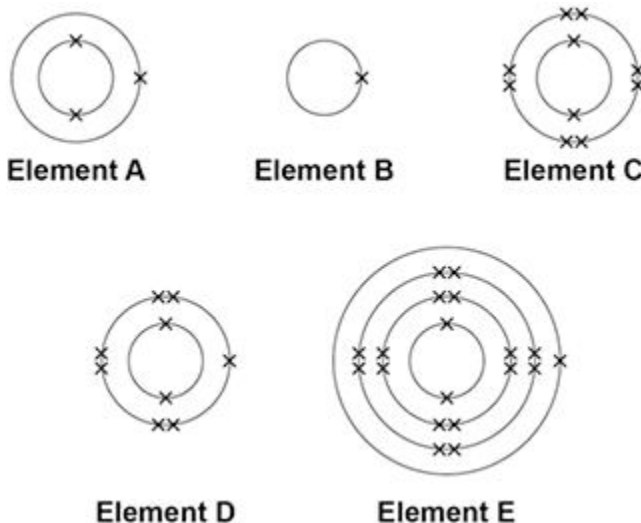


1

The electronic structure of the atoms of five elements are shown in the figure below.

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



Choose the element to answer the question. Each element can be used once, more than once or not at all.

Use the periodic table to help you.

(a) Which element is hydrogen?

Tick **one** box.

A

 B

 C

 D

 E

(1)

(b) Which element is a halogen?

Tick **one** box.

A

 B

 C

 D

 E

(1)

(c) Which element is a metal in the same group of the periodic table as element **A**?

Tick **one** box.

A

 B

 C

 D

 E

(1)

(d) Which element exists as single atoms?

Tick **one** box.

A B C D E

(1)

(e) There are two isotopes of element **A**. Information about the two isotopes is shown in the table below.

Mass number of the isotope	6	7
Percentage abundance	92.5	7.5

Use the information in the table above to calculate the relative atomic mass of element **A**.

Give your answer to 2 decimal places.

.....

.....

.....

.....

.....

.....

.....

Relative atomic mass =

(4)

(Total 8 marks)

2

An atom of aluminium has the symbol ${}_{13}^{27}\text{Al}$

(a) Give the number of protons, neutrons and electrons in this atom of aluminium.

Number of protons

Number of neutrons

Number of electrons

(3)

(b) Why is aluminium positioned in Group 3 of the periodic table?

.....

.....

(1)

(c) In the periodic table, the transition elements and Group 1 elements are metals.

Some of the properties of two transition elements and two Group 1 elements are shown in the table below.

	Transition elements		Group 1 elements	
	Chromium	Iron	Sodium	Caesium
Melting point in °C	1857	1535	98	29
Formula of oxides	CrO Cr ₂ O ₃ CrO ₂ CrO ₃	FeO Fe ₂ O ₃ Fe ₃ O ₄	Na ₂ O	Cs ₂ O

Use your own knowledge **and** the data in the table above to compare the chemical and physical properties of transition elements and Group 1 elements.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6)
(Total 10 marks)

3

This question is about halogens and their compounds.

The table below shows the boiling points and properties of some of the elements in Group 7 of the periodic table.

Element	Boiling point in °C	Colour in aqueous solution
Fluorine	-188	colourless
Chlorine	-35	pale green
Bromine	X	orange
Iodine	184	brown

(a) Why does iodine have a higher boiling point than chlorine?

Tick **one** box.

Iodine is ionic and chlorine is covalent

Iodine is less reactive than chlorine

The covalent bonds between iodine atoms are stronger

The forces between iodine molecules are stronger

(1)

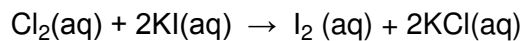
(b) Predict the boiling point of bromine.

.....

(1)

- (c) A redox reaction takes place when aqueous chlorine is added to potassium iodide solution.

The equation for this reaction is:



Look at table above.

What is the colour of the final solution in this reaction?

Tick **one** box.

Brown

Orange

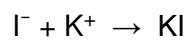
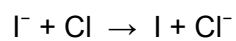
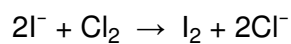
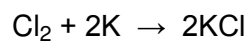
Pale green

Colourless

(1)

- (d) What is the ionic equation for the reaction of chlorine with potassium iodide?

Tick **one** box.



(1)

Use the correct letter, **V**, **W**, **X**, **Y** or **Z**, to answer each question.

(a) Which element is a transition metal?

(1)

(b) Which element is in Group 2?

(1)

(c) Which element is a noble gas?

(1)

(d) Which element has an atomic (proton) number of 4?

(1)

(e) Which element forms only 1+ ions?

(1)

(Total 5 marks)

5

This question is about atoms.

Atoms contain electrons, neutrons and protons.

(a) (i) Which of these particles has a positive charge?

Tick (✓) **one** box.

Electron

Neutron

Proton

(1)

(ii) Which of these particles does **not** have an electrical charge?

Tick (✓) **one** box.

Electron

Neutron

Proton

(1)

(b) How are the elements in the periodic table arranged?

Tick (✓) **one** box.

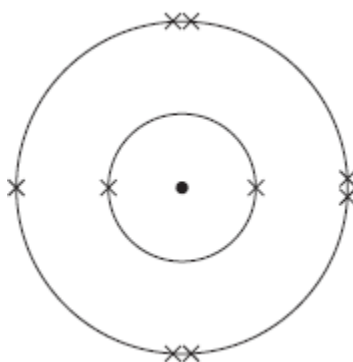
In order of increasing atomic number

In order of increasing mass number

In order of increasing reactivity

(1)

- (c) The diagram shows the arrangement of the electrons in an atom of fluorine.



- (i) How many protons are in an atom of fluorine?

Tick (✓) **one** box.

2

7

9

(1)

- (ii) The boiling point of fluorine is $-188\text{ }^{\circ}\text{C}$.

What is the state of fluorine at room temperature?

Tick (✓) **one** box.

Solid

Liquid

Gas

(1)

(d) Fluorine reacts with copper to form an ionic compound.

- (i) Explain, in terms of electrons and electronic structure, what happens to a fluorine atom when it reacts with copper.

Use Above **Figure** to help you to answer this question.

.....

.....

.....

.....

.....

(2)

- (ii) Describe a chemical test which would show that a solution contains copper(II) ions.

.....

.....

.....

.....

.....

(2)

(Total 9 marks)

6

This question is about metals.

- (a) Which unreactive metal is found in the Earth as the metal itself?

Tick (✓) **one** box.

aluminium

gold

magnesium

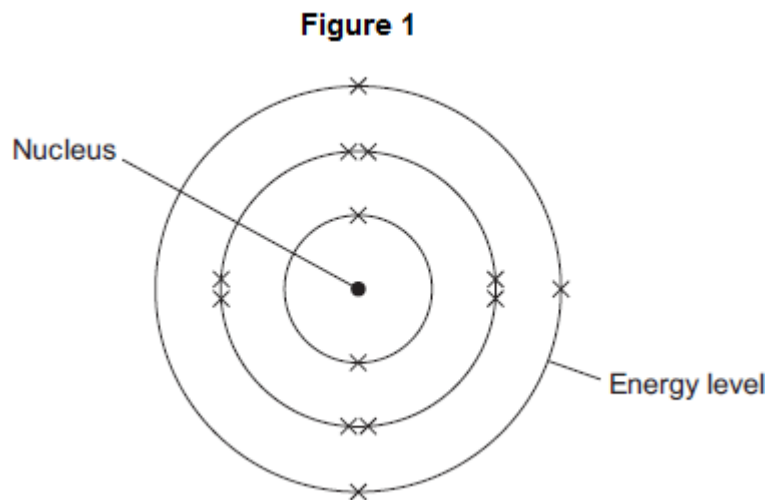
(1)

- (b) Complete the sentence.

Aluminium is an element because aluminium is made of
only one type of

(1)

- (c) **Figure 1** shows the electronic structure of an aluminium atom.



