GCSE AQA Chemistry

Write-on

Paper 1A Foundation

Time allowed: 1 hour 45 minutes
Total marks: 100

Name	

You will need:
- a calculator
- a ruler
- a periodic table

Instructions
- Answer **all** questions.
- Cross through any work you do not want to be marked, including any rough work.
- You may use a calculator.

Advice
- The marks for each question are given in brackets.
- Show your working in calculation questions.
- Use good English in written answers.

Section A	
Question	**Mark**
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total	

01 Sulfuric acid is a compound with the formula H_2SO_4. It is a common acid in school laboratories.

1.1 How many atoms are there in a single molecule of H_2SO_4? **[1]**

.....

1.2 How is the pH value of sulfuric acid different from the pH value of water? **[1]**

.....

.....

1.3 From the following list, identify **two** true statements about compounds. **[2]**

*Tick **two** boxes.*

- ☐ Elements in compounds are easy to separate
- ☐ Compounds are formed by chemical reactions
- ☐ Elements in compounds can be combined in any ratio
- ☐ Compounds do not contain elements that are bonded together
- ☐ Compounds have different properties from the elements they are made from

1.4 Sulfuric acid was added to an alkali. What type of reaction is this? **[1]**

*Tick **one** box.*

- ☐ Neutralisation
- ☐ Oxidation
- ☐ Reduction
- ☐ Distillation

1.5 In order to perform this reaction, a student carried out a titration.

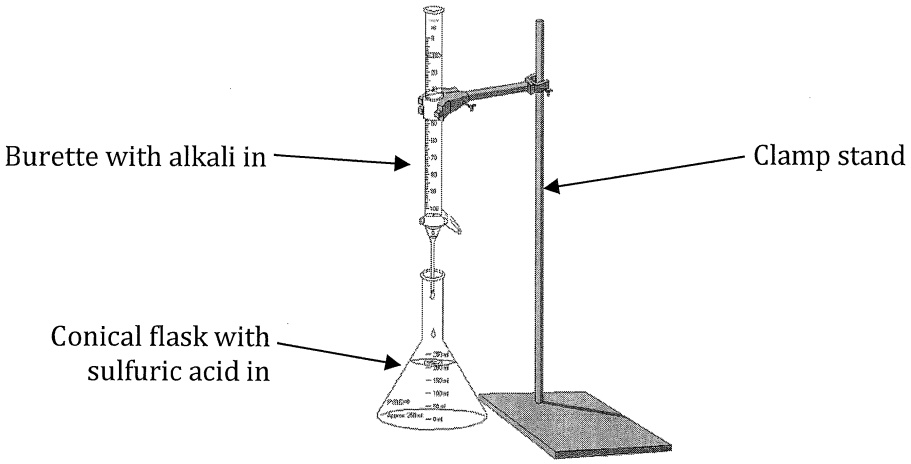

Figure 1.1 – set-up of apparatus

- The student measured 25.00 cm^3 of sulfuric acid into a conical flask.
- The student added a few drops of indicator to the conical flask.
- The student set up a burette, and added alkali into the burette until the zero line.
- The student opened the tap on the burette, and let the alkali run into the conical flask with the acid in.
- The student closed the tap as soon as the reaction finished, and checked how much alkali had been added.

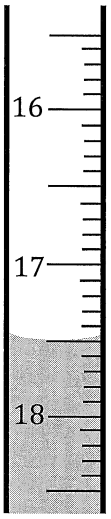

Figure 1.2 – reading at the end

According to the reading in **Figure 1.2** above, how much alkali was left at the end of the titration?

Give your answer to **two decimal places**. **[1]**

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1.6 Explain why an indicator was used in this experiment. **[2]**

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1.7 Suggest why the student used a burette to add the alkali, rather than a measuring cylinder. **[1]**

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1.8 When the student added the alkali to the burette, there was a risk of spilling some alkali because the burette is narrow. Identify a piece of apparatus that the student could use when pouring the alkali into the burette in order to avoid spilling the alkali. **[1]**

*Tick **one** box.*

- ☐ Pipette
- ☐ Funnel
- ☐ Condenser
- ☐ Flask

Question total: 10 marks

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02 A student wanted to make the salt copper chloride from a piece of copper. To do this the student carried out the following steps.

