

Name:

Date:

C1 - Test 3
ATOMIC STRUCTURE AND THE
PERIODIC TABLE
Intermediate

GCSE

CHEMISTRY

AQA - Combined 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.

This question is about the periodic table.

In 1864 John Newlands suggested an arrangement of elements.

Figure 1 shows the arrangement Newlands suggested.

Figure 1

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

(a) Give **two** differences between the groupings in **Figure 1** compared with the modern periodic table.

1. _____

2. _____

(2)

In 1869 Mendeleev produced his periodic table.

(b) Why was Mendeleev's table called a periodic table?

(1)

(c) When Mendeleev was developing his periodic table he changed the order of some of the elements.

Explain why.

(2)

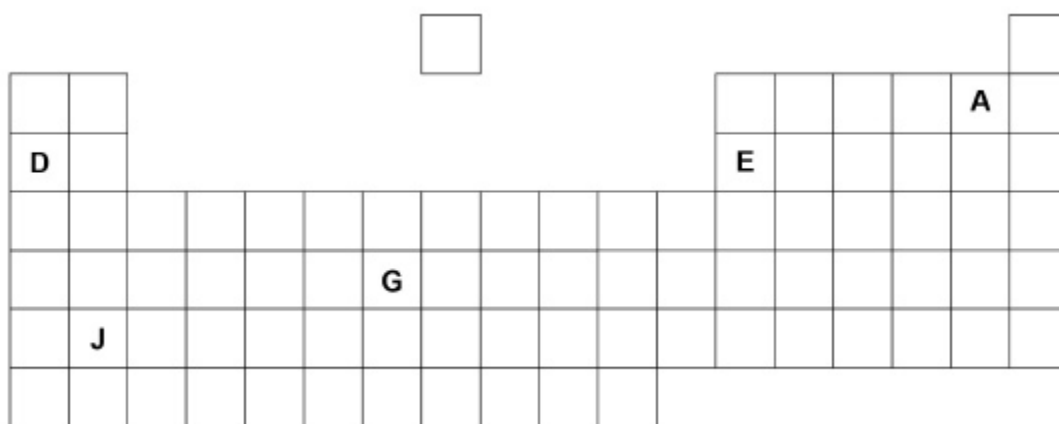
(d) Explain why the elements are ordered differently in the modern periodic table.

You should refer to isotopes.

(2)

(e) **Figure 2** shows part of the modern periodic table.

Figure 2



Draw **one** line from each statement about an element to the letter representing that element.

Statement	Letter representing element
An alkali metal	A
An element consisting of molecules	D
An element that has atoms with the electronic structure 2.8.3	E
	G
	J

(3)

(Total 10 marks)

- (iii) Explain why the reactivity of the elements increases going down Group 1 from lithium to rubidium but decreases going down Group 7 from fluorine to iodine.

(4)

(Total 8 marks)

3.

(a) The symbols for seven different elements are shown in **Figure 1**.

Figure 1

																He	
	Be																
Na													S			Ar	
	Ca						Fe										

Choose the correct symbol from **Figure 1** to answer each question.

You may use each symbol once, more than once or not at all.

Write the symbol that represents:

(i) a Group 1 element

(1)

(ii) a transition metal

(1)

(iii) an element with electrons in the same number of energy levels as an atom of argon (Ar)

(1)

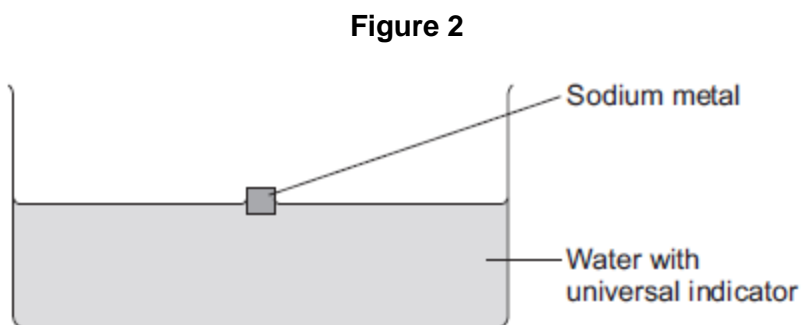
(iv) an element which forms an oxide that dissolves in water to form an acidic solution

(1)

(v) an element that forms a chloride with the formula XCl

(1)

- (b) A teacher put a cube of sodium metal into water containing universal indicator, as shown in **Figure 2**.



The equation for the reaction is:



- (i) The sodium floated on the surface of the water. The universal indicator turned purple.

Give **three other** observations that would be seen during the reaction.

1. _____

2. _____

3. _____

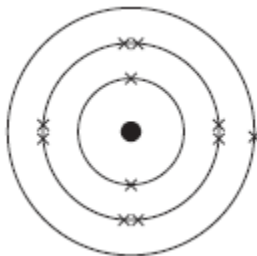
(3)

- (ii) Name the ion that made the universal indicator turn purple.

(1)

(c) **Figure 3** represents the electronic structure of a sodium atom.