- (i) Use the correct words from the box to complete the sentence.

electrons	ions	protons	neutrons	shells
------------------	-------------	----------------	-----------------	---------------

The nucleus of an aluminium atom contains and
.....

(2)

- (ii) Complete the sentence.

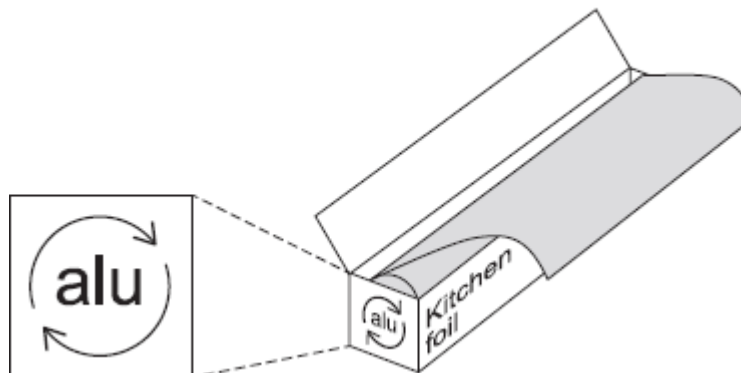
In the periodic table, aluminium is in Group

(1)

(d) Aluminium is used for kitchen foil.

Figure 2 shows a symbol on a box of kitchen foil.

Figure 2



The symbol means that aluminium can be recycled. It does not show the correct chemical symbol for aluminium.

(i) What is the correct chemical symbol for aluminium?

.....

(1)

(ii) Give **two** reasons why aluminium should be recycled.

.....
.....
.....
.....

(2)

(e) Aluminium has a low density, conducts electricity and is resistant to corrosion.

Which **one** of these properties makes aluminium suitable to use as kitchen foil?

Give a reason for your answer.

.....
.....
.....
.....

(2)
(Total 10 marks)

7

This question is about atomic structure and elements.

(a) Complete the sentences.

(i) The atomic number of an atom is the number of (1)

(ii) The mass number of an atom is the number of
..... (1)

(b) Explain why an atom has no overall charge.

Use the relative electrical charges of sub-atomic particles in your explanation.

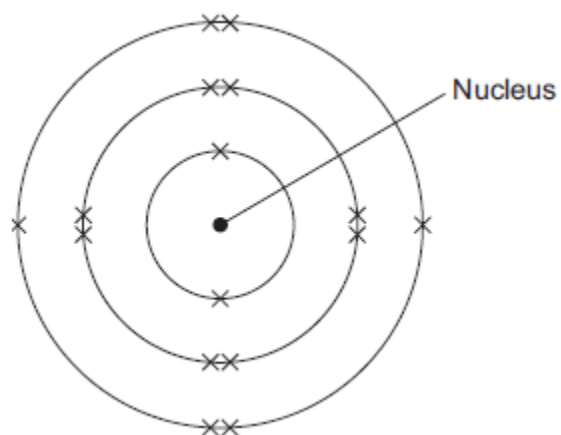
.....
.....
.....
..... (2)

(c) Explain why fluorine and chlorine are in the same group of the periodic table.

Give the electronic structures of fluorine and chlorine in your explanation.

.....
.....
.....
..... (2)

- (d) The diagram shows the electronic structure of an atom of a non-metal.



What is the chemical symbol of this non-metal?

Tick (✓) **one** box.

Ar

O

S

Si

(1)

- (e) When elements react, their atoms join with other atoms to form compounds.

Complete the sentences.

- (i) Compounds formed when non-metals react with metals consist of particles called

(1)

- (ii) Compounds formed from only non-metals consist of particles called

(1)

(Total 9 marks)

8

The diagram shows the chemical symbols of five elements in the periodic table.

Group 1		2							3	4	5	6	7	0
														He
									C					
Na													Cl	
								Cu						

(a) Choose the correct chemical symbol to complete each sentence.

(i) The element that is an alkali metal is

(1)

(ii) The element that is a transition metal is

(1)

(iii) The element in Group 4 is

(1)

(iv) The element with a full outer energy level (shell) of electrons is

.....

(1)

(b) Which other element goes in the shaded box?

.....

(1)

(Total 5 marks)

9

In 1866 John Newlands produced an early version of the periodic table.

Part of Newlands' periodic table is shown below.

Column	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

Newlands' periodic table arranged all the known elements into columns in order of their atomic weight.

Newlands was trying to show a pattern by putting the elements into columns.

- (a) Iron (Fe) does **not** fit the pattern in column 7.

Give a reason why.

.....

(1)

- (b) In 1869 Dmitri Mendeleev produced his version of the periodic table.

Why did Mendeleev leave gaps for undiscovered elements in his periodic table?

.....

(1)

- (c) Newlands and Mendeleev placed the elements in order of atomic weight.

Complete the sentence.

The modern periodic table places the elements in order of

.....

(1)

- (d) Lithium, sodium and potassium are all in Group 1 of the modern periodic table.

Explain why.

.....

.....

.....

.....

(2)
(Total 5 marks)

10

This question is about the halogens (Group 7).

- (a) How do the boiling points of the halogens change down the group from fluorine to iodine?

.....

.....

(1)

- (b) Sodium bromide is produced by reacting sodium with bromine.

Sodium bromide is an ionic compound.

- (i) Write down the symbols of the **two** ions in sodium bromide.

.....

(1)

- (ii) Chlorine reacts with sodium bromide solution to produce bromine and one other product.

Complete the word equation for the reaction.

chlorine + sodium bromide \longrightarrow bromine +

(1)

- (iii) Why does chlorine displace bromine from sodium bromide?

.....

.....

(1)

- (iv) Use the Chemistry Data Sheet to help you to answer this question.

Suggest which halogen could react with sodium chloride solution to produce chlorine.

.....

(1)
(Total 5 marks)

11

The positions of eight elements in the modern periodic table are shown below.

Group 1		2								3		4	5	6	7	0
Li													N			
											Al					
K							Fe			Cu			As		Br	

Choose the correct chemical symbols to complete each sentence.

(a) The **two** metals that react vigorously with water are and

.....

(1)

(b) The element used as a catalyst in the Haber process is

(1)

(c) The **two** elements with five electrons in their outer shell (highest energy level) are and

(1)

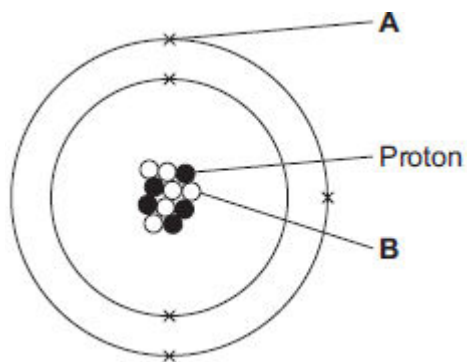
(d) Iron has ions with different charges.

The other metal that has ions with different charges is

(1)

(Total 4 marks)

12

(a) **Figure 1** shows an atom of element **G**.**Figure 1**

Draw a ring around the correct answer to complete each sentence.

(i) Label **A** shows**an electron****an ion****a nucleus**

(1)

(ii) The particle labelled **B** is**an isotope****a molecule****a neutron**

(1)

(iii) The mass number of element **G** is**5****6****11**

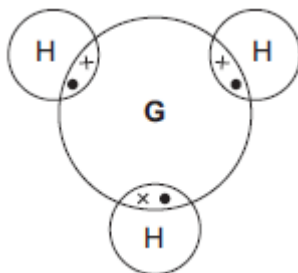
(1)

(iv) Use the periodic table to identify element **G**.Element **G** is**boron****carbon****sodium**

(1)

- (b) **Figure 2** shows a compound of **G** and hydrogen.

Figure 2



Draw a ring around the correct answer to complete each sentence.