1. The student weighed out some copper powder into a crucible dish. The crucible and copper together weighed **23.15 g**.
2. The student heated the crucible dish over a Bunsen burner to react the copper with oxygen and form **copper oxide** powder.
3. The student reweighed the crucible.
4. The student poured the copper oxide into hydrochloric acid to form a copper chloride solution.
5. The student poured the copper chloride solution into an evaporating dish, and used an electric heater to evaporate the water from the solution to form **copper chloride crystals**.
6. The student removed the evaporating dish from the heater, and left the crystals for one day, to ensure the copper chloride crystals were dry.

2.1 Complete the table to work out the mass of copper added to the crucible dish in step 1. **[1]**

Mass of empty crucible dish (g)	18.05
Mass of crucible dish + copper (g)	23.15
Mass of copper (g)	

2.2 When the student reweighed the crucible in step 3, the student found that the mass had increased.

Why would this have occurred? **[1]**

*Tick **one** box.*

- ☐ More copper has been added
- ☐ The mass of the oxygen atoms has added to the mass of the copper
- ☐ Metals always get heavier when they are heated
- ☐ New mass has been made

2.3 Suggest **one** thing the student could have done to ensure **all** the copper oxide reacted to form copper chloride in step 4. **[1]**

.....

.....

2.4 Give the **state symbol** of the copper chloride after the following steps: **[2]**

Step 4: .....

Step 6: .....

2.5 When a metal oxide such as copper oxide reacts with hydrochloric acid, a salt is formed – such as copper chloride – along with one other product.

Identify the other product formed when hydrochloric acid reacts with a metal oxide. **[1]**

*Tick **one** box.*

- ☐ Water
- ☐ Chlorine
- ☐ Carbon dioxide
- ☐ Hydrogen

2.6 Why couldn't the student have just reacted copper and dilute hydrochloric acid together to make copper chloride? **[1]**

*Tick **one** box.*

- ☐ Copper and hydrochloric acid would react together to make copper sulfate instead
- ☐ Copper and hydrochloric acid do not react together because copper is too unreactive
- ☐ Copper and hydrochloric acid would react together too violently
- ☐ Copper and hydrochloric acid would form too many side products as well as copper chloride

2.7 The formula of copper ions is Cu^{2+} and the formula of chloride ions is Cl^-. **[1]**

What is the formula of copper chloride?

.....

Question total: 8 marks

03 This question is about the atom.

In ancient times it was thought that the atom could not be split. Later, the electron was discovered which led the scientist J J Thomson to suggest a new model of the atom.

In the model of the atom suggested by J J Thomson, the atom is a ball of positive charge with negative particles scattered throughout. This is represented by **Figure 3**.

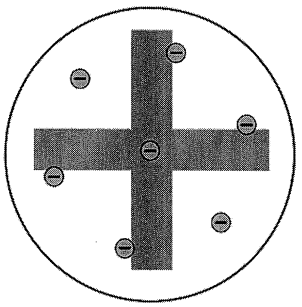

Figure 3

3.1 What is the name of this model of the atom? **[1]**

*Tick **one** box.*

- ☐ Plum pudding model
- ☐ Electron model
- ☐ Proton model
- ☐ Rutherford model

3.2 Suggest why the negative particles remain far apart from each other in this model. **[1]**

.....

.....

The model of the atom in **Figure 3** was later replaced by the nuclear model based on new scientific evidence.

The nuclear model is the basis for the current model of the atom.

3.3 Which of the following pieces of evidence led to the model of the atom in **Figure 3** being rejected? **[1]**

*Tick **one** box.*

- ☐ It was found that the atom contained no negative particles
- ☐ It was found that neutral particles exist in shells around the nucleus
- ☐ It was found that the positive charge is in a central nucleus
- ☐ It was found that the negative particles are in a central nucleus

3.4 Atoms can now be represented using symbols. How many protons and neutrons does the following phosphorus atom have? **[2]**

$$^{31}_{15}P$$

Protons: .....

