magnesium oxide*

1

which lowers activation energy

accept provides alternative / lower energy pathway

or *which lowers (energy change)* ***B***

if hydrogen peroxide is given as a catalyst instead of MnO_2 penalise once only in question

1

(c) *any* ***two*** *from:*

- *(chemicals) not mixed / stirred*
- *heat / energy lost (from apparatus)*
- *(apparatus) not insulated* ***or*** *no lid*
- *low amount / mass / not enough MnO_2* ***or*** *low concentration H_2O_2*
- *thermometer read incorrectly*

ignore other experimental error

2

[7]

M16. (a) *eg plastic (beaker) / insulation / lid / cover* ***or*** *any mention of enclosed*

any sensible modification to reduce heat loss

ignore prevent draughts

ignore references to gas loss

1

(b) *all the substances react* ***or*** *all (the substances) react fully / completely* ***or*** *heat evolved quickly* ***or*** *distribute heat*

accept to mix them

'so they react' is insufficient for the mark

accept increase chances of (successful) collisions / collision rate increase

do ***not*** *accept rate of reaction increase / make reaction faster*

1

(c) *experiment 2* ***and*** *different / higher / initial / starting temperature*

accept experiment 2 ***and*** *the room is hotter / at higher temperature*

do ***not*** *accept temperature change / results higher*

1

(d) temperature change does not fit pattern

accept anomalous / odd ***or*** *it is the lowest* ***or*** *it is lower than the others* ***or*** *it is different to the others*

'results are different' is insufficient

1

(e) 7 / 7.0

1

(f) (100 × 4.2 × 7) = 2940

ecf from (e)

1

(g) diagram A ***and*** *reaction exothermic / heat evolved / Δ H is negative / temperature rises*

accept energy is lost (to the surroundings)

1

[7]

M17. *(a) (i)*

calcium carbonate → calcium oxide + carbon dioxide

accept $CaO_3 \rightarrow CaO + CO_2$

1

(ii) (thermal) decomposition

accept endothermic

accept reversible

1

(b) (i) neutralisation

accept exothermic

1

(ii) sulphuric (acid) H_2SO_4

2

(c) (i) to speed up the reaction

*accept to increase the rate of reaction **or** to increase the number **or** rate of collisions*

*do **not** accept "dissolves" copper oxide faster*

1

(ii) all acid reacts

*accept there will be no acid left **or** acid used up*

1

***acid is neutralised** (for **2** marks)*

*do **not** accept to form a concentrated **or** saturated solution*

1

(excess) copper oxide collects in filter paper

accept larger particles (of copper oxide) cannot pass through filter paper

1

copper sulphate solution passes through the filter paper

*accept dissolved copper sulphate passes through filter paper **or** smaller particles (of copper sulphate) in solution (liquid) pass through filter paper*

*accept (black) solid collects in filter paper and filtrate **or** soluble solid **or** (blue) solution (liquid) passes through filter paper for 1 mark only*

1

[10]

***M18.**(a) (i) neutrons*

this order only

1

electrons

1

protons

1

(ii) box on the left ticked

1

(b) (i) effervescence / bubbling / fizzing / bubbles of gas

*do **not** accept just gas alone*

1

magnesium gets smaller / disappears

allow magnesium dissolves

*allow gets hotter **or** steam produced*

ignore references to magnesium moving and floating / sinking and incorrectly named gases.

1

(ii) Marks awarded for this answer will be determined by the Quality of Communication (QC) 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 are simple statements of some of the steps in a procedure for obtaining magnesium chloride.

Level 2 (3−4 marks)
There is a description of a laboratory procedure for obtaining magnesium chloride from dilute hydrochloric acid and magnesium.

*The answer must include a way of ensuring the hydrochloric acid is fully reacted **or** a method of obtaining magnesium chloride crystals.*

Level 3 (5−6 marks)
There is a well organised description of a laboratory procedure for obtaining magnesium chloride that can be followed by another person.

