

Name:

Date:

C1 - Test 5
ATOMIC STRUCTURE
Advanced

GCSE

CHEMISTRY

AQA - Triple Science

Mark

Grade

Materials

For this paper you must have:

- Ruler
- Pencil and Rubber
- Scientific calculator, which you are expected to use when appropriate

Instructions

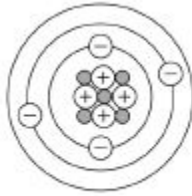
- Answer all questions
- Answer questions in the space provided
- All working must be shown

Information

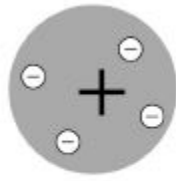
- The marks for the questions are shown in brackets

1.

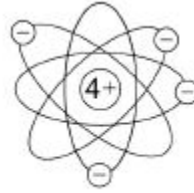
The diagram below represents different models of the atom.



A



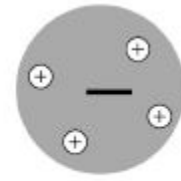
B



C



D



E

(a) Which diagram shows the plum pudding model of the atom?

Tick **one** box.

A		B		C		D		E	
---	--	---	--	---	--	---	--	---	--

(1)

(b) Which diagram shows the model of the atom developed from the alpha particle scattering experiment?

Tick **one** box.

A		B		C		D		E	
---	--	---	--	---	--	---	--	---	--

(1)

(c) Which diagram shows the model of the atom resulting from Bohr's work?

Tick **one** box.

A		B		C		D		E	
---	--	---	--	---	--	---	--	---	--

(1)

(d) Define the mass number of an atom.

(1)

(e) Element **X** has two isotopes. Their mass numbers are 69 and 71

The percentage abundance of each isotope is:

- 60% of ^{69}X
- 40% of ^{71}X

Estimate the relative atomic mass of element **X**.

Tick **one** box.

< 69.5

Between 69.5 and 70.0

Between 69.5 and 70.0

Between 70.0 and 70.5

> 70.5

(1)

(f) Chadwick's experimental work on the atom led to a better understanding of isotopes.

Explain how his work led to this understanding.

(3)

(Total 8 marks)

2.

X is an element with the following properties:

- melts at -220°C and boils at -188°C ;
- does not conduct electricity at room temperature;
- forms molecular compounds with non-metals;
- forms ionic salts with metals in which its ion has a 1–charge.

(a) Would you expect X to be a solid, a liquid or a gas at 20°C ?

(1)

(b) Predict the formula of the product formed when X reacts with aluminium.

(The aluminium ion is Al^{3+} and the X ion is X^{-} .)

Select your answer from the list below.

AlX

AlX_2

AlX_3

Al_3X

Al_2X_3

Predicted formula _____

(1)

(c) To which Group of the Periodic Table does the element X belong?

(1)

(Total 3 marks)

3.

One definition of an element is:

“A substance that cannot be broken down into simpler substances by chemical methods”

The table below shows some of the ‘substances’ which Antoine Lavoisier thought were elements. He divided the ‘substances’ into four groups. He published these groups in 1789.

The modern names of some of the ‘substances’ are given in brackets.

ACID-MAKING ELEMENTS	GAS-LIKE ELEMENTS	METALLIC ELEMENTS		EARTHY ELEMENTS
sulphur	light	cobalt	mercury	lime (calcium oxide)
phosphorus	caloric (heat)	copper	nickel	magnesia (magnesium oxide)
charcoal (carbon)	oxygen	gold	platina (platinum)	barytes (barium sulphate)
	azote (nitrogen)	iron	silver	argilla (aluminium oxide)
	hydrogen	lead	tin	silex (silicon dioxide)
		magnese	tungsten	
		zinc		

Dmitri Mendeleev devised a Periodic Table of the elements in 1869. A modern version of this table is shown on the Data Sheet.

Give **two** ways in which Mendeleev’s table is more useful than Lavoisier’s.

1. _____

2. _____

(Total 2 marks)

4.

(a) What is the name given to the block of elements in the middle of the Periodic Table which includes vanadium?

(1)

(b) Some of the properties of vanadium are shown in this list.

- It has a high melting point.
- It is a solid at room temperature.
- It is a conductor of electricity.
- It is a good conductor of heat.
- It forms coloured compounds.
- It forms crystalline compounds.
- It forms compounds that are catalysts.

Select **two** properties, from the list above, which are **not** typical of a Group 1 metal.

1. _____

2. _____

(2)

(Total 3 marks)

5.

(a) Dmitri Mendeleev was one of the first chemists to classify the elements by arranging them in order of their atomic weights. His periodic table was published in 1869.

How did Mendeleev know that there must be undiscovered elements **and** how did he take this into account when he designed his periodic table?

(2)

(b) By the early 20th century protons and electrons had been discovered.

Describe how knowledge of the numbers of protons and electrons in atoms allow chemists to place elements in their correct order and correct group.

(3)

(c) The transition elements are a block of elements between Groups 2 and 3 of the periodic table.

(i) Transition elements have similar properties.

Explain why, in terms of electronic structure.

(2)

(ii) There are **no** transition elements between the Group 2 element magnesium and the Group 3 element aluminium.