Neutrons: .....

3.5 The phosphorus atom in 3.4 can be changed into another particle.

$$^{31}_{15}P^{+}$$

Which of these statements is true? **[1]**

*Tick **one** box.*

- ☐ The phosphorus atom has gained an electron to form a positive ion
- ☐ The phosphorus atom has lost an electron to form a positive ion
- ☐ The phosphorus atom has gained a proton to form a positive ion
- ☐ The phosphorus atom has lost a proton to form a positive ion

3.6 Phosphorus can also exist as the following type of atom, which has a different mass number.

$$^{33}_{15}P$$

What word is used for atoms of the same element that have a different mass number like this? **[1]**

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Question total: 7 marks

04 A student chose to investigate the temperature change when different concentrations of an alkali, sodium hydroxide, were added to hydrochloric acid. Each experiment was carried out three times.

The results are shown in **Table 4** with the averages given to the nearest whole number.

	Temperature rise (°C)			
Concentration (mol/dm³)	**Repeat 1**	**Repeat 2**	**Repeat 3**	**Average**
0.2	3.0	4.5	3.5	4
0.4	6.5	6.5	7.5	7
0.6	14.5	9.0	9.5	9
0.8	11.5	11.0	10.0	11
1.0	14.0	13.5	14.0	14

Table 4

4.1 The average temperature rise for a concentration of 0.6 mol/dm³ was calculated using only two of the repeats. Explain why. **[1]**

.....

.....

4.2 What was the range for the temperature rises when 0.2 mol/dm³ was used? **[1]**

.....

4.3 From the following list, place a tick next to the three most important variables that would need to be kept the same throughout this experiment to ensure it is fair. **[2]**

*Tick **three** boxes.*

- ☐ Volume of hydrochloric acid
- ☐ Thermometer used
- ☐ Starting temperature of hydrochloric acid
- ☐ Amount of stirring
- ☐ Concentration of hydrochloric acid
- ☐ Temperature of room

4.4 The experiment was carried out in a polystyrene cup rather than a glass beaker. Suggest how this will make the results more accurate. **[1]**