*The answer must include a way of ensuring the hydrochloric acid is fully reacted **and** a method of obtaining magnesium chloride crystals.*

examples of the points made in the response:

- *hydrochloric acid in beaker (or similar)*
- *add small pieces of magnesium ribbon*
- *until magnesium is in excess or until no more effervescence occurs **
- *filter using filter paper and funnel*
- *filter excess magnesium*
- *pour solution into evaporating basin / dish*
- *heat using Bunsen burner*
- *leave to crystallise / leave for water to evaporate / boil off water*
- *decant solution*
- *pat dry (using filter paper).*

**Student may choose to use a named indicator until it turns a neutral colour, record the number of pieces of magnesium added then repeat* *without the indicator.*

6

[12]

M19. *(a)* *Group O / 8*

accept transition elements / metals

***or** noble / rare / inert gases*

apply list principle

1

(b) *(chemically) similar elements (now) in the same group / column*

accept iodine has properties of Group 7 / halogens

***or** iodine does not have group 6 properties*

***or** converse for tellurium*

ignore 'it fits the pattern' or any reference to proton / atomic numbers / atomic structure

1

(c) *any **three** from:*

*ignore not enough evidence / proof **or** Mendeleev not respected*

- *(some) boxes had <u>two</u> elements*

  allow <u>two</u> correctly identified elements together (in the same box)

- *Group 1: copper / silver unreactive (not like the others)*

  allow copper / silver not alkali metals / Group 1

- *there are non-metals and metals in the same group / box*

  accept named examples

- *Mendeleev left spaces / gaps*

  accept (some chemists thought) there were no more elements to discover

- *Medeleev reversed the order (for some elements)*

3

(d) *any **two** from:*

ignore mass number / atomic weight / neutrons throughout

- *elements arranged in proton / atomic number order*

  allow number of protons / electrons increases across period

- *group: elements in same group / column have same number of outer electrons*

- *elements in same period / row have same number of (electron) shells / energy levels*

  allow number of (electron) shells / energy level increase down group

  allow electron rings

  allow orbits

2

[7]

***E3.**(a)* *(i)* *This was well answered. Several students adopted an excellent strategy of writing out the structure as 2, 8, 3 and then drawing the diagram. Most students used dots or crosses to represent the electrons. Some students changed their minds and over-wrote their original answer; so at times it was difficult to tell whether an electron had been crossed out or not. The most common errors were putting more than 2 electrons in the first shell or fewer than 8 in the second shell.*

(ii) *The names of the two sub-atomic particles in the nucleus were well known. The most common error was to include electron and, occasionally, nucleus.*

(iii) *Only a minority of students answered this correctly. Several students were confused about the names and the charges on sub-atomic particles. Others incorrectly thought that the overall electrical charge was related to the number of electrons in the outer shell.*

(b) *(i)* *This question was well done with only a few students giving an incorrect answer or not providing an answer. A few put symbols or formulae on the dotted lines, suggesting that they do not know what is meant by balancing a chemical equation.*

(ii) *A majority of students did not understand why aluminium reacts with iron oxide. A substantial number of students did not appreciate that the reactivity series relates to the reactivity of metals not compounds. Others attempted unsuccessfully to answer in terms of electrons.*

***E4.**(a)* *(i)* *The majority of students achieved the mark for knowing that at the centre of an atom is the nucleus.*

(ii) *Many students achieved the mark for knowing that around the centre of an atom are energy levels (shells).*

(b) Most students scored full marks for understanding numbers of protons and electrons in atoms and for knowing the term mass number. The most common problem was that students scribbled out link lines and drew new link lines but did not always make it clear which lines were their final choice. Students must read and analyse the information provided, then plan their answer before drawing the link lines. A few students had drawn only one link line because they had not understood the instruction to draw one line from each question to its correct answer. Note that no credit can be given when two or more lines are drawn from a question to two or more answers.

(c) The majority of students worked out that the percentage of the rest of the elements in the Sun was 2%. The most common incorrect responses were either 98% or 12%.

(d) (i) Students were advised to use the Chemistry Data Sheet to help them answer this question. From the periodic table most students did realise that a neon atom has 10 protons, however, 20 protons was a common incorrect answer.

(ii) Students were advised to use the Chemistry Data Sheet to help them answer this question. From the periodic table most students did realise that helium and neon are in group 0. Noble gases was an acceptable answer. Common answers not gaining credit included 'non-metals' and 'gases'.

E5. *Part (a) was well answered with virtually all of the candidates gaining at least one of the two marks and over half gaining both marks. Diamond was the best known of the three structures. For part (b) the type of bonding in part (b)(i) and the properties in parts (b)(iii) and (b)(v) were well known. Less well known were the number of bonds to each carbon in graphite and diamond.*

A wide range of answers were seen in part (c) which included references to metals, non-metals and a number of different elements. This part highlights the importance of reading the question carefully since the answer can be worked out from the information given in the question.

E6. *(a) Most students scored full marks for these three parts.*

(b) Generally well answered with a large number of students fully understanding the idea of layers in graphite that could slide or move over each other. Only a minority were able to explain that the layers were joined by weak bonds. Vague references to the layers having weak bonds, weak bonds in the layers, atoms not being close together and particles rubbing or slipping received no credit.

