The Periodic Table

Question Paper 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Chemistry
Exam Board	AQA
Topic	5.1 Atomic Structure and the Periodic Table
Sub-Topic	The Periodic Table
Difficulty Level	Gold Level
Booklet	Question Paper 1

Time Allowed: **59 minutes**

Score: **/57**

Percentage: **/100**

Grade Boundaries:

Q1. Elements are made up of atoms.

(a) What is the approximate radius of an atom?

Tick **one** box.

1×10 m ☐

1×10^{-1} m ☐

1×10^{-10} m ☐

1×10^{-100} m ☐

(1)

(b) The figure below shows the atoms of five elements.

$^{6}_{3}R$ $^{7}_{3}S$ $^{23}_{11}T$ $^{39}_{19}U$ $^{85}_{37}V$

The letters are **not** the symbols of these elements.

Complete the sentence.

All of the elements in the figure above are in Group

..... of the periodic table.

(1)

(c) Which **two** atoms in the figure above are isotopes of the same element?

Explain your answer fully.

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(3)

(d) The halogens are in Group 7 of the periodic table.

Explain the trend in reactivity of the halogens.

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(6)
(Total 11 marks)

Q2. In 1869 there were 60 known elements.

Mendeleev arranged the elements in order of their atomic mass (atomic weight).

He realised that elements with similar properties occurred at regular intervals.

(a) Suggest why one of the groups that is on today's periodic table was not in Mendeleev's periodic system.

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(1)

(b) Explain the arrangement of the first 20 elements in today's periodic table.

You should answer in terms of atomic structure.

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(2)

(c) A student put some potassium bromide solution in a test tube.

She added a few drops of chlorine solution and observed the result.

She repeated the process using different potassium halide salts and different halogens.

The table below shows the student's results.

Solution of halogen	Potassium chloride solution	Potassium bromide solution	Potassium iodide solution
Chlorine		Orange colour forms	Brown colour forms
Bromine	No reaction		Brown colour forms
Iodine	No reaction	No reaction	

Give the order of reactivity of the halogens from the results in the table above.

Explain how you used the results to show this order of reactivity.

Order .....

Explanation .....

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(2)

(d) Write a balanced ionic equation for the reaction of chlorine with bromide ions in solution.

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(3)

(e) Explain the order of reactivity of Group 7 elements.

Include information about atomic structure.

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(2)
(Total 10 marks)

Q3. 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.

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(1)

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

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(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.

$$Br_2 + 2KI \longrightarrow 2KBr + I_2$$

(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?

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(1)

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

$$2I^- \longrightarrow$$

(2)

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

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(3)
(Total 8 marks)

Q4.(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?

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(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.

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(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.

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(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.

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(1)
(Total 8 marks)

Q5. 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	Ca	–	Ti	V	Cr	Mn	Fe Co Ni
	Cu	Zn	–	–	As	Se	Br	

(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 .....

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(2)

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

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(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.

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(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.

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(2)

(c) In terms of their electronic structure:

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

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(1)

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

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(3)
(Total 10 marks)

Q6. The table shows some properties of gases in dry air

Gas in dry air	Density in kg/m^3	Melting point in °C	Boiling point in °C	Percentage (%) in air
Nitrogen	1.2506	–210	–196	78.08

Oxygen	1.4290	–219	–183	20.95
Carbon dioxide	1.977	–57	–57	0.033
Helium	0.1785	–272	–269	0.00052
Neon	0.8999	–249	–246	0.0019
Argon	1.7837	–189	–186	0.934
Krypton	3.74	–157	–153	0.00011
Xenon	5.86	–112	–108	0.0000087

(a) In 1895, Lord Rayleigh isolated nitrogen from dry air by removing the other known gases, oxygen and carbon dioxide.
He then discovered that nitrogen from dry air had a different density to pure nitrogen produced from chemical reactions.
He concluded that nitrogen extracted from dry air was mixed with another gas.
The density of nitrogen extracted from dry air was higher than the density of pure nitrogen.

Use the information above to explain why.

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(2)

(b) Gases from the air are separated to provide raw materials used in many different industrial processes.

Steps in dry air separation:

Step 1: Filter to remove solid particles

Step 2: Remove carbon dioxide

Step 3: Cool the remaining air to –200 °C

Step 4: Separate by allowing the liquefied gases to warm up.

(i) Carbon dioxide is removed before the air is cooled to –200 °C.

Suggest **one** reason why.

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(1)

(ii) Which two gases do **not** condense when the remaining air is cooled to –200 °C?

.....and .....

(1)

(iii) Two gases in air do **not** separate completely when the liquefied gases are allowed to warm up.

Name these **two** gases and give a reason for your answer.

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(2)
(Total 6 marks)

Q7. The halogens are in Group 7 of the periodic table.

(a) Why, in terms of electrons, are the halogens in Group 7?

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(1)

(b) Sea water contains bromide ions (Br^-).
The bromide ions can be changed to bromine by bubbling chlorine gas into sea water.

Chlorine is able to displace bromine from sea water because chlorine is more reactive than bromine.

$2Br^-(aq) + Cl_2(g) \rightarrow Br_2(g) + 2Cl^-(aq)$

Explain, in terms of electrons, why chlorine is more reactive than bromine.

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(3)
(Total 4 marks)