GCSE AQA Chemistry

Write-on

Paper 1B 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

7 **Li** lithium 3
23 **Na** sodium 11
39 **K** potassium 19
85 **Rb** rubidium 37
133 **Cs** caesium 55

Figure 1

The figure above shows part of the periodic table.

1.1 A section of how many periods is shown in **Figure 1**? **[1]**

.....

1.2 How many groups are shown in **Figure 1**? **[1]**

.....

1.3 Which of these things do these five elements have in common? **[2]**

*Tick **two** boxes.*

- ☐ They all have one electron in their outer shell
- ☐ They all have the same number of shells
- ☐ They all need to lose the same number of electrons for a full outer shell
- ☐ They all have the same number of full shells
- ☐ They all lose one electron shell when they react

1.4 Early chemists performed experiments with lithium, sodium and potassium. The results of some experiments are in the table.

	Observations from experiments		
	Reaction with water	**Reaction when heated in chlorine**	**Reaction when heated in air**
Lithium (Li)	Fizzes violently and dissolves	Forms a white powder in a few seconds	Melts quickly, then forms a white solid
Sodium (Na)	Fizzes very violently and dissolves quickly	Forms a white powder in a few seconds	Melts quickly, then forms a white solid
Potassium (K)	Fizzes violently, catches fire and dissolves very quickly	Forms a white powder in a few seconds	Melts quickly, then forms a white solid

Table 1

How could early chemists have used these results when deciding where to put each element in the periodic table? **[1]**

*Tick **one** box.*

- ☐ It shows they should be put in the same period because they have similar reactions
- ☐ It shows they should be put in the same group because they have similar reactions
- ☐ It shows they should be put in different periods because they have similar reactions
- ☐ It shows they should be put in different groups because they have similar reactions

1.5 Identify one physical change that is mentioned in **Table 1**. **[1]**

.....

1.6 Based on the information in **Figure 1** and **Table 1**, complete the sentences to predict how rubidium (Rb), which is below potassium, would react with water, and explain your answer.

Use the words from the box in your answer. **[2]**

Explosively	Decreases	Stays the same
Quite quickly	Increases	Slowly

When rubidium reacts with water it reacts.....*.*

This is because reactivity ..... *down Group 1.*

1.7 Iron is a transition metal and also reacts rapidly with chlorine. Predict one difference about the product compared to the product of the reactions of lithium, sodium and potassium with chlorine. **[1]**

*Tick **one** box.*

- ☐ Iron chloride would be covalent, not ionic like the group 1 chlorides
- ☐ Iron chloride would melt much more easily than group 1 chlorides
- ☐ Iron chloride would be coloured, not white like the group 1 chlorides
- ☐ Iron chloride would be a mixture, unlike the group 1 chlorides

1.8 Iron chloride is added to certain industrial reactions to help more of the product to be produced in a certain amount of time.

What is the name of a chemical like iron chloride that is added to a reaction in order to help the reaction happen faster, and which doesn't get used up? **[1]**

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Question total: 10 marks

02 A school teacher decided to show the elements bromine and iodine to their class. The teacher showed the elements at room temperature, and then heated a small sample of them using a Bunsen burner.

The observations the students made are shown in **Table 2**.

Element	Appearance at room temperature	Observation on heating
Bromine	Brown liquid	Turns into a brown gas after about five seconds of heating
Iodine	Grey solid	Turns into a purple gas after about 10 seconds of heating

Table 2

2.1 What change of state happens to the bromine after about five seconds of heating? **[1]**

*Tick **one** box.*

- ☐ Freezing
- ☐ Melting
- ☐ Boiling
- ☐ Condensing

2.2 **Figure 2** below shows the bromine particles at the **end** of the demonstration.

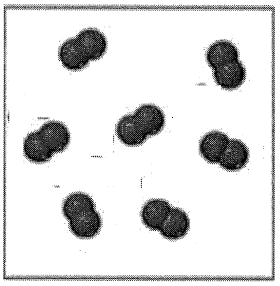

Figure 2

Describe the arrangement of the particles in the liquid **before** the bromine was heated. **[2]**

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.....

.....