- (i) The formula of the compound in **Figure 2** is

GH₃ **G₃H** **3HG**

(1)

- (ii) The type of bonding shown in **Figure 2** is

covalent **ionic** **metallic**

(1)

(Total 6 marks)

13

- (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

.....

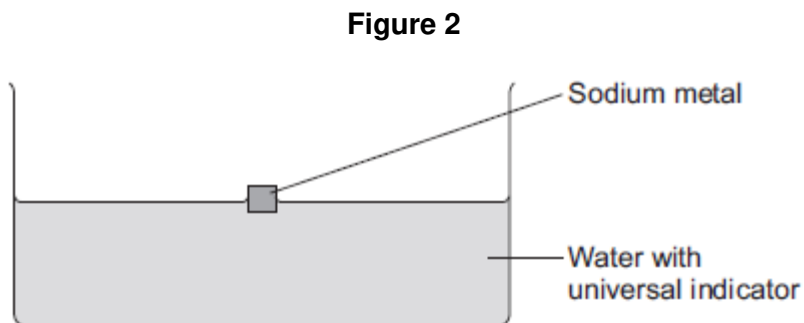
(1)

(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)

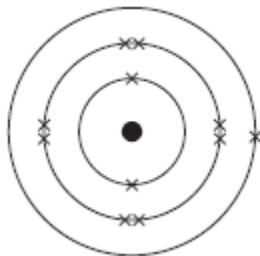
- (ii) Name the ion that made the universal indicator turn purple.

.....

(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)

14

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)

15

This question is about the periodic table of elements.

Use the Chemistry Data Sheet to help you to answer these questions.

In 1869 Dmitri Mendeleev produced an early version of the periodic table.

(a) Draw a ring around the correct answer to complete each sentence.

(i) Mendeleev first arranged the elements in order of their

atomic weight.
date of discovery.
electron number.

(1)

(ii) Mendeleev then placed elements with similar properties in columns called

groups.
periods.
shells.

(1)

(iii) When the next element did not fit the pattern,

Mendeleev

ignored the element.
left a gap.
put the element at the end of the row.

(1)

(iv) Mendeleev was not able to include the noble gases (Group 0) in his periodic table

because the noble gases

are not elements.
are not reactive.
had not been discovered by 1869.

(1)

(b) Use the correct word from the box to complete each sentence.

electrons	molecules	neutrons	protons
------------------	------------------	-----------------	----------------

In the modern periodic table elements are arranged in order of the number of in their nucleus. Elements in the same group have the same number of in their highest energy level (outer shell).

(2)

(c) Sodium (Na) is in Group 1 of the periodic table.

Nickel (Ni) is a transition element.

Tick (✓) **two** correct statements about sodium and nickel.

Statement	Tick (✓)
Sodium and nickel are both metals.	
Sodium has a higher melting point than nickel.	
Sodium is more reactive than nickel.	
Sodium is harder than nickel.	

(2)

(d) Chlorine, bromine and iodine are in Group 7 of the periodic table.

Chlorine is more reactive than bromine.

(i) Complete the word equation for the reaction between chlorine and sodium bromide.

chlorine + sodium bromide \longrightarrow + sodium chloride

(1)

(ii) Why does iodine **not** react with sodium bromide solution?

.....

(1)

(Total 10 marks)

16

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)

17

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

Part of the periodic table is shown below.

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

Choose your answers **only** from the letters shown in the periodic table above.

Which letter, **A**, **B**, **C**, **D** or **E**, represents:

(a) (i) an alkali metal

Letter

(1)

(ii) a transition element

Letter

(1)

(iii) a Group 4 element ?

Letter

(1)

- (b) A chemistry teacher demonstrated the reaction between sodium and water to a class of students. One of the students wrote the following notes:

The reaction between sodium and water

A piece of sodium was cut easily into smaller pieces with a knife.

The sodium was added to some water in a trough.

The sodium:

- floated
- melted quickly to give a silvery ball
- moved on the surface of the water
- fizzed.

Use the information in the box to help you answer these questions.

What evidence is there that:

- (i) sodium has a low melting point

.....
.....

(1)

- (ii) sodium is soft

.....
.....

(1)

- (iii) a gas was produced?

.....
.....

(1)

(Total 6 marks)

18

- (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)

19

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.

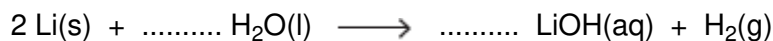
State **two** other observations that the student would **see** during the reaction.

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)

20

This question is about lithium and sodium.

(a) Use the Chemistry Data Sheet to help you to answer this question.

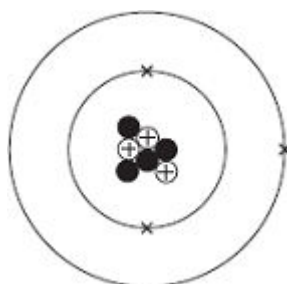
In which group of the periodic table are lithium and sodium?

Group

(1)

(b) A lithium atom can be represented as ${}^7_3\text{Li}$

The diagram represents the lithium atom.



(i) Some particles in the nucleus have a positive charge.

What is the name of these particles?

(1)

(ii) Some particles in the nucleus have no charge.

What is the name of these particles?

(1)

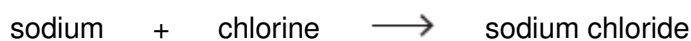
(iii) Use the correct answer from the box to complete the sentence.

3	4	7
---	---	---

The mass number of this atom of lithium is

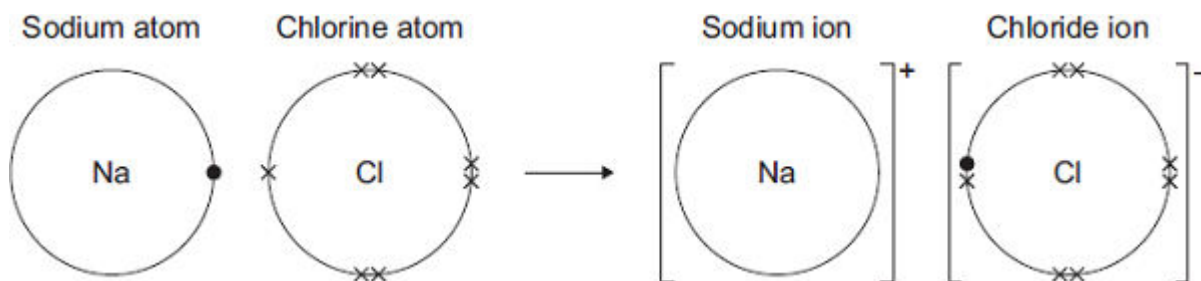
(1)

(c) Sodium reacts with chlorine to produce sodium chloride.



The diagram shows how the reaction happens.

Only the outer electrons are shown.



Draw a ring around the correct answer to complete each sentence.

(i) A sodium atom changes into a sodium ion by an electron.

(1)

(ii) A sodium ion has charge.

(1)

(iii) The ions in sodium chloride are held together by strong forces.

(1)

(d) Sodium chloride is an ionic compound.

Tick (✓) **two** properties of ionic compounds.

Property	Tick (✓)
Do not dissolve in water	
High melting points	
Low boiling points	
Strong bonds	

(2)

(e) (i) The formula of sodium chloride is NaCl

Calculate the relative formula mass of sodium chloride.

Relative atomic masses: Na = 23; Cl = 35.5

.....

Relative formula mass =

(1)

(ii) Draw a ring around the correct answer to complete each sentence.

The relative formula mass of a substance, in grams, is one

ion

isotope

mole

of the substance.

(1)

(f) Nanoparticles of sodium chloride (salt) are used to flavour crisps.

What are nanoparticles?

.....

(1)

(Total 12 marks)

21

This question is about the periodic table.

Use the Chemistry Data Sheet to help you answer these questions.

(a) Complete the sentences.

Elements in the periodic table are arranged in order of atomic

The elements in Group are called the noble gases.

(2)

(b) Calcium (Ca) is in Group 2.

Name **one** other element in Group 2.

.....