E7. Double Award only

Even the first question produced many vague answers with no mention of copper oxide or insoluble solids. The main incorrect answers included 'to remove crystals'. Both heating and cooling were allowable answers in (a) (ii). Many candidates did not know the meaning of (aq). Most thought incorrectly that it indicated a liquid. The answers to part (b) displayed that many candidates appeared not to have read the question correctly. Most of their answers included 'use litmus', 'test the pH', 'measure the boiling point' or 'use cobalt chloride paper'. Some candidates even thought that heating and cooling caused the colour change.

E9. *The question was designed to allow candidates to demonstrate their ability to apply simple mathematics to a chemical problem. Many found the mathematics was beyond them and some made no attempt. Part (a) was often better answered than (b). A number of candidates correctly wrote "100 – 44" and then failed to make the subtraction correctly in part (a).*

E10.*(a) Correct answers gave a combination of 1 for the neutron and 0 / very small / negligible or zero mass for the electron. The majority of responses were incorrect with students confusing the charge of the particles with their mass and giving 0 for the neutron and 1 / -1 for the electron. Some students wrote + / - next to their numbers. Guesses such as 12 and 6, 2 and 2 and 2 and 3 were seen.*

(b) Were generally well answered.

(c) Were generally well answered.

(d) (i) Were generally well answered.

(ii) A common incorrect answer was 2.

(e) (i) Over half of responses were correct with an answer of 28. Incorrect responses gave the calculation of the M_r as 12 × 16 = 192.

(ii) Correct answers followed the correct M_r to display the correct mathematical logic to produce the answer within the range 42-43.
Partial credit was given for errors carried forward from 1(e)(i)
e.g. 12 / 192 × 100 = 6.25% and 12 / 44 × 100 = 27.3%.
A number of students gave the correct M_r in (i) and then proceeded to work out their answer without including it.

(f) (i) The majority were able to read the y axis and get 0.9%.

(ii) The most commonly seen correct answer was accurate with a few students giving rapid or sensitivity. Common errors were references to reliability or precision or vague references to the amounts of carbon dioxide in the air.

E11. *(a) This question was not very well answered with the majority of the candidates being unable to pick out the idea of 'gases from the equation. Most answers indicated that the water and carbon dioxide were used and burnt in the flame or that the water evaporated and the carbon dioxide was burnt. Vague references to waste products escaping were also prevalent.*

(b) Parts (b)(i) and (b)(ii) were quite well answered. In general Foundation Tier candidates are getting better at calculating relative formula mass. Over half of the candidates gained both of the marks in part (b)(i) which is similar to the same type of question last year. A correct answer gained two marks but one mark could be gained if there was evidence of an intention to add the correct numbers. Common errors included multiplying the atomic masses '64 × 16 = 1024' and subtracting '64 - 16 = 48'. Foundation Tier candidates have for many years found the calculation of the percentage of an element in a compound very difficult so it is pleasing to note about a third of candidates gained both marks. A number of candidates gained one mark by showing 64/80 or a suitable error carried forward from part (i). Here the most common error was not to have used 100 in their calculations. The most common answer gaining no marks was 51.2 % derived from 64 × 80/100.

(iii) A considerable number of candidates copied the information from the results table given for (c) instead of using their answer from (b)(ii) and wrote 3.3.Only a minority of candidates scored a mark for this question. Many answers were far in excess of 4 grams even though their answer to (b)(ii) was much less than 100 %. Many candidates did not use the 4 grams in their calculation and therefore guesses abounded.

(c) (i) A significant number of candidates did not have a calculator. Common answers were 10 as they forgot to divide by 3 and some included the 4.0 in the calculation.

(ii) The idea of smaller scale division eg measuring to more decimal places was not widely understood. The majority thought that comparing or repeating the test made it more precise. Many candidates were confused and suggested that rounding up to the nearest whole number improved precision.

(iii) This part was not answered well with only a small percentage of candidates scoring both marks. The main problem was that answers were too vague or not qualified. For example the responses 'measuring error' or 'reading error' were common as well as 'measuring the amount of copper/copper oxide'. In the latter case it was required that candidates demonstrated that they knew that it was the mass of copper/copper oxide being measured or at least that the apparatus being used was a balance. The sloppy use of scientific terms was prevalent, such as interchanging copper and copper oxide in statements as if they were the same substance. The difference between the terms temperature and heat is not understood. Another common incorrect response was the issue of reliability and candidates responded in terms of not enough repeats as an experimental error. Students are also unaware of the consequences of systematic errors. The most common correct responses were those detailing that the copper/copper oxide had been weighed incorrectly, recording the results wrongly and the balance being faulty. Other creditworthy responses referred to the heat control between experiments and the regulation of the amount of methane passed during the experiments.