2.3 Bromine is a liquid when it is used in the experiment. Based on this information, which of the following is a possible **melting point** for bromine? **[1]**

*Tick **one** box.*

- ☐ -7 °C
- ☐ 30 °C
- ☐ 46 °C
- ☐ 323 °C

2.4 The teacher said that:

> 'The demonstration shows that the forces between the iodine particles are stronger than the forces between the bromine particles.'

Explain how the experiment shows this. **[2]**

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2.5 Name a piece of apparatus that the teacher could use to work out the exact temperature the changes of state occurred at. **[1]**

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2.6 When the teacher tried to measure the temperature, they found that a gas formed too quickly for the temperature to be measured accurately.

Which of the following changes would allow the experiment to occur more slowly so it could be measured more accurately? **[1]**

*Tick **one** box.*

- ☐ Using less of the elements
- ☐ Using a Bunsen burner on a roaring blue flame
- ☐ Stirring the elements
- ☐ Using a more gentle heating method

2.7 The teacher carried out the experiment in a fume hood, which has a vacuum pump to pump any gases out away from the classroom. Suggest why the teacher carried out the experiment in a fume hood. **[1]**

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.....

Question total: 9 marks

03 Salts can be made using a variety of different reactions. The following word equations give some examples.

Reaction 1: Nitric acid + Sodium hydroxide → Sodium nitrate + Water
Acid *Base* *Salt* *Side product*

Reaction 2: Hydrochloric acid + Zinc carbonate → Compound X + Water + Carbon dioxide
Acid *Metal carbonate* *Salt* *Side product + Side product*

Reaction 3: Compound Y + Calcium → Calcium sulfate + Hydrogen
Acid *Metal* *Salt* *Side product*

3.1 Complete the name of the salt labelled as Compound X. **[1]**

Zinc.....

3.2 Compound Y is an acid that is used to make calcium sulfate. Identify Compound Y. **[1]**

..... acid

3.3 A student wished to carry out **Reaction 1** and collected the necessary chemicals. Before the student began, they checked the pH of the chemicals.

How could the student check the pH of the chemicals? **[1]**

.....

3.4 Which of these is a possible value for the pH of sodium hydroxide solution at the start of the reaction? **[1]**

*Tick **one** box.*

- ☐ 1
- ☐ 4
- ☐ 7
- ☐ 14

3.5 How will the pH of the sodium hydroxide change during the reaction? **[1]**

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3.6 After the reaction, the student had a dilute solution of sodium nitrate.

Explain how the student would carry out crystallisation to obtain pure, dry, solid sodium nitrate from this solution. **[2]**

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3.7 In this reaction it is important to add exactly the right amount of nitric acid to sodium hydroxide when preparing the sodium nitrate salt.

Name a **practical technique** that could be used to add exactly the right amount of nitric acid to sodium hydroxide to make the sodium nitrate salt. **[1]**

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3.8 Why is it important not to add too much acid to the sodium hydroxide when making the sodium nitrate salt? **[1]**

*Tick **one** box.*

- ☐ Because otherwise the reaction could explode
- ☐ Because otherwise the salt would have leftover acid in it
- ☐ Because otherwise the reaction would make a different salt
- ☐ Because otherwise the reaction would be too slow

Question total: 9 marks

04 A GCSE student carried out a series of experiments on the following chemicals in a lab.

- Titanium – a metal
- Calcium chloride – an ionic compound
- Polythene – a covalent polymer

4.1 In their first experiment, the student heated the material using a Bunsen burner to see what temperature it melted at.

Name a suitable piece of apparatus that the student could use to hold a piece of titanium in a Bunsen burner flame. **[1]**

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4.2 When the polymer melts, the covalent bonds do not break or get weakened.

What are weakened and can break when a polymer melts? **[1]**

*Tick **one** box.*

- ☐ Ionic bonds
- ☐ Electrostatic attractions
- ☐ Intermolecular forces
- ☐ Lattices

4.3 In the second experiment, the student tested the electrical conductivity of each of the chemicals. Match each substance to the expected result of this experiment. **[3]**

Draw **one** line from each chemical.