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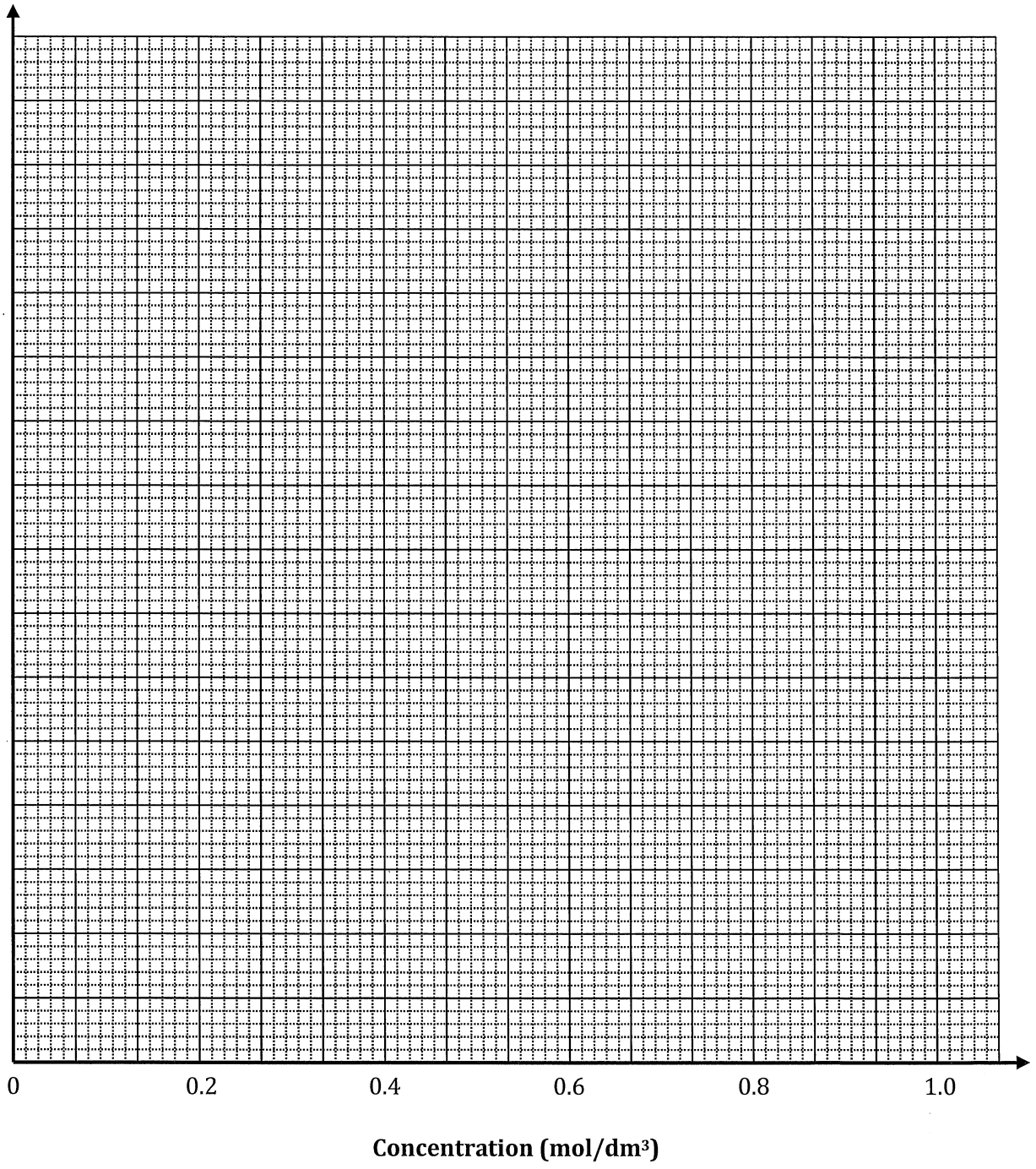
.....

4.5 Draw a graph of concentration of sodium hydroxide against average temperature rise. **[3]**

- Ensure you choose an appropriate scale for the y-axis.
- Include a line of best fit.



4.6 In terms of energy, explain why this reaction is described as '**exothermic**'. **[1]**

*Tick **one** box.*

- ☐ It takes in energy overall
- ☐ It takes in and gives out equal amounts of energy
- ☐ It gives out energy overall

4.7 Match up the type of reaction to the example. Draw **two** lines from each type of reaction. **[2]**

Exothermic Reaction	Burning fuel
	Thermal decomposition
	Sports injury packs
Endothermic Reaction	Self-heating can

Question total: 11 marks

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05 Figure 5 shows a carbon nanotube that was slid into a protective casing that was 1.5×10^{-2} m long and had a square end with sides 5×10^{-8} m wide.

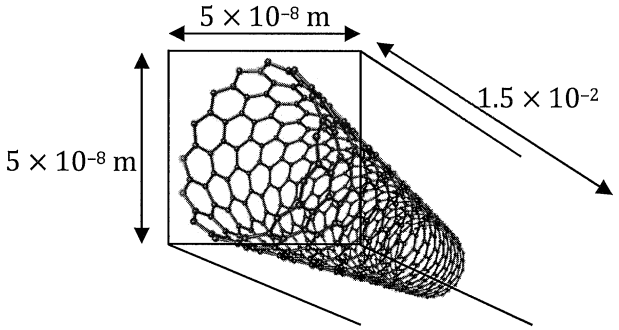

Figure 5

5.1 Calculate the surface area of **one** of the rectangular sides, in m^2. **[2]**

Rectangular side: .....

.....

