

Name:

Date:

C1 - Test 6  
ATOMIC STRUCTURE  
Advanced

**GCSE**

CHEMISTRY

AQA - Triple Science

Mark

Grade

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### 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 electronic structures of five elements, V, W, X, Y and Z are shown below.

V	W	X	Y	Z
2.1	2.6	2.8.4	2.5	2.8.6

(a) (i) Write the letters of the **two** elements which belong to the same group in the Periodic Table \_\_\_\_\_

(ii) To which group do they belong? \_\_\_\_\_

(2)

(b) Write the letters of **two** elements that are gases \_\_\_\_\_

(1)

(c) Lithium, sodium and potassium are the first three elements in Group 1 of the Periodic Table.

(i) Lithium reacts with cold water to produce lithium hydroxide and hydrogen.

Describe how the reaction between sodium and water is

**(A)** similar and **(B)** different to that between lithium and water.

(A) Similar \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(B) Different \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(3)

(ii) Potassium is much more reactive than lithium.

Explain this in terms of their electronic structures.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(3)

(Total 9 marks)

2.

The table shows how Group 7 elements react with hydrogen.

Element	Reaction with hydrogen	
	Description	Product
Fluorine	Explosive reaction in dim light	Hydrogen fluoride
Chlorine	Explosive reaction in sunlight	Hydrogen chloride
Bromine	Reacts if heated	Hydrogen bromide
Iodine	Reacts if heated strongly	Hydrogen iodine

Explain the difference in the rates of the reaction of fluorine with hydrogen and of iodine with hydrogen.

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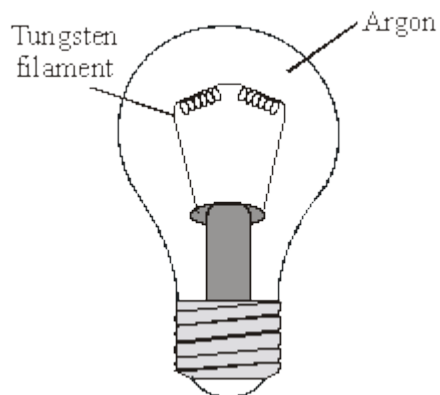
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(Total 2 marks)

3.

The diagram shows an electric light bulb.



When electricity is passed through the tungsten filament it gets very hot and gives out light.

(a) What reaction would take place if the hot tungsten was surrounded by air?

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(1)

(b) State why argon is used in the light bulb. Explain your answer in terms of the electronic structure of an argon atom.

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(3)

(Total 4 marks)

4.

This question is about atoms.

(a) What does the number 19 represent in  ${}_{9}^{19}\text{F}$  ?

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(1)

(b) How many atoms are present in one mole of fluorine atoms?

Tick (✓) **one** box.

$2.03 \times 10^{26}$

$2.06 \times 10^{23}$

$6.02 \times 10^{23}$

$6.02 \times 10^{26}$

(1)

- (c) The plum pudding model of the atom was replaced by the nuclear model.  
The nuclear model was developed after the alpha particle scattering experiment.  
Compare the plum pudding model with the nuclear model of the atom.

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(4)

- (d) An element has three isotopes.  
The table shows the mass numbers and percentage of each isotope.

	Isotope 1	Isotope 2	Isotope 3
Mass number	24	25	26
Percentage (%)	78.6	10.1	11.3

Calculate the relative atomic mass ( $A_r$ ) of the element.

Give your answer to 3 significant figures.

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Relative atomic mass = \_\_\_\_\_

(2)

(Total 8 marks)

**5.**

(a) The table shows how Group 7 elements react with hydrogen.

Element	Reaction with hydrogen	
	Description	Product
Fluorine	Explosive reaction in dim light	Hydrogen fluoride
Chlorine	Explosive reaction in sunlight	Hydrogen chloride
Bromine	Reacts if heated	Hydrogen bromide
Iodine	Reacts if heated strongly	Hydrogen iodine

(i) Explain why all the Group 7 elements react in a similar way with hydrogen.

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(2)

(ii) Explain the difference in the rates of the reaction of fluorine with hydrogen, and of iodine with hydrogen.

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(2)

(b) Explain why Group 0 elements are monatomic.

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(2)

(Total 6 marks)

**6.** The halogens are in Group 7 of the periodic table.

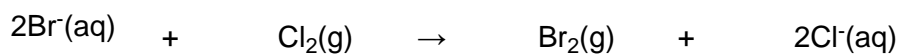
(a) Why, in terms of electrons, are the halogens in Group 7?