Titanium	Does not conduct electricity as a solid or as a liquid when melted
Polythene	Does conduct electricity as a solid but not when melted
Calcium chloride	Conducts electricity as a solid and as a liquid when melted
	Does not conduct electricity as a solid, but does conduct as a liquid when melted

4.4 The student then hit each of the materials using a hammer to see how easy each material was to bend.

The student recorded the following results.

Material	Observation when hit with hammer
Titanium	Bends quite easily
Calcium chloride	Hard – does not bend
Polythene	Bends very easily

Give one reason hitting a material with a hammer may not be a fair test. **[1]**

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4.5 **Figure 4.1** below shows the particles in calcium chloride. Why is calcium chloride hard? **[1]**

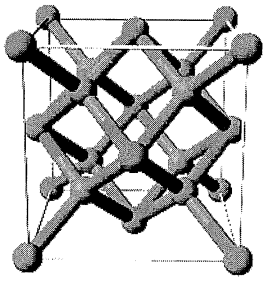


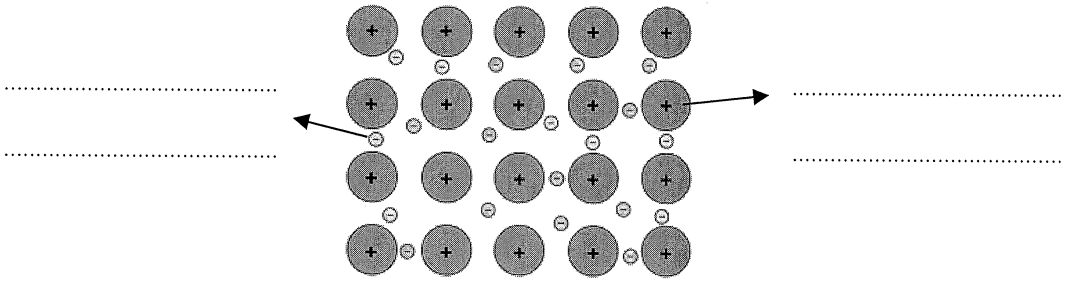
Figure 4.1

*Tick **one** box.*

- ☐ It has a giant structure with simple molecules
- ☐ It has a simple structure with weak attractions between atoms
- ☐ It has a covalent structure with many bonds
- ☐ It has a giant structure with strong attractions between ions

4.6 The diagram below shows the arrangement of particles in the titanium metal.

Label the diagram to describe the arrangement of particles in a metal. **[2]**



4.7 By using the diagram, explain why titanium metal can be bent. **[2]**

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Question total: 11 marks

05 Extraction of metals from their compounds is a key industry that is important for jobs and the economy around the world.

The quantity of some different metals that were extracted in 2017 is shown in table 5.

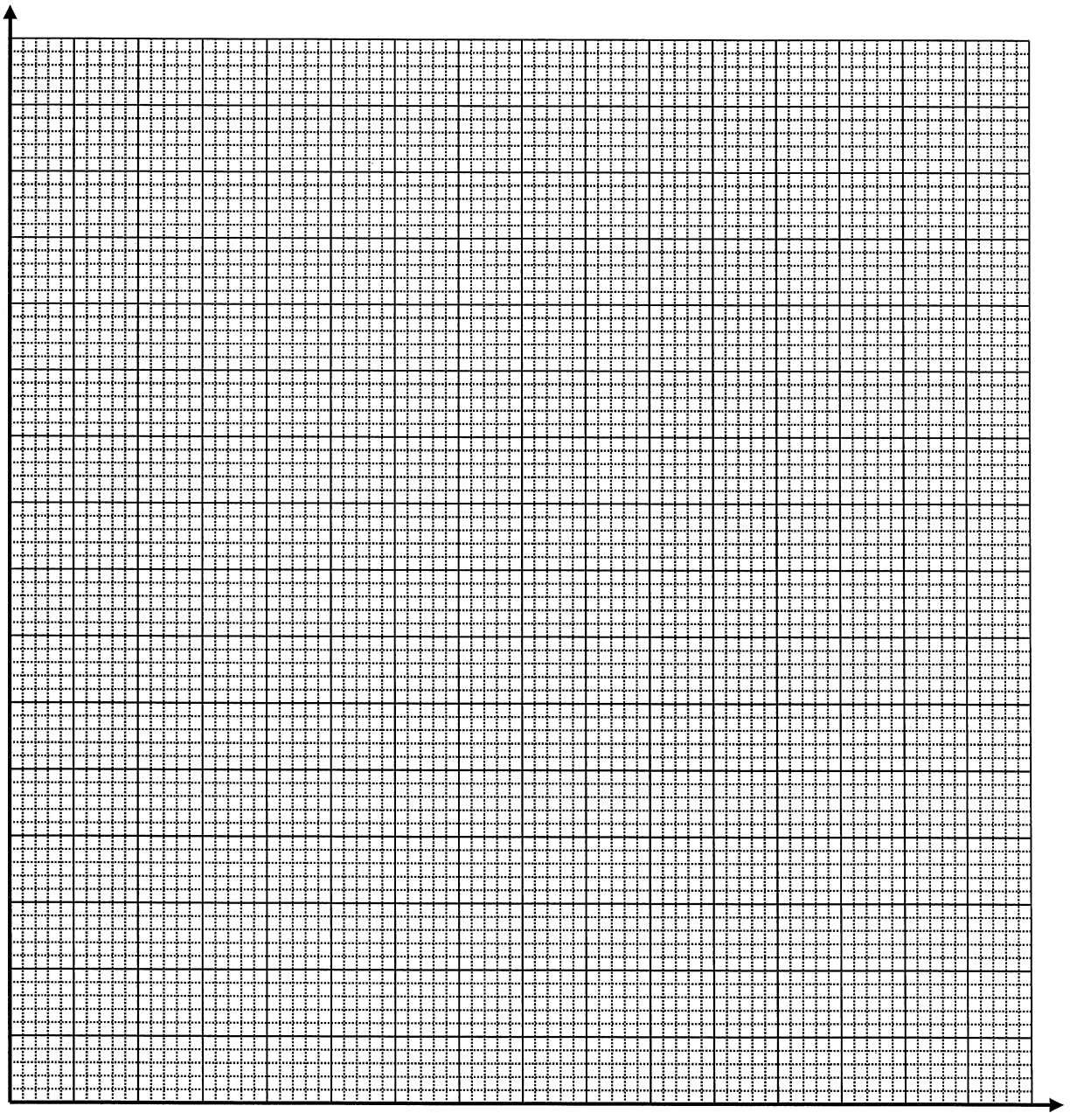
Metal	Mass of metal extracted (millions of tonnes)
Zinc	13
Nickel	5
Lead	8
Copper	22

Table 5

5.1 Draw a bar chart of this data. Ensure you:

- choose a suitable scale for the y-axis
- include all necessary labels

[4]



Metal

5.2 One million tonnes is equal to 1 000 000 000 kg.

How many kg of lead would be produced in **three years** if the rate in 2017 continued? **[2]**

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5.3 Aluminium production in 2017 was approximately 200 million metric tons. Suggest why it would be difficult to compare aluminium production to the other metals in **table 5** on a bar chart. **[1]**

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5.4 Extracting aluminium is more expensive than extracting many other metals because it is extracted by electrolysis.

Choose the correct words from the box to complete the description of electrolysis below. **[2]**

mixtures	elements	compounds	atoms	molecules

During electrolysis electricity is used to split molten _____ into

the _____ they are made from.

5.5 One of the reasons aluminium extraction is expensive is because of the high temperatures needed.

How does mixing aluminium oxide with cryolite allow aluminium extraction to occur at a lower temperature? **[1]**

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Question total: 10 marks

06 A student carried out two different reactions to make magnesium oxide.

Reaction A: $MgCO_3 \rightarrow MgO + CO_2$

Reaction B: $Mg(OH)_2 \rightarrow MgO + H_2O$

6.1 Give the chemical name of the reactants in the two reactions: **[2]**

$MgCO_3$ = ...

$Mg(OH)_2$ = ...

6.2 The relative formula masses of some of the compounds in each reaction are shown below.

Reaction A		
$MgCO_3$	**MgO**	**CO_2**
	40	44

Reaction B		
$Mg(OH)_2$	**MgO**	**H_2O**
58	40	18

What is the relative formula mass of the missing reactant in **Reaction A**? **[1]**

.....

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6.3 The percentage atom economy of a reaction is given by the formula

$$\text{Atom economy} = \frac{\text{Relative formula mass of desired product}}{\text{Sum of relative formula masses of all reactants}} \times 100$$

Calculate the atom economy for **Reaction B** to make magnesium oxide. **[3]**

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6.4 **Reaction A** has a lower atom economy than **Reaction B**. Suggest why this information may make **Reaction B** more preferable if these reactions were done on a large scale. **[2]**

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6.5 The percentage yield of a reaction can be calculated using the formula

$$\text{Percentage yield} = \frac{\text{Actual mass of product obtained}}{\text{Theoretical mass of product expected}} \times 100$$

The student expected to obtain 6.0 g of magnesium oxide by **Reaction B**, but only obtained an 80 % yield.

By rearranging the formula, work out the actual mass of product obtained. **[3]**

You are encouraged to show your working.

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Question total: 11 marks

07 When ammonium nitrate dissolves in water the temperature decreases.

7.1 What word is used to describe a process where the temperature decreases? **[1]**

*Tick **one** box.*

- ☐ Exothermic
- ☐ Endothermic
- ☐ Oxidation
- ☐ Reduction

7.2 Which arrow on the reaction profile in **Figure 7** shows the energy change for this reaction? **[1]**

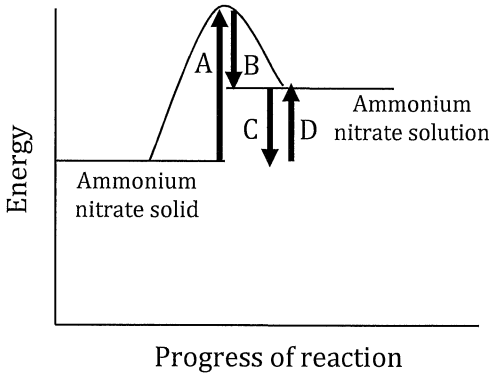

Figure 7

*Tick **one** box.*

- ☐ A
- ☐ B
- ☐ C
- ☐ D

7.3 A research student decided to investigate how the volume of water that ammonium nitrate is dissolved in affects the temperature decrease.

Name three pieces of apparatus that the student will need in order to do this experiment. **[3]**

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7.4 Write a method that the research student could follow in order to work out how the volume of water affects the temperature change when ammonium nitrate is added to water. **[6]**

In your answer you should include:
• key steps for the student to follow in a sensible order
• anything the student should keep the same throughout their experiment
• any relevant safety precautions

Question total: 11 marks

08 In 2015 the National Graphene Institute was opened in Manchester to focus on the unique chemistry and potential of graphene.

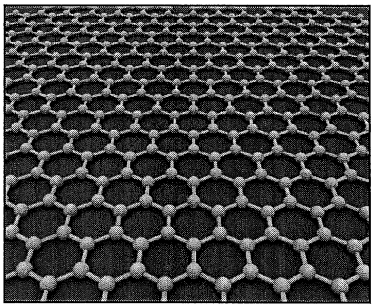

Figure 8

8.1 The image in **Figure 8** represents graphene. What name is given to models of chemical structures like this? **[1]**

*Tick **one** box.*

- ☐ Space-filling models
- ☐ Electron models
- ☐ Crystal models
- ☐ Ball-and-stick models

8.2 Using the diagram above to help, describe the structure of graphene. **[4]**

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8.3 Some of the properties of graphene are listed below.

Graphene properties
• Hard
• Flexible
• Low density
• Good electrical conductor

In terms of properties, what similarities does graphene have with diamond and with graphite, if any? **[2]**

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8.4 Identify one use of graphene based on the properties listed above. **[1]**

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8.5 Why can graphene conduct electricity? **[2]**

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8.6 Graphene is flexible partly because it is thin. Some measurements of samples of graphene are shown in **Table 8**.

	Sample 1	Sample 2	Sample 3	Sample 4
Width (nm)	4.5	4.3	5.1	4.9

Table 8

Calculate the (mean) average width of a sample. Give your answer in **metres** in **standard form**. **[3]**

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Question total: 13 marks

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09 A student carried out an experiment to work out what metals to use to make a battery.

The student started off by using the two metals copper and zinc. These were placed in two solutions which were connected by a wire and a salt bridge to make a circuit.

The voltmeter recorded the voltage in the circuit.

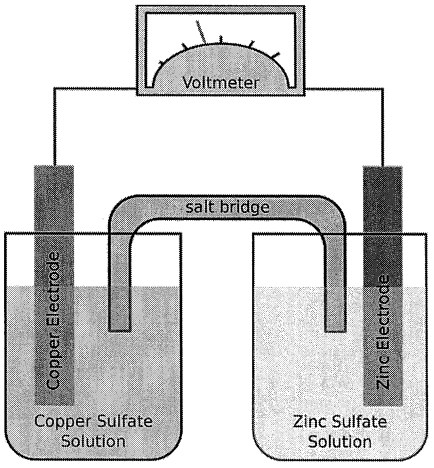

Figure 9.1

9.1 The two solutions both conduct electricity. What name is given to a solution that can conduct electricity? **[1]**

*Tick **one** box.*

- ☐ Electrolyte
- ☐ Electrode
- ☐ Electrolysis
- ☐ Electron

9.2 Why can the two solutions conduct electricity? **[1]**

*Tick **one** box.*

- ☐ The electrons can flow
- ☐ The ions can flow
- ☐ The water can flow
- ☐ The metals can flow

9.3 The student wanted to change the voltage by trying different metals and different solutions in **Figure 9.1** instead of the zinc and zinc sulfate.

The student obtained the following results:

Metal / Metal salt solution	Voltage
Zinc / Zinc salt solution	1.31
Magnesium / Magnesium salt solution	2.17
Lead / Lead salt solution	0.58
Nickel/ Nickel salt solution	0.83

Table 9

Identify one error in the way the information in table 9 has been recorded. **[1]**

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9.4 What is the dependent variable in this experiment? **[1]**

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9.5 Explain how this experiment shows which metal is most similar in reactivity to copper. **[2]**

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9.6 The student left the experiment running over the weekend, and returned after a few days to see how the values had changed. Explain why there may be no voltage recorded after the weekend. **[1]**

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9.7 The diagram in **Figure 9.2** below shows a hydrogen fuel cell.

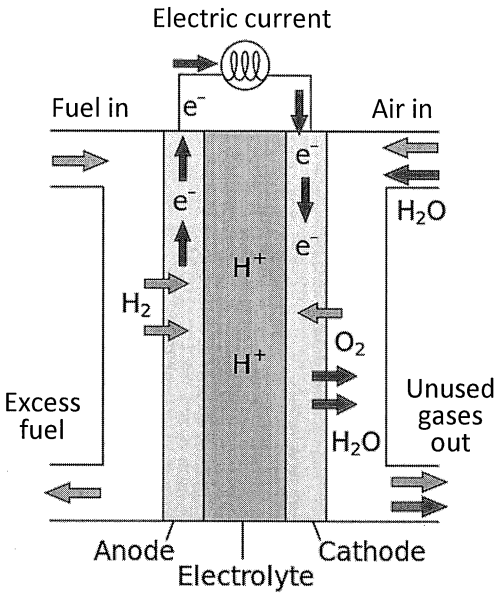

Figure 9.2

Identify two differences in the way that the fuel cell in **Figure 9.2** creates a potential difference compared to the cells in **Figure 9.1.** **[2]**

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9.8 Give one reason why hydrogen fuel cells are difficult to use to power vehicles. **[1]**

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Question total: 10 marks

10 Before the scientific developments of recent centuries, it was believed that the atom was the smallest particle. Developments over recent centuries have shown that the atom contains subatomic particles.

The timeline below describes some key experiments.

1897	Thomson discovers negative particles and develops the plum pudding model.
1911	Rutherford shows that while most positive alpha particles pass through the atom, some get deflected.
1913	Bohr shows how the negative particles are arranged in the atom.
1932	James Chadwick discovers the neutron.

Use this information to describe the current understanding of what the atom is made of, and how this is different to the plum pudding model.

In your answer you should include the names, charges and relative masses of the subatomic particles. **[6]**

Question total: 6 marks