Figure 3



In the space below, draw the electronic structure of a sodium ion. Include the charge on the ion.

(2)

(Total 11 marks)

4.

In 1869, Dmitri Mendeleev produced his periodic table of the elements.

Mendeleev placed the alkali metals in the same group.

(a) What evidence did Mendeleev use to decide that the alkali metals should be in the same group?

(1)

(b) Describe how the elements in the modern periodic table are arranged:

(i) in terms of protons

(1)

(ii) in terms of electrons.

(1)

(c) State **two** properties of transition elements that make them more useful than alkali metals for making water pipes.

(2)

(d) Describe and explain the trend in reactivity of the alkali metals (Group 1).

(4)

(Total 9 marks)

5.

A student was investigating the reaction of lithium and water.

She added a few drops of universal indicator to water in a trough and added a piece of lithium.



The word equation for the reaction is:



(a) (i) The lithium floated on the water.

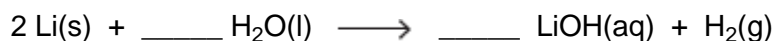
State **two** other observations that the student would **see** during the reaction.

1. _____

2. _____

(2)

(ii) Balance the symbol equation for the reaction of lithium and water.



(2)

(iii) Describe a simple test and the result that would show the gas was hydrogen.

(1)

(iv) All Group 1 metals have similar reactions with water.

State why, in terms of electronic structure.

(1)

(b) Lithium and other Group 1 metals have different properties from the transition metals.

Tick (✓) **two** properties that are properties of Group 1 metals.

They react with oxygen.

They form coloured compounds.

They are strong and hard.

They have low melting points.

(2)

(c) The electronic structure of a potassium atom is 2, 8, 8, 1

(i) Draw a diagram to show the electronic structure of a potassium ion.

Show the charge on the potassium ion.

(2)

(ii) Potassium is more reactive than sodium.

Explain why, in terms of electronic structure.

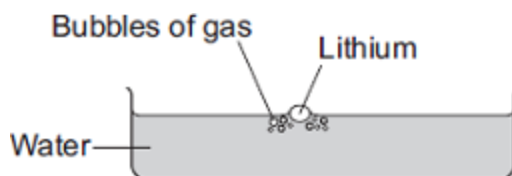
(3)

(Total 13 marks)

6.

Lithium is in Group 1 of the periodic table.

Lithium reacts with water to produce a gas and an alkaline solution.



(a) (i) Name the gas produced.

(1)

(ii) Which ion causes the solution to be alkaline?

(1)

- (b) Potassium is also in Group 1 of the periodic table.
Potassium reacts with water in a similar way to lithium.

Write down **two** differences you would see between the reactions of potassium and lithium with water.

1. _____

2. _____

(2)
(Total 4 marks)

7.

John Newlands was a chemist who worked in a sugar factory.

In 1866 he designed a periodic table.

He arranged the elements in order of their relative atomic masses.

He found a repeating pattern for some of the elements.

Newlands wrote, 'the eighth element starting from a given one, is a kind of repetition of the first, like the eighth note in an octave of music'.

H	Li	G	Bo	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co, Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce, La	Zr	Di, Mo	Ro, Ru
Pd	Ag	Cd	U	Sn	Sb	Te
I	Cs	Ba, V	Ta	W	Nb	Au
Pt, Ir	Tl	Pb	Th	Hg	Bi	Os

Newlands' periodic table

- (a) In Newlands' periodic table, the elements lithium, sodium and potassium are grouped together.

Give **two** properties of these elements which support the idea that they should be grouped together.

1. _____

2. _____

(2)

(b) Newlands' periodic table was not accepted by most chemists in 1866.

Suggest reasons why.

Use the Newlands' periodic table above to help you to answer this question.

(3)

(c) State **and** explain **one** way in which Mendeleev improved Newlands' periodic table.

(2)

(Total 7 marks)

8.

Mendeleev constructed a periodic table in 1869.

In his periodic table:

- most of the elements were put in order of increasing relative atomic mass;
- elements with similar properties were put into groups;
- Mendeleev changed the order of some elements to put them with similar elements;
- spaces were left for elements that Mendeleev thought would be discovered in the future.

One space was in Group 3 between the elements aluminium and indium.

Group 3
Boron
Aluminium
?
Indium
Thallium

Mendeleev called this undiscovered element 'eka-aluminium'. This element is now known as gallium. In 1871, he also predicted some of the properties of gallium.

The table shows the properties of aluminium and indium, along with some of the predictions made by Mendeleev for gallium.

	Appearance	Metal or non-metal	Boiling point in °C	Density in g per cm³	Relative atomic mass
Aluminium	silvery white	metal	2467	2.7	27
Predicted properties of gallium	silvery white	metal	?	?	68
Indium	silvery white	metal	2080	7.31	115

- (i) Suggest **two** reasons why other scientists in 1871 did not accept Mendeleev's periodic table.

Reason 1 _____

Reason 2 _____

(2)

- (ii) Suggest why the discovery of gallium in 1875 convinced other scientists that Mendeleev's table was correct.

(1)
(Total 3 marks)