..... m^2

5.2 What is the width of this tube, 5×10^{-8} m, in nm? **[1]**

..... nm

5.3 The tube was cut in half to give two shorter segments of the tube. Which of these describes how the surface area will change? **[1]**

*Tick **one** box.*

- ☐ Surface area will increase
- ☐ Surface area will stay the same
- ☐ Surface area will decrease

5.4 A company was interested in using nanoparticles with a high surface area to volume ratio in its cosmetics. Give one advantage and one disadvantage of using nanoparticles in cosmetics. **[2]**

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Question total: 6 marks

06 The elements chlorine, bromine and iodine in group 7 can all react with iron metal in a similar way.
A teacher carried out the following experiment:

- The teacher used a pipette to measure 2 cm depth of bromine into the bottom of a test tube.
- The teacher placed the test tube in a clamp.
- The teacher weighed 0.5 g of iron wool (thin coils of iron tangled up like cotton wool) and pushed it halfway down the tube.
- The teacher used a Bunsen burner to heat the iron and then the bromine, causing them to react together.

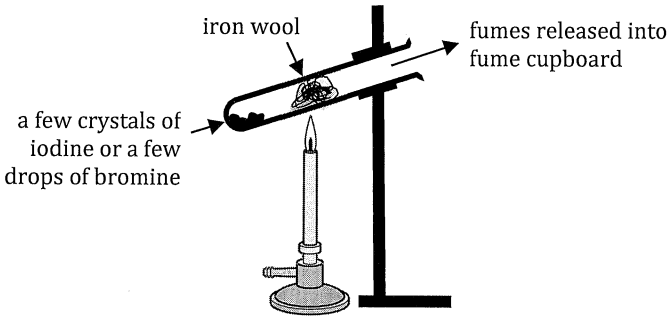

Figure 6

6.1 The bottle of bromine used stated that bromine is **corrosive**. The teacher was already wearing a lab coat and goggles.

Suggest one additional precaution that the teacher could take to protect against the fact that bromine is corrosive. **[1]**

.....

.....

6.2 Complete the word equation for the reaction of iron with bromine. **[1]**

Iron + Bromine → .....

6.3 In terms of their electron arrangement, why do chlorine, bromine and iodine all react in a similar way? **[2]**

*Tick **two** correct statements.*

- ☐ They all have seven electrons in their outer shell
- ☐ They all need to lose one electron
- ☐ They have a full outer shell
- ☐ Their electron configurations end in '1'
- ☐ They gain an electron from other elements when they react

6.4 When the teacher repeated the experiment using chlorine gas, the teacher found that the chlorine started reacting with the iron even before the teacher started heating.

Which **one** of the following is a conclusion that the teacher can make from this observation? **[1]**

*Tick **one** box.*

- ☐ Chlorine is more reactive than bromine
- ☐ Chlorine has a higher boiling point than bromine
- ☐ Chlorine is more reactive than iron
- ☐ Chlorine has a lower boiling point than iron

6.5 Predict and explain what the teacher would observe if they heated helium, a noble gas, with iron. **[2]**

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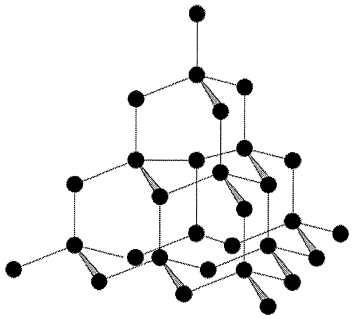
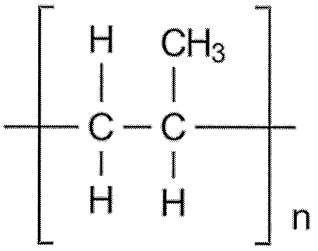
Question total: 7 marks

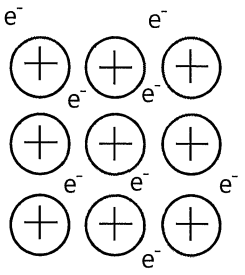
07 The following images show three very different structures.