E12. *In this chemistry-based question, it was encouraging to see that the responses were much better than in previous years.*

Most candidates realised that hydrogen is given off as gas, although somewhat fewer knew that an acid is needed to neutralise potassium hydroxide solution. Most candidates correctly gave the number 7 as the pH value of a neutral solution but only the better candidates could identify potassium as being in Group 1 of the Periodic Table.

In part (d) it was clear that many candidates had seen demonstrations of the reactions of the alkaline metals with water. They could therefore describe the reaction in some detail but were often struggling to name one of the products: simply stating 'an alkaline solution', which was a common answer. Most candidates realised that universal indicator or litmus could be used to show that the solution was alkaline, however, many failed to state the result of such a test. This is an example of where candidates should be encouraged to take note of the number of marks awarded for the question. Seeing 2 marks printed by the margin should have alerted them to the fact that they needed to make two mark-worthy points, in this case a test and a result.

The most common correct answer to how lithium could be made to react faster was to state that the water should be heated. The majority of candidates were able to state this but then struggled to find a second way. Many candidates erroneously thought that a *catalyst could be used.*

E14. *Almost all candidates obtained the mark for (a) but many responses to part (b) looked like guesswork and no marks were obtained even though there was one mark for the very small minority who had blue and white in the wrong order.*

Parts (c) and (d) discriminated well but too few candidates seemed to understand what was happening or could express themselves clearly. Only a minority obtained credit in (e) and (f). The practical parts of this question generally scored less well than expected given that this reversible reaction is specified in part 7.4.1 of the syllabus.

E15. *(a) This question was answered better than in previous years and about a quarter of the candidates gained credit. However, the majority of candidates continue to have difficulty expressing their ideas clearly and accurately and precisely without contradiction. Once again, a very common error was the suggestion that 'less energy is needed to break bonds than to make them'. It is a difficult concept for candidates to understand that bond formation releases energy because it seems logical that an input of energy is needed when something is made. Many candidates think the answer is to do with the number of bonds broken/formed. There were also many meaningless statements such as 'bond making is higher than bond breaking'.*

*(b) (i) Over three-quarters of the candidates successfully used the diagram to explain why the reaction was exothermic. A popular misconception was that energy change **B** shows that heat is evolved.*

*(ii) Just over half the candidates knew that energy change **B** (activation energy) must be high. Candidates who gained no credit often suggested that 'it took a long time to reach the energy change' or that 'activation energy uses a lot of energy'.*

(iii) The majority of the candidates knew that manganese(IV) oxide was a catalyst but fewer explained that it lowers the activation energy or provides a lower energy pathway even though they recognised that a catalyst provides a surface upon which the reaction takes place. Many candidates think a catalyst supplies energy or that less heat is given off if a catalyst is used. A significant number of candidates were penalised because they referred to the catalyst as magnesium or magnesium oxide - some even giving an explanation in terms of the reactivity series. Candidates should also be aware that 'manganese' is not the same substance as 'manganese oxide', and that they should use the

correct names for chemicals and similarly if they use the formula of a compound it should be the correct formula.

(c) While a majority of the candidates realised that the lower temperature was due to heat loss, only a quarter stated that this was due to lack of insulation. Many candidates incorrectly suggested that a catalysed reaction produces less heat or attributed the lower temperature to a lowering of the activation energy. Some even suggested the catalysed reaction was too quick, so there wasn't enough time to heat up the water!

E16. Foundation Tier

Very few candidates gained a mark in part (a)(i). Some candidates gave the symbol with no charge while quite a few wrote chlorine. A few other incorrect named ions or atoms appeared occasionally.

For part (a)(ii) many candidates were aware that Universal Indicator could be used but were unable to give the correct colour changes. A large number of candidates used titration as their answer. Some also mentioned litmus. A few candidates talked in terms of number of atoms in each acid. Most correct responses came from reactivity differences. No candidates gave answers in terms of conductivity differences.

The candidates were able to pick out the points from the information given and almost all gained full marks on parts (b)(i) and (b)(ii).

Higher Tier

Apart from part (g) this question was well answered by the candidates.

Most candidates in part (a) made sensible suggestions about insulating the beaker to reduce heat loss. Several candidates were unaware that bomb calorimeters are used to measure enthalpies of combustion rather than enthalpies of neutralisation.