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(1)

(b) Sea water contains bromide ions ( $\text{Br}^-$ ).  
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.



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

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(3)

(Total 4 marks)

**7.**

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



John Newlands was one of the first chemists to arrange the known elements in order of increasing atomic mass. In 1866, he put forward the Law of Octaves. He suggested that there was a repeating pattern of elements with similar chemical properties every eighth element, just like the eighth note of an octave of music. A version of his periodic table is shown below.

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	Os	Hg	Tl	Pb	Bi	Th

However, other chemists did not accept Newlands' ideas. It was not until much later that his contribution to the development of the modern periodic table was recognised.

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

(a) What is the modern symbol for the element 'Bo'? \_\_\_\_\_

(1)



(b) Describe **one** piece of evidence to support the Law of Octaves.

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(2)

(c) Suggest **two** reasons why other chemists did not accept Newlands' ideas.

1. \_\_\_\_\_

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2. \_\_\_\_\_

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(2)

(d) The alkanes are a series of hydrocarbons with similar chemical properties. They have the general formula  $C_nH_{2n+2}$ .

Suggest why the alkanes do not appear in the periodic table.

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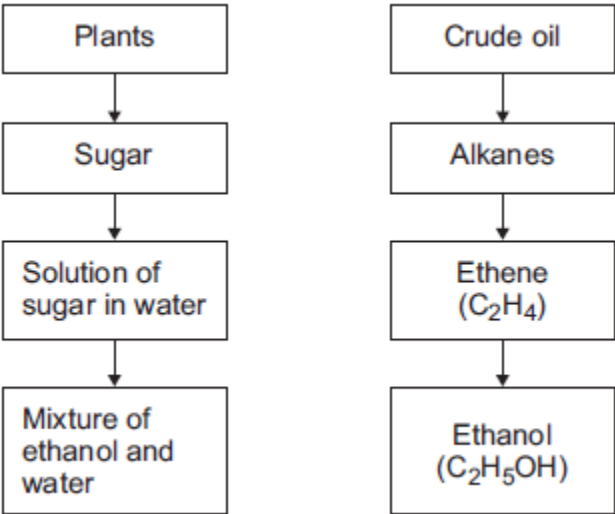
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(1)

(Total 6 marks)

8.

Ethanol can be made from plants and from crude oil as shown in the diagram below.



(a) Describe how the solution of sugar in water is used to produce the mixture of ethanol and water.

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(2)

(b) Ethanol has a boiling point of 78 °C.  
Water has a boiling point of 100 °C.

Describe how distillation is used to separate a mixture of ethanol and water.

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(3)

(Total 5 marks)

9.

The table shown below was devised by John Newlands in 1864. He arranged the elements in order of their relative atomic masses. He found a repeating pattern, with elements having similar properties in the vertical columns (Groups). He called this pattern the 'Law of Octaves', because elements with similar properties seemed to be repeated every eighth element.

H	Li	Be	B	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

- (a) Many scientists were critical of Newlands' Law of Octaves. Suggest why other scientists were critical of the Law of Octaves. You should give examples from the table and use your knowledge of the chemistry of the elements.

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(3)

- (b) The diagram below shows a version of Mendeleev's Periodic Table of 1871. Mendeleev placed most of the elements in order of relative atomic mass.

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 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
Period 5	Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	? I	Ru Rh Pd

This table became accepted by other scientists.

Give **two** ways in which Mendeleev's table improved on Newlands' table.

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

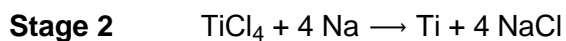
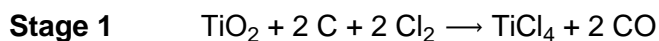
(2)

(Total 5 marks)

10.

Titanium is a transition metal.

Titanium is extracted from titanium dioxide in a two-stage industrial process.



(a) Suggest **one** hazard associated with **Stage 1**.

\_\_\_\_\_

\_\_\_\_\_

(1)

(b) Water must be kept away from the reaction in **Stage 2**.

Give **one** reason why it would be hazardous if water came into contact with sodium.

\_\_\_\_\_

\_\_\_\_\_

(1)

(c) Suggest why the reaction in **Stage 2** is carried out in an atmosphere of argon and **not** in air.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2)