Name:

Date:

C1 - Test 5
ATOMIC STRUCTURE AND THE PERIODIC TABLE
Advanced

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

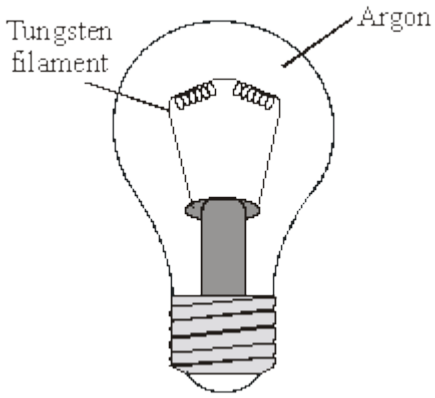
Instructions

- 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. 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?

_____

_____

_____

(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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_____

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_____

(3)

(Total 4 marks)

2. Fluorine is more reactive than chlorine. Fluorine reacts with most elements in the Periodic Table. However, fluorine does not react with argon.

Atomic numbers: F 9; Cl 17; Ar 18.

(a) To which group of the Periodic Table do fluorine and chlorine belong?

_____

(1)

(b) (i) Give **one** use for argon.

_____

(1)

(ii) Explain why the noble gas argon is unreactive.

_____

_____

_____

_____

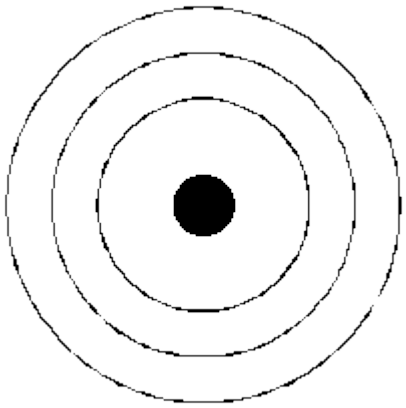
(2)

(c) (i) Give **one** use for chlorine.

_____

(1)

(ii) Draw the electron arrangement of a chlorine atom.



(2)

(iii) Explain why fluorine is more reactive than chlorine.

(3)

(Total 10 marks)

3. 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.

(1)

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

You should answer in terms of atomic structure.

(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 _____

_____

_____

_____

(2)

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

_____

(3)

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

Include information about atomic structure.

_____

_____

_____

_____

_____

(2)

(Total 10 marks)

4. 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.

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

(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?

_____

_____

(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.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 8 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.

_____

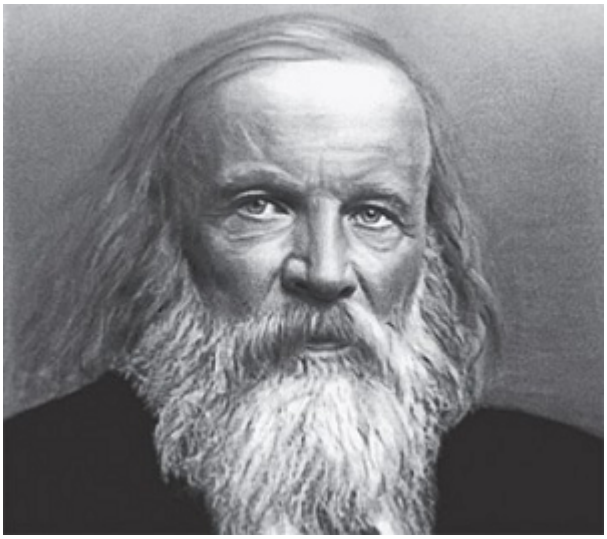
_____

_____

(1)

(Total 8 marks)

6. (a) Dimitri 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.



By unknown / неизвестен (here / здесь) [Public domain], via Wikimedia Commons

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 this discovery allowed 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.

Explain why in terms of electronic structure.

(1)

(Total 8 marks)

7. 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)

8. The following article appeared recently in the *Manchester Gazette*.

> **Sodium Drum Blaze Scare**
>
> A 20 litre drum containing sodium burst into flames when it reacted violently with rainwater at a Manchester factory. It is believed that the sodium, which is normally stored under oil, had been accidentally left outside with the lid off.
>
> A factory worker put out the blaze before the fire services arrived, and a leading fire fighter said, "It was fortunate that potassium wasn't involved as it would have reacted more violently and exploded. These Group 1 *alkali metals* can be very dangerous".

(a) Group 1 metals are stored under oil.

Suggest why.

_____

(1)

(b) Balance the equation which represents the reaction between sodium and water.

$$Na + H_2O \rightarrow NaOH + H_2$$

(1)

(c) Explain why the Group 1 metals are called the *alkali metals*.

_____

_____

(1)

(d) Explain, in terms of electrons, why potassium reacts more violently than sodium.

_____

_____

_____

_____

_____

_____

(3)

(Total 6 marks)