In part (b) the idea that the chemicals were stirred to mix them thoroughly and ensure a complete reaction was well known. Typical vague responses included "so they react properly" and "to get the correct results".

Many candidates in part (c) identified experiment 4. Of those candidates who correctly identified experiment 2, a significant number were less than precise with their reason, making only some vague reference to the results rather than the initial temperature.

Part (d) was very well answered, although many candidates were again less than precise with their language and referred to results rather than temperature change. While many different spellings of 'anomalous' often gained credit, the mark scheme did not extend to 'enormous' or "miscellaneous".

Parts (e) and (f) were very well answered.

Calculating the average proved difficult for some candidates but they usually gained credit in part (f) with the help of consequential marking.

Only just over a third of the candidates in part (g) gained credit for this part. However, most candidates chose diagram B and some of them then went on to give the correct reason. Candidates appeared to confuse temperature increase and energy decrease.

E17. Double and Single Award

Candidates generally wrote down the word equation using only the information given and did not realise that carbon dioxide was produced. Very few candidates understood that this was a thermal decomposition or an endothermic reaction. This was also the case in (b)(i), with few candidates recognising that it was a neutralisation reaction. For (b)(ii) hydrochloric acid was the most common answer. Those candidates who realised sulphuric acid is needed to make a sulphate. frequently could not write the chemical formula of this acid. Most candidates understood that heating will 'speed up the reaction'. However, in (c)(ii) most did not consider that all the acid would react completely or would be neutralised, In the final part there were many acceptable, general descriptions of filtration, but few referred to the specific substances in this reaction. When they did name substances, the most frequent errors were that 'copper' was written instead of 'copper oxide' and that 'copper sulphate would be in the filter paper and water would collect in the beaker'.

E18.*(a) (i) This was answered correctly by the majority of students.*

(ii) Most students scored all three marks.

(b) (i) Most students were able to score both marks on this question. However, there was some confusion with the reaction of sodium with water (comments such as the magnesium forms a ball) and some students thought that fizzing, bubbling and effervescing were different things − answers such as effervescing and bubbling being common. Some students had difficulty with the spelling of "effervescing". There is nothing wrong with using the term "fizzes" because the meaning is the same and it will gain the mark.

(ii) Many excellent and well written answers were seen describing in detail this salt preparation with very clear descriptions of the crucial points of adding excess magnesium and obtaining crystals from the final solution. However, it was common for students to specify that excess acid was required and a small, but

significant, minority stated that the solution should be evaporated to dryness.

Some students did not plan their answers, and arrows showing where things that had been missed out should be inserted were commonly seen. Some students gave overly detailed answers, focusing on the irrelevant and missing out the important steps in the process. At this level there is no need to explain how to light a Bunsen burner, or how to arrange apparatus using a gauze and tripod so something can be heated. Apparatus lists are not required, but correctly named apparatus needs to be linked to where it is used in the method. Despite the instruction in the stem, lists of safety precautions were also given.

E19. *(a) Most candidates gained credit for mentioning the Noble Gases or the transition elements. A common incorrect response involved candidates writing 'Group 0' or 'Group 8' and then adding 'Halogens'.*

(b) Candidates were aware that the position of these elements was reversed because their properties did not fit the original groups but poor powers of expression meant that they often did not gain credit. There were vague references to fitting (or not fitting) a pattern, or 'because they matched up with those around them'. Other candidates simply referred to atomic (proton) number or outer electron configuration, apparently unaware that atomic structure was unknown in 1869! Just under half of candidates scored the mark.

*(c) While the majority of candidates gained at least 1 mark, only a very small minority gained all 3 marks. Many candidates realised that Mendeleev mixed metals and non-metals <u>in the same group</u>, and that there were two elements in more than one box. Saying that Mendeleev mixed solids/liquids/gases in the same group received no credit. Most candidates were aware that Mendeleev left gaps, and that he had reversed the order for some elements. However, simply stating that all the elements had not been discovered is **not** the reason why chemists disagreed with Mendeleev! Very many candidates mentioned Mendeleev's youth, low status in the scientific community and lack of expertise, or referred to lack of evidence/proof, the religious beliefs at the time or that other scientists were jealous! Some even suggested he wasn't a proper scientist because he was only a chemist! In 1869 neither Mendeleev nor his peers would have been aware of modern atomic theory, so any discussion would not involve protons, electrons, etc. Clearly teachers have some issues to address here.*

(d) This question was well answered by the majority of candidates. There continue to be references to 'outer shell atoms' and elements having 'more outer shells'. A minority of candidates confused groups/columns and periods/rows.