Diamond



Poly(propene)



Silver metal

Figure 7

7.1 Complete the table to describe the bonding in each of the structures in **Figure 7** above. **[3]**

Each row may require 1 tick, 2 ticks or 3 ticks.

	Diamond	Poly(propene)	Silver metal
Contains delocalised electrons			
Contains covalent bonds			
Very hard and almost impossible to bend			

7.2 What does the letter 'n' show in the structure of poly(propene)? **[1]**

*Tick **one** box.*

- ☐ It contains nitrogen
- ☐ It is unreactive
- ☐ It is made from many monomers joined together
- ☐ It is a mixture not a compound

7.3 Explain why you may burn your fingers if you stir a beaker of hot water with a spoon made of silver. **[1]**

.....

.....

7.4 It is possible to make a silver alloy by mixing atoms of another metal with the silver. Draw a labelled diagram, similar to the one for silver in **Figure 7**, to illustrate the arrangement of silver atoms and atoms of another metal in a silver alloy. **[2]**

7.5 The table below shows the melting points of the different substances. **[6]**

Substance	Melting point (°C)
Diamond	4730 (high pressure also required)
Poly(propene)	160
Silver metal	962

Explain why the substances have different melting points, using the diagrams in **Figure 7** at the start of the question to help. In your answer, you should compare the forces holding the particles together in each structure.

Question total: 13 marks

08 The dot-and-cross diagram below shows a compound made from the elements oxygen and chlorine.

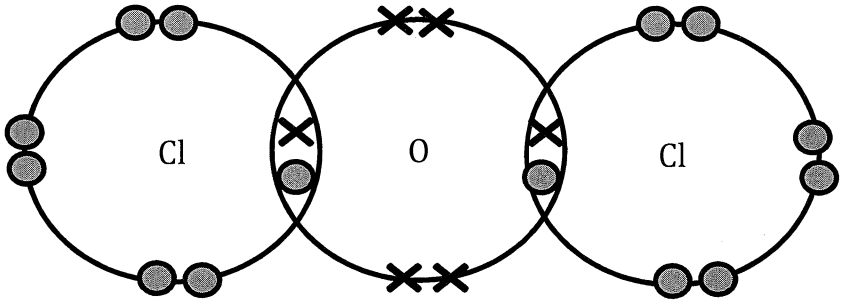


Figure 8.1 – dot-and-cross diagram of a compound of oxygen and chlorine

8.1 Which of these describes the bonding in this compound? **[1]**

*Tick **one** box.*

- ☐ Atoms of oxygen and chlorine bonded together
- ☐ Ions of oxygen and chlorine bonded together
- ☐ Molecules of oxygen and molecules of chlorine bonded together
- ☐ A giant structure of oxygen and chlorine particles

8.2 What is the molecular formula of this compound? **[1]**

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8.3 As well as being represented using dot-and-cross diagrams, compounds can also be represented using lines to represent bonds. An example of this representation is shown for methane in **Figure 8.2**.

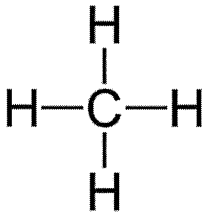

Figure 8.2 – methane drawn with lines for bonds

In the box, draw the structure of the compound of oxygen and chlorine shown in **Figure 8.1**, using this representation. **[1]**

8.4 A student looked up the properties of the compound of oxygen and chlorine and found the following information:

Melting point: -121 °C **Boiling point**: 2 °C **Electrical conductivity**: None

What state of matter will this compound be in at room temperature, 25 °C? Give a reason for your answer. **[2]**

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.....

8.5 Which of these statements correctly explains the lack of conductivity of this compound? **[1]**

*Tick **one** box.*

- ☐ The compound has weak intermolecular forces
- ☐ The compound has no charge
- ☐ The compound is not reactive
- ☐ The compound is not a metal, and only metals conduct

8.6 A compound of lithium and chlorine (lithium chloride) has a very different structure, which is shown in **Figure 8.3**.

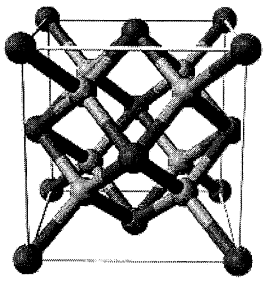

Figure 8.3 – a compound of lithium and chlorine

Describe the structure of this compound. **[3]**

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8.7 Lithium chloride is soluble in water, whereas silver chloride is not soluble in water. Suggest how this information can be used to obtain pure, dry samples of lithium chloride and silver chloride from a solid mixture of the two. **[3]**

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Question total: 12 marks

09 A teacher decided to demonstrate the reactivity of six metals:

zinc, calcium, iron, potassium, copper, magnesium

9.1 In nature, all of these metals are found only in compounds, but gold is found just as an element by itself. Explain why this is the case. **[1]**

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.....

9.2 To obtain the metals above, the compounds they are found as in nature must be reduced. What element is lost during reduction? **[1]**

*Tick **one** box.*

- ☐ Oxygen
- ☐ Hydrogen
- ☐ Carbon

9.3 90 % of all metal that is extracted and used is iron. Write this percentage as the simplest possible fraction. **[1]**

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9.4 In the first stage of the demonstration, the teacher reacted each metal with cold water.
Identify **two** observations that would be made when a piece of potassium is reacted with water. **[2]**

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.....

.....

9.5 From the list below, tick **two** statements which describe what occurs when **calcium** is added to water. **[2]**

*Tick **two** boxes.*

- ☐ Carbon dioxide is produced
- ☐ An element is formed
- ☐ Calcium hydroxide is produced
- ☐ Calcium loses two electrons
- ☐ Calcium forms a negative ion

9.6 In the second stage of the demonstration, the teacher carried out a series of **displacement** reactions with the metals that didn't react with cold water.

The teacher added the different metals to different salt solutions. The results are shown in table 9 below. The crossed out boxes indicate combinations that were not necessary to do.

		Metal salt solution			
		Iron chloride	**Zinc chloride**	**Copper chloride**	**Magnesium chloride**
Metal	**Iron**		No reaction	Reaction	No reaction
	Zinc	Reaction		Reaction	No reaction
	Copper	No reaction	No reaction		No reaction
	Magnesium	Reaction	Reaction	Reaction	

Table 9

Describe the patterns shown by these results and explain how they show the order of reactivity of these metals.

To achieve the highest mark in this question you must include one correct word equation. **[6]**

Question total: 13 marks

10 The diagram in **Figure 10** below shows the electrolysis of molten potassium bromide. This process can be carried out to obtain the elements potassium and bromine.

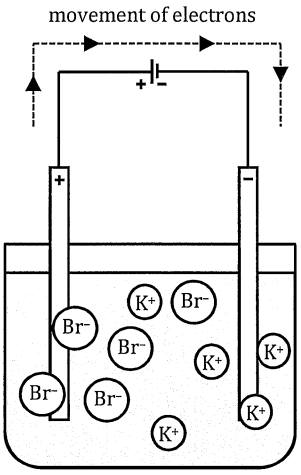

Figure 10

10.1 Give two reasons why large amounts of energy are needed for this process. **[2]**

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10.2 Describe how the elements potassium and bromine are formed from the potassium and bromide ions. **[3]**

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10.3 Complete the symbol equation for this process by writing the formula of potassium bromide and then balancing the equation. **You may not need to write numbers in all the gaps.** **[2]**

.... → ..... **K** + ... **Br_2**

Potassium bromide → Potassium + Bromine

10.4 From 10 000 kg of potassium bromide an industrial chemist expected to obtain 3277 kg of potassium from this electrolysis process. The actual amount obtained was 2500 kg. Calculate the percentage yield of this process. Give your answer to **one decimal place**. **[3]**

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10.5 Write 3277 kg in grams in standard form. **[2]**

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10.6 Suggest one reason why this reaction did not give a 100 % yield. **[1]**

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Question total: 13 marks