Give a reason why, in terms of electronic structure.

(1)

(Total 8 marks)

6.

Use the periodic table and the information in the table below to help you to answer the questions.

The table shows part of an early version of the periodic table.

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

(a) Hydrogen was placed at the top of Group 1 in the early version of the periodic table.

The modern periodic table does **not** show hydrogen in Group 1.

(i) State one **similarity** between hydrogen and the elements in Group 1.

(1)

(ii) State one **difference** between hydrogen and the elements in Group 1.

(1)

(b) Fluorine, chlorine, bromine and iodine are in Group 7, the halogens.

The reactivity of the halogens decreases down the group.

Bromine reacts with a solution of potassium iodide to produce iodine.



(i) In the reaction between bromine and potassium iodide, there is a reduction of bromine to bromide ions.

In terms of electrons, what is meant by reduction?

(1)

(ii) Complete the half equation for the oxidation of iodide ions to iodine molecules.



(2)

- (iii) Explain, in terms of electronic structure, why fluorine is the most reactive element in Group 7.

(3)

(Total 8 marks)

7.

By 1869, about 60 elements had been discovered. Mendeleev arranged these elements in a table, in order of their atomic weight. He also put elements with similar chemical properties in the same columns.

Mendeleev and part of his table are shown below.



	Group							
	1	2	3	4	5	6	7	8
Period 1	H							
Period 2	Li	Be	B	C	N	O	F	
Period 3	Na	Mg	Al	Si	P	S	Cl	
Period 4	K Cu	Ca Zn	– –	Ti –	V As	Cr Se	Mn Br	Fe Co Ni

- (a) (i) Name **one** element in Group 1 of Mendeleev's table that is not in Group 1 of the periodic table on the Data Sheet. Give a reason why this element should not be in Group 1.

Name of element _____

Reason _____

(2)

(ii) Which group of the periodic table on the Data Sheet is missing from Mendeleev's table?

(1)

(b) The gaps (–) in Mendeleev's table were for elements that had not been discovered.

(i) Compare Mendeleev's table with the periodic table on the Data Sheet.

Name **one** of the elements in Period 4 that had not been discovered by 1869.

(1)

(ii) Mendeleev was able to make predictions about the undiscovered elements. This eventually led most scientists to accept his table.

Suggest what predictions Mendeleev was able to make about these undiscovered elements.

(2)

(c) In terms of their electronic structure:

(i) state why lithium and sodium are both in Group 1

(1)

(ii) explain why sodium is more reactive than lithium.

(3)

(Total 10 marks)

8.

The table gives some properties of the element silicon.

Melting point	1410 °C
Relative atomic mass	28
Conductivity	Conducts electricity
Compounds	Forms compounds with covalent bonds
Position in periodic table	Group 4
Reaction with water	Unreactive
Density	Relatively low

(a) Give **two** ways in which silicon is similar to the alkali metals.

1. _____

2. _____

(2)

(b) Give **two** ways in which the properties of silicon are different from those of the alkali metals.

1. _____

2. _____

(2)

(Total 4 marks)

9.

Read the information about the development of the periodic table and answer the questions that follow:

Johann Döbereiner was a chemist who realised there was a link between atomic weight and chemical properties. Although it was difficult to measure atomic weights accurately, by 1829 Döbereiner had arranged many elements with similar chemical reactions in groups of three. He noticed that the middle element had an atomic weight that was approximately the average of the other two. These groupings were known as triads. Three of these triads are shown below:

Li 7	S 32	Cl 35.5
Na 23	Se 79	Br 80
K 39	Te 128	I 127

As new elements were discovered, it became difficult to group them in triads, and it was left to others to build on Döbereiner's work. The result was the first periodic table, suggested by Dimitri Mendeleev in 1869.

Our modern periodic table has evolved from Mendeleev's Table. Lithium, sodium and potassium are still together in Group 1, and chlorine, bromine and iodine are in Group 7.

It was many years before chemists understood the nature of the transition elements.

The modern periodic table on the Data Sheet may help you to answer these questions.

(a) Döbereiner suggested that calcium (Ca), strontium (Sr) and barium (Ba) were also a triad.

Use relative atomic masses to explain why.

(1)

(b) Suggest why Döbereiner's ideas were replaced by those of Mendeleev.

(1)

(c) Lithium, sodium and potassium are in Group 1. All these elements react with water.

Describe what you **see** when potassium is added to water.

(2)

(d) In terms of electronic structure, explain why:

(i) elements in the same group of the periodic table have similar chemical properties

(1)

(ii) transition elements have similar properties even though they are not in the same group

(2)

(iii) in Group 1, lithium is **less** reactive than potassium.

(2)

(Total 9 marks)

10.

A scientist produces zinc iodide (ZnI_2).

This is the method used.

1. Weigh 0.500 g of iodine.
2. Dissolve the iodine in ethanol.
3. Add an excess of zinc.
4. Stir the mixture until there is no further change.
5. Filter off the excess zinc.
6. Evaporate off the ethanol.

(a) Ethanol is flammable.

Suggest how the scientist could carry out **Step 6** safely.

(1)

(b) Explain why the scientist adds excess zinc rather than excess iodine.

(3)