(1)

(c) Draw a ring around the correct answer to complete each sentence.

(i) Sodium (Na) is

an alkali metal.
a non-metal.
a transition metal.

(1)

(ii) Nickel (Ni) is

an alkali metal.
a non-metal.
a transition metal.

(1)

(d) In 1869 Mendeleev produced his periodic table.

Why did Mendeleev leave gaps in his periodic table?

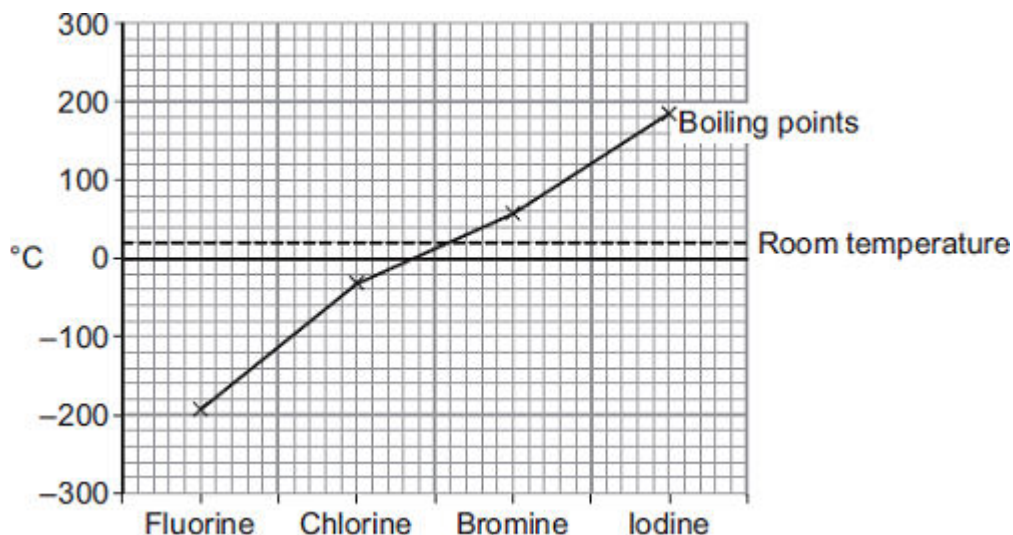
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.....

(1)**(Total 6 marks)**

22

The graph shows the boiling points of the halogens.



(a) Use the graph to help you answer these questions.

(i) Use the correct answer from the box to complete the sentence.

gas	liquid	solid
-----	--------	-------

At room temperature chlorine is a

(1)

(ii) Describe the trend in boiling point from fluorine to iodine.

.....

(1)

(b) Chlorine reacts with metals to produce metal chlorides.

(i) When a chlorine atom forms a chloride ion it gains one electron.

What is the charge on a chloride ion?

.....

(1)

(ii) Write a word equation for the reaction between sodium and chlorine.

.....

(1)

(c) In the UK water companies add chlorine to tap water.

Why is chlorine added to tap water?

.....

(1)

(d) Water companies add fluoride to tap water in some parts of the UK.

Fluoride is added to improve dental health.

Suggest **one** reason why some people are against adding fluoride to tap water.

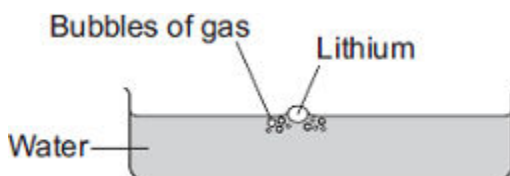
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.....
.....

(1)
(Total 6 marks)

23

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

.....

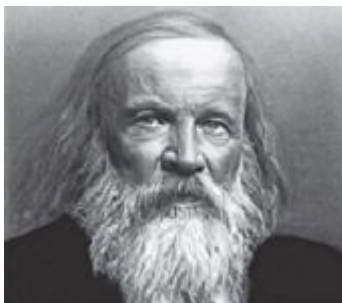
2

.....

(2)
(Total 4 marks)

24

By 1869, about 60 elements had been discovered. Mendeleev arranged these elements in a table, in order of their atomic weight. He put elements with similar chemical properties in the same column. Mendeleev and part of his table are shown below.



Column						
1	2	3	4	5	6	7
H						
Li	Be	B	C	N	O	F
Na	Mg	Al	Si	P	S	Cl

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

Use the periodic table on the Data Sheet to help you to answer these questions.

- (a) Draw a ring around the correct answer to complete the sentence.

In the periodic table the columns are known as

groups.
periods.
rows.

(1)

- (b) Suggest **one** reason why hydrogen should **not** have been put in column 1.

.....

(1)

- (c) In 1895, the first of a new family of elements was discovered. One of the new elements was called helium.

Where has this new family of elements been placed in the modern periodic table?

.....

(1)

(d) Complete the sentence.

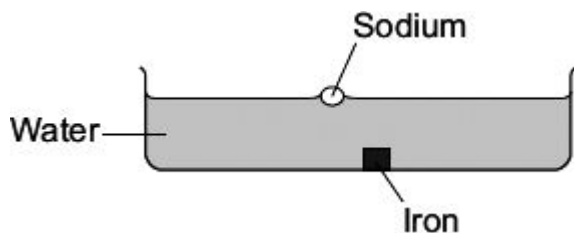
In the periodic table on your Data Sheet, the elements are arranged in order of their atomic

(1)
(Total 4 marks)

25

How a metal is used depends on its properties.

A teacher demonstrated some of the properties of sodium (an alkali metal) and iron (a transition element) by placing a small cube of each metal into water.



A student observed that:

Sodium	Iron
floated on the surface of the water	sank to the bottom of the water
melted to form a molten ball of sodium	did not melt
reacted to produce a gas	did not react
no sodium was left after 5 minutes	the cube of iron remained after 5 minutes

- (a) Tick (✓) **two** properties of sodium compared with iron that are shown by the student's observations.

Sodium compared with iron	Tick(✓)
sodium has a higher boiling point	
sodium has a lower density	
sodium is harder	
sodium is more reactive	
sodium is softer	

(2)

(b) Draw a ring around the correct answer to complete the word equation.

sodium + water → sodium hydroxide +

carbon dioxide

hydrogen

oxygen

(1)

(c) Draw a ring around the correct answer to complete the sentence.

Sodium hydroxide is an alkali because it produces

H⁺(aq)

OH⁻(aq)

Na⁺(aq)

ions

in aqueous solution.

(1)

(Total 4 marks)

26

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.

.....

.....

.....

.....

.....

.....

.....

.....

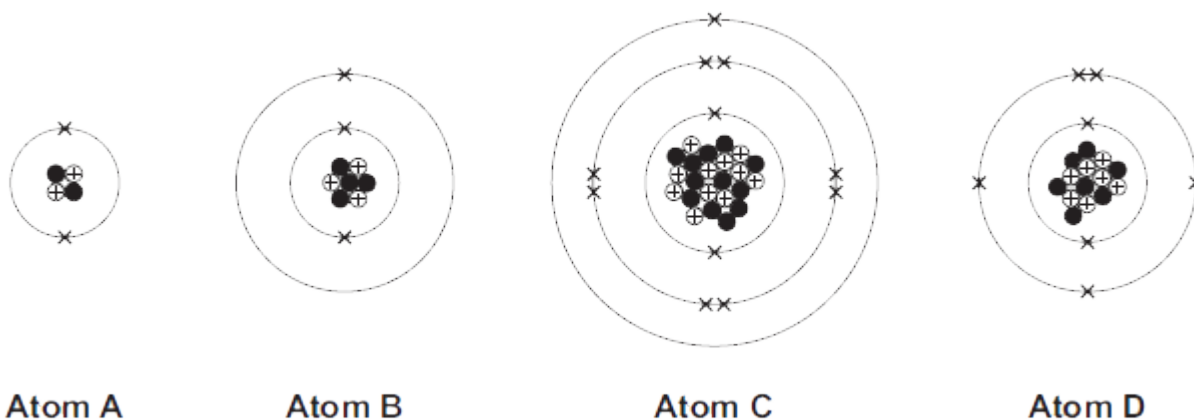
.....

(3)

(Total 10 marks)

27

The diagrams show the sub-atomic particles in four different atoms.



Use the Chemistry Data Sheet to help you to answer these questions.

(a) Draw a ring around the correct answer to complete each sentence.

(i) The centre of each atom is called the

energy level.
molecule.
nucleus.

(1)

(ii) The centre of each atom contains neutrons and

bonds.
electrons.
protons.

(1)

(b) Complete the sentence.

There is no overall electrical charge on each atom because the
number of is equal to the number of

(1)

(c) What is the name of the element represented by atom **D**?

(1)

- (d) Which **two** of the atoms, **A**, **B**, **C** and **D**, are in the same group of the periodic table?

Give a reason for your answer.

Atom and atom

Reason

.....

(2)
(Total 6 marks)

28

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.

.....

.....

.....

.....

(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 $-200\text{ }^{\circ}\text{C}$

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

- (i) Carbon dioxide is removed before the air is cooled to $-200\text{ }^{\circ}\text{C}$.

Suggest **one** reason why.

.....
.....

(1)

- (ii) Which two gases do **not** condense when the remaining air is cooled to $-200\text{ }^{\circ}\text{C}$?

.....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.

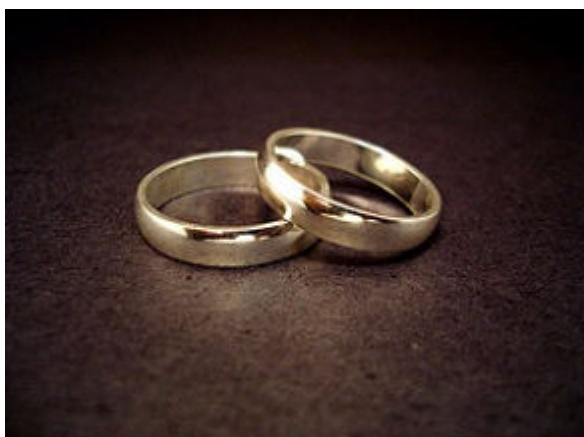
.....
.....
.....
.....

(2)

(Total 6 marks)

29

Platinum and gold can both be used to make wedding rings.



By Jeff Belmonte from Cuiabá, Brazil (Flickr) [CC-BY-2.0], via Wikimedia Commons

Use the Data Sheet to help you to answer these questions.

- (a) Draw a ring around the part of the periodic table in the list below to which platinum and gold belong.

group 1

group 2

transition elements

group 7

(1)

- (b) Platinum and gold have properties that make them suitable for wedding rings.

Tick (✓) **two** of these properties.

Property	Tick (✓)
These metals do not react with air.	
These metals have low melting points.	
These metals do not react with water.	
These metals have low densities.	

(2)
(Total 3 marks)

30

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)

31

The halogens are in Group 7 of the periodic table.

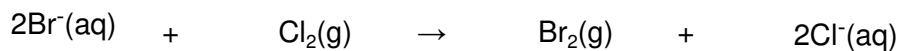
(a) Why, in terms of electrons, are the halogens in Group 7?

.....

.....

(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.



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

.....

.....

.....

.....

.....

.....

.....

.....

(3)
(Total 4 marks)

- (b) The table shows the boiling points of the Group 7 elements.

The elements are arranged **in alphabetical order**.

Group 7 element		
Name	Symbol	Boiling point in °C
Astatine	At	337
Bromine		58
Chlorine	Cl	-34
Fluorine	F	-188
Iodine	I	184

- (i) The symbol for bromine is missing from the table.

What is the symbol for bromine? Symbol =

(1)

- (ii) Arrange these elements in order of **decreasing** boiling point. The first one and the last one have been done for you.

At F

Highest boiling point \longrightarrow Lowest boiling point

(1)

(c) The table shows some statements about Group 7 elements.

Tick (✓) the **two** correct statements.

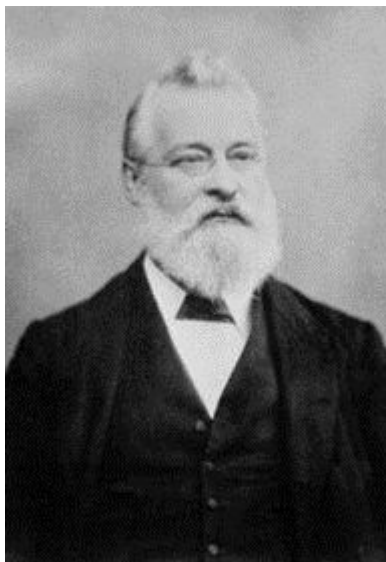
	Tick (✓)
They are halogens.	
They are metals.	
They become less reactive down Group 7.	
They are compounds.	

(2)
(Total 9 marks)

33

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

- (a) Many chemists have contributed to the development of the periodic table.



John Newlands was one of the first chemists who attempted to classify elements in a systematic way based on atomic weight. In 1866 he suggested that there was a repeating pattern of elements with similar properties every eighth element. Part of Newlands' periodic table is shown below.

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

Many chemists in 1866 did not accept Newland's; periodic table.

By Conget at nl.wikipedia [Public domain], from Wikimedia Commons

- (i) Give **one** piece of evidence which supports Newlands' ideas.

.....

.....

(1)

- (ii) Suggest **two** reasons why many chemists in 1866 did not accept Newlands' ideas.

1

.....

.....

2

.....

.....

(2)

- (b) Chlorine, bromine and iodine are Group 7 elements.

A student investigated the reactivity of these elements.

The student added:

- aqueous chlorine to potassium bromide and potassium iodide solutions
- aqueous bromine to potassium chloride and potassium iodide solutions
- aqueous iodine to potassium chloride and potassium bromide solutions.

The student's results are shown below.

Solution	Potassium chloride	Potassium bromide	Potassium iodide
Chlorine		Solution turned orange-brown	Solution turned brown
Bromine	No reaction		Solution turned brown
Iodine	No reaction	No reaction	

- (i) Use these results to state **and** explain the trend in reactivity of these Group 7 elements.

.....

.....

.....

.....

(2)

- (ii) Complete the equation below, which represents the reaction between chlorine and potassium bromide.



(1)

- (iii) In terms of electronic structure, state why chlorine, bromine and iodine are in Group 7.

.....

.....

(1)

- (c) Lithium, sodium and potassium are Group 1 elements.

Group 1 elements become **more** reactive down the group.

Explain why in terms of electronic structure.

.....

.....

.....

.....

.....

.....

(3)

(Total 10 marks)

34

Use the periodic table on the Data Sheet to help you to answer these questions.

- (a) The following is a list of symbols of some elements.

Sb	Se	Si	Sn	Sr
-----------	-----------	-----------	-----------	-----------

Choose your answers **only** from the symbols shown in the box above.

Which symbol represents

- (i) a Group 5 element

(1)

(ii) the element in the same group as oxygen (O)

(1)

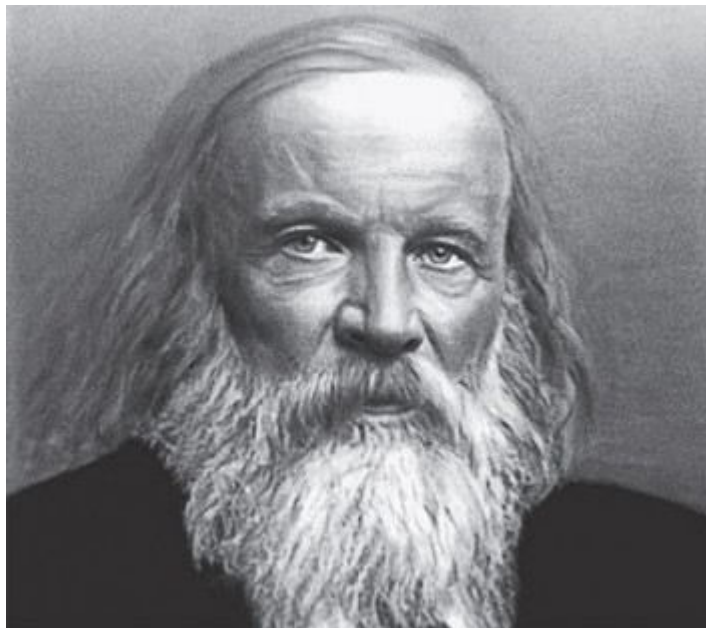
(iii) the element with atomic (proton) number of 50

(1)

(iv) silicon?

(1)

(b)



Mendeleev suggested his version of the periodic table in 1869.

Part of Mendeleev's table is shown below.

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
K	Ca	#	Ti	V	Cr	Mn
Cu	Zn	#	#	As	Se	Br

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

There are differences between Mendeleev's table and the periodic table on the Data Sheet.

Draw a ring around the correct answer to complete the sentences.

(i) Mendeleev left gaps (shown by #) in his table.

Mendeleev left gaps for

compounds
elements
mixtures

 that had not been discovered.

(1)

(ii) Mendeleev put copper (Cu) in the same box as

bromine (Br).
chromium (Cr).
potassium (K).

(1)

(iii) Mendeleev did **not** have a Group

0.
3.
5.

(1)

(Total 7 marks)

Read the information about protecting the bottoms of ships.

A Copper-bottomed Investment



From the 16th to the 19th century, the bottoms of many wooden ships were protected from marine organisms by being covered with sheets of metal.

At first lead was used on the bottoms of ships, then copper was used until 1832 when Muntz Metal replaced it. Muntz Metal is an alloy of two transition metals, copper and zinc.

Table of data

	Lead	Copper	Muntz Metal
Cost (£/kg)	£1.20	£3.20	£2.30
Melting point (°C)	327	1083	904
Stops sea worms attacking wood	Yes	Yes	Yes
Stops barnacles and seaweed sticking to the bottom of the ship	No	Yes	Yes

- (a) Use the information to answer the following questions.
- (i) Suggest why copper replaced lead.

.....
.....

(1)

(ii) Suggest why Muntz Metal replaced copper.

.....
.....

(1)

(b) A sample of Muntz Metal contains a very small amount of iron as an impurity.

(i) Name an instrumental method of analysis that could be used to detect iron.

.....

(1)

(ii) Suggest why an instrumental method would detect the iron in this sample of Muntz Metal but a chemical method is **not** likely to be successful.

.....
.....

(1)

(c) Today, ships are made from steel. Steels are alloys of iron, a transition metal.

Give **two** properties of transition metals that make them suitable for making ships.

Property 1

.....

Property 2

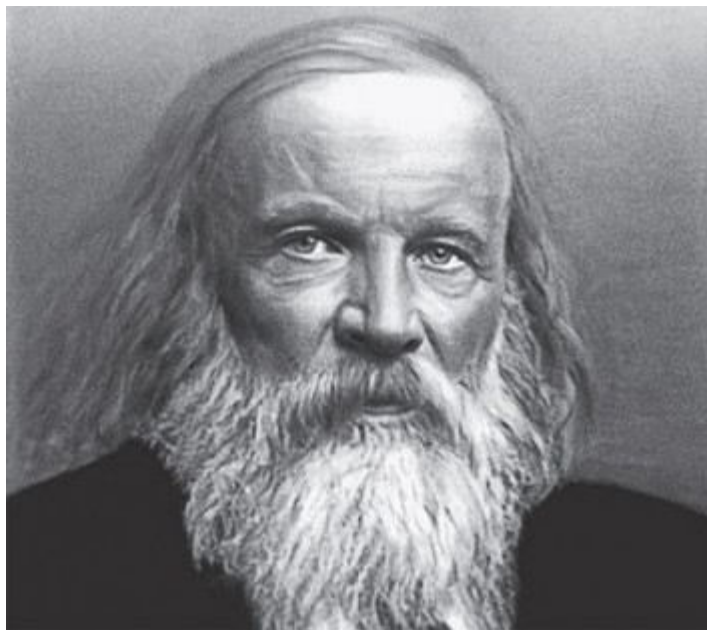
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(2)

(Total 6 marks)

36

Use the periodic table on the Data Sheet and the information below to help you answer these questions.



Mendeleev was one of the first chemists who classified elements in a systematic way based on atomic weight. He suggested his version of the periodic table in 1869.

He put the elements in order of their atomic weights but reversed the order for some pairs of elements. Then he arranged them in a table so that chemically similar elements were in columns known as Groups. He also left gaps and made predictions.

Part of Mendeleev's table is shown below.

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
K	Ca	#	Ti	V	Cr	Mn
Cu	Zn	#	#	As	Se	Br
Rb	Sr	Y	Zr	Nb	Mo	#

Ag	Cd	In	Sn	Sb	Te	I
The gaps Mendeleev left are shown by #.						

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3

- (a) Which group of elements in the modern periodic table is missing from Mendeleev's table?

.....

(1)

- (b) Mendeleev reversed the order for some pairs of elements. For example, he put tellurium (Te, atomic weight 128) before iodine (I, atomic weight 127), as shown in his table.

Why did he do this?

.....

.....

(1)

- (c) In 1869 many chemists did **not** agree with Mendeleev's periodic table.

Suggest **three** reasons why.

.....

.....

.....

.....

.....

.....

.....

(3)

- (ii) the element calcium Letter (1)
- (iii) a transition element Letter (1)
- (iv) a Group 4 element? Letter (1)

- (b) A chemistry teacher demonstrated the reaction between sodium and water to some students. One of the students wrote the following notes.

The reaction between sodium and water

A piece of sodium was cut easily into smaller pieces with a knife.

The sodium was added to water in a trough.

The sodium:

- floated
- melted quickly to give a silvery ball
- moved on the surface of the water
- fizzed.

Use the information in the box to help you to answer these questions.

What evidence is there that:

- (i) sodium has a low melting point
-
- (1)
- (ii) sodium is soft
-
- (1)

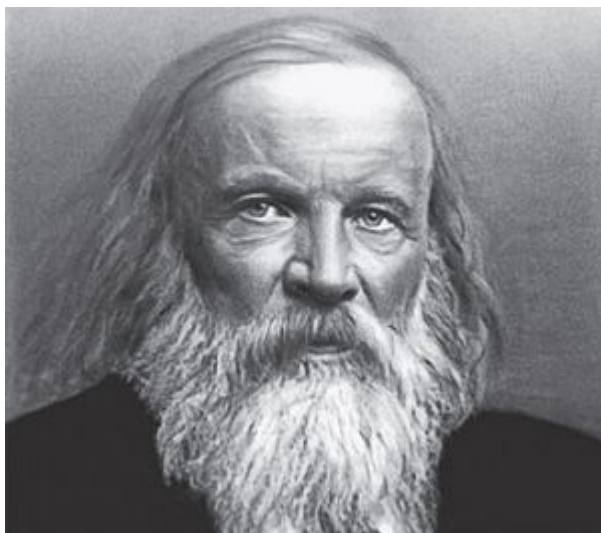
(iii) a gas was produced?

.....
.....

(1)
(Total 7 marks)

38

(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)

- (b) The table shows the melting points of the Group 1 metals arranged in alphabetical order.

Group 1 metal		
Name	Symbol	Melting point in °C
Caesium	Cs	29
Francium	Fr	27
Lithium	Li	180
Potassium	K	64
Rubidium	Rb	39
Sodium	Na	98

- (i) Arrange these metals in order of increasing melting point. Three have been done for you.

Fr Cs Li

Lowest \longrightarrow Highest

(1)

- (ii) Use the periodic table on the Data Sheet **and** your answer in part (b)(i) above to complete this sentence about how the melting points change.

Going down Group 1, the melting points

(1)

- (c) The transition metals are a block of elements between Groups 2 and 3 of the periodic table.
Transition metals have different properties to Group 1 metals.

Put ticks (✓) next to the **three** correct statements about transition metals in the table below.

Statement	(✓)
They are harder than Group 1 metals	
They have lower densities than Group 1 metals	
They have higher melting points than Group 1 metals	
They are more reactive with water than Group 1 metals	
They often form coloured compounds but Group 1 compounds are usually white	

(3)
(Total 10 marks)

40

Sodium is a Group 1 element.

- (a) (i) A small piece of sodium is added to some water containing Universal Indicator solution.

Describe what you would **see** happening.

.....

.....

.....

.....

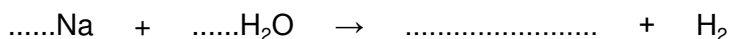
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.....

.....

(3)

- (ii) Complete **and** balance the equation for the reaction of sodium with water.



(2)

- (b) Francium is the most reactive element in Group 1.

Explain why in terms of electronic structure.

.....

.....

.....

.....

.....

.....

(3)

- (c) The transition elements have different properties from the elements in Group 1.

Give **two** of these different properties of transition elements.

1

.....

2

.....

(2)

(Total 10 marks)

41

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

- (a) Draw a ring around the correct answer to complete these sentences.

(i)

	compounds.
Dimitri Mendeleev attempted to classify	elements.
	mixtures.

(1)

(ii)

	atomic weight.
He arranged them in order of their	boiling point.
	electrical conductivity.

(1)

(iii)

	atomic (proton) number.
They are now arranged in order of their	atomic weight.
	mass number.

(1)

(b) In the periodic table between Groups 2 and 3 there is a block of metals which includes chromium, iron and nickel.

(i) Which **one** of the following is the correct name for this block of metals?

Draw a ring around the correct answer.

alkali metals

reactive metals

transition metals

(1)

(ii) The properties of iron and those of the Group 1 metal sodium are different.

Put a tick (✓) next to the **two** correct phrases which could complete the following sentence.

Compared to sodium, iron

	(✓)
has a higher melting point.	
has a lower density.	
is harder.	
is more reactive.	
is weaker.	

(2)

(Total 6 marks)

42

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.

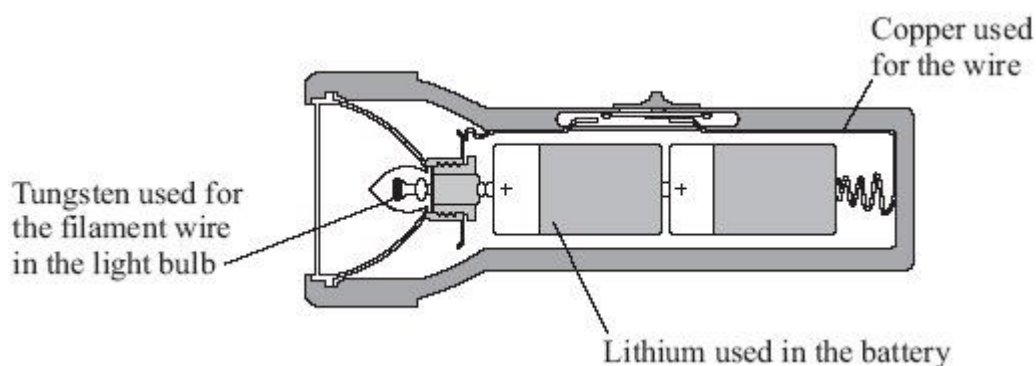
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(2)

(Total 9 marks)

43

The diagram shows a circuit that is used in a torch. Electrons flow through this circuit.

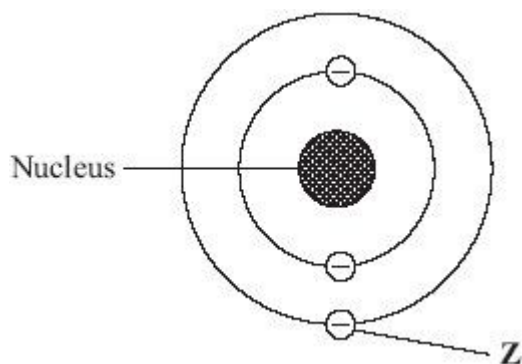


- (a) Why is copper used for the wire?

.....

(1)

- (b) The diagram shows the structure of an atom of lithium.



Name the particle labelled **Z**.

.....

(1)

- (c) The table shows some properties of the metals used in the electrical circuit.

Metal	Melting point in °C	Boiling point in °C	Reaction with oxygen
Copper	1083	2582	Reacts slowly to form a thin oxide layer on surface
Lithium	179	1317	Reacts rapidly to form oxide
Tungsten	3370	5930	Reacts only when very hot to form oxide

- (i) Use information from the table to suggest the order of reactivity for copper, lithium and tungsten.

most reactive

.....

least reactive

(2)

- (ii) The filament wire glows because it gets very hot.

Use information from the table to suggest **one** reason why tungsten is used for the filament wire in the light bulb.

.....

.....

(1)

- (d) The gas used in the light bulb is argon.

Draw a ring around the correct word in the box to complete the sentence.

Argon is used in the light bulb because it is

dense.
solid.
unreactive.

(1)

(Total 6 marks)

44

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

Draw a ring around the correct answer to complete these sentences.

- (a) The Russian chemist who introduced his periodic table in 1869 was

Brønsted.
Lowry.
Mendeleev.

(1)

- (b) He put elements with similar chemical reactions in columns, known as

groups.
periods.
rows.

(1)

(c) He left gaps for elements that were

insoluble.
unreactive.
undiscovered.

(1)

(d) He did **not** put water, H₂O, into the periodic table because water is a

compound.
liquid.
mixture.

(1)

(Total 4 marks)**45**

Group 7 is an important family of elements in the periodic table.

(a) (i) What name is given to the Group 7 elements?

Draw a ring around your answer.

Halogens**Noble gases****Transition elements**

(1)

(ii) The grid shows some statements about Group 7 elements.

Tick (✓) the **two** correct statements.

Statement	(✓)
They are metals	
They consist of molecules	
They have coloured vapours	
They have high melting points	

(2)

- (b) The table gives information about some of the Group 7 elements.

Name of element	Melting point in °C	Boiling point in °C	Electronic structure
Fluorine	-220	-188	2, 7
Chlorine	-101	-35	2, 8, 7
Bromine	-7	58	2, 8, 18, 7
Iodine	114	183	2, 8, 18, 18, 7

Use information from the table to help you to answer these questions.

Write the correct number in the box to complete the sentence.

- (i) All these elements are in Group 7 because they have electrons in their outer shell.

(1)

- (ii) Draw a ring around the correct word in the box to complete the sentence.

At 20 °C bromine is a

gas. liquid. solid.

(1)

- (iii) Use the periodic table on the **Data Sheet** to name the Group 7 element that is **not** shown in the table.

.....

(1)

- (c) A student investigated the reactivity of three Group 7 elements.

The student added:

- aqueous chlorine to potassium bromide and potassium iodide solutions
- aqueous bromine to potassium chloride and potassium iodide solutions
- aqueous iodine to potassium chloride and potassium bromide solutions.

The student's results are shown in the table.

Solutions of	Potassium chloride	Potassium bromide	Potassium iodide
Chlorine		Solution turned orange-brown	Solution turned brown
Bromine	No change		Solution turned brown
Iodine	No change	No change	

Explain how these results show that chlorine is more reactive than bromine and iodine.

.....

.....

.....

.....

(2)
(Total 8 marks)

46

Chlorine and bromine are important Group 7 elements.

- (a) Explain why chlorine is added to drinking water.

.....

.....

(1)

- (b) Describe what you would **see** when bromine water is added to an unsaturated organic compound.

.....

.....

(1)

(c) Bromine can be extracted from seawater. The dissolved bromide ions are reacted with chlorine. Bromine and chloride ions are formed.

(i) Complete and balance the equation below, which represents the reaction between chlorine and bromide ions.



(1)

(ii) Describe what you **see** when chlorine is added to a solution containing bromide ions.

.....
.....

(1)

(d) In terms of electronic structure:

(i) state why bromine and chlorine are both in Group 7

.....
.....

(1)

(ii) explain why bromine is less reactive than chlorine.

.....
.....
.....
.....
.....
.....
.....
.....

(3)

(e) What is the result of adding acidified silver nitrate solution to a solution containing:

(i) chloride ions

.....

(1)

(ii) bromide ions?

.....

(1)

(Total 10 marks)

47

Read the information about the periodic table.

In 1869 Dimitri Mendeleev classified the elements by first putting them in order of their atomic weights.

Then he arranged them in a table, so that elements with similar properties and reactions were in columns known as Groups.

He also left gaps in his table for undiscovered elements.

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

(a) Some elements were **not** placed in order of increasing atomic weights.

In terms of properties, suggest why potassium (atomic weight 39) should be placed after argon (atomic weight 40).

.....
.....
.....

(1)

(b) Some scientists thought that Mendeleev's table was **not** correct.

Suggest why, by referring to the elements in Group 4.

.....
.....
.....

(1)

(b) Complete these sentences by drawing a ring around the correct answer.

(i) Attempts to classify the elements into a periodic table were made

by

Arrhenius and Dalton
Brønsted and Lowry
Mendeleev and Newlands

(1)

(ii) They arranged the elements in order of their

atomic weight
melting point
reactivity

(1)

(iii) They put elements in the same Group if they had similar

boiling points
chemical reactions
electrical conductivities

(1)

(iv) We now know that elements in the same Group have the same number of

electrons
neutrons
protons

in their outer shell (energy level).

(1)

(Total 8 marks)

Read the information about the periodic table.



Portrait of Dimitri Mendeleev by Ilya Repin

When the Russian chemist Dimitri Mendeleev put forward his periodic table in 1869, the atomic structure of elements was unknown.

Mendeleev tried to arrange the elements in a meaningful way based on their chemical reactions. First he put the elements in order of their increasing atomic weight.

He then put elements with similar properties in the same column.

However, he left gaps, and sometimes did not follow the order of increasing atomic weight – for example, he placed iodine (atomic weight 127) after tellurium (atomic weight 128).

Within a few years there was sufficient evidence to prove that Mendeleev was correct.

Our modern periodic table has evolved from Mendeleev's table.

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

- (a) (i) State why Mendeleev left gaps.

.....
.....

(1)

(ii) State why some elements were **not** placed in order of increasing atomic weight.

.....
.....

(1)

(b) (i) The periodic table is now based on atomic structure.

Explain how.

.....
.....
.....
.....
.....
.....
.....
.....
.....

(3)

(ii) Suggest why it is impossible to have an undiscovered element that would fit between sodium and magnesium.

.....
.....

(1)

(c) Explain, in terms of electrons, why fluorine is the most reactive element in Group 7.

.....
.....
.....
.....
.....
.....
.....

(3)

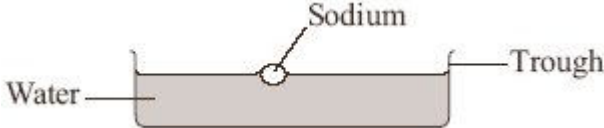
(Total 9 marks)

50

- (a) Read a student's report about the reaction between sodium and water.

The reaction between sodium and water

A small piece of sodium was added to some water in a trough.



The sodium floated and started to react.

The sodium moved along the surface of the water and melted to give a ball of molten metal.

The ball became smaller and smaller until it had all gone.

A gas was given off and a colourless solution was left.

The word equation for this reaction is:

sodium + water → sodium hydroxide + hydrogen

Use the information from the student's report to answer these questions.

- (i) Which information shows that sodium has a low density?

.....

(1)

- (ii) Which information shows that the reaction is exothermic?

.....

(1)

- (iii) Name the gas given off.

.....

(1)

- (b) The periodic table on the Data Sheet may help you to answer these questions.

- (i) Sodium is in Group 1.

Name a Group 1 element that is more reactive than sodium.

.....

(1)

(ii) Here are some statements about Group 1 elements.

Only **two** of these statements are correct.

Put a tick (✓) next to the two correct statements.

Statement	(✓)
They are halogens	
They are metals	
They form covalent compounds	
They form ions with a +1 charge	

(2)

(c) Dimitri Mendeleev put forward his periodic table in 1869.

Complete these sentences by drawing a ring around the correct answer.

(i) Mendeleev arranged the elements in order of their

atomic weight density reactivity
--

(1)

(ii) The table is called a periodic table because elements with properties occur at regular intervals.

identical the same similar

(1)

(iii) The vertical columns are known as

groups periods rows

(1)

- (d) How did Mendeleev overcome the problem of undiscovered elements when he designed his table?

.....

(1)

(Total 10 marks)

51

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".

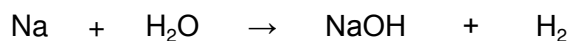
- (a) Group 1 metals are stored under oil.

Suggest why.

.....

(1)

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



(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.

.....

.....

.....

.....

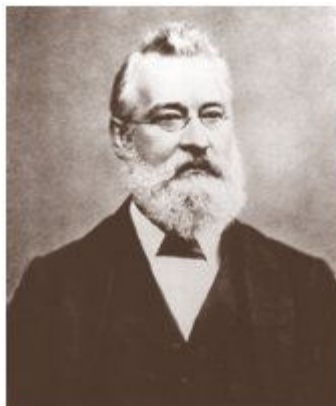
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(3)
(Total 6 marks)

52

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.

.....
.....
.....
.....

(2)

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

1

.....

.....

.....

2

.....

.....

.....

(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.

.....

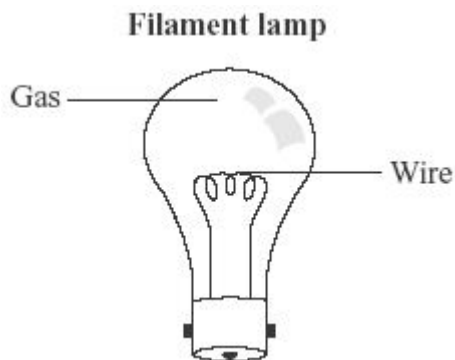
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(1)

(Total 6 marks)

53

When electricity passes through a thin wire, the wire gets hot. If the wire gets very hot, it may glow. This idea is used in filament lamps.



- (a) The table shows some metals and their melting points.

Metal	Melting point in °C
Aluminium	660
Copper	1084
Iron	1540
Tungsten	3410

Which metal in the table should be used to make the wire in a filament lamp?

Give a reason for your answer.

.....

.....

.....

.....

(2)

Choose your answers **only** from the letters shown on this outline table.

Which letter, **A** to **H**, represents an element which:

(a) is in Group 3,

Letter

(1)

(b) is in Period 2,

Letter

(1)

(c) is a transition element,

Letter

(1)

(d) is the least reactive element in Group 7,

Letter

(1)

(e) is the most reactive metal?

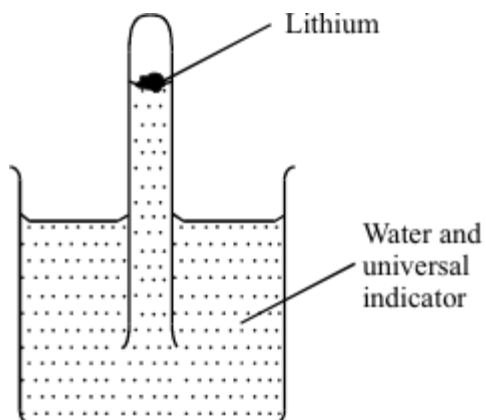
Letter

(1)

(Total 5 marks)

55

The diagram shows an experiment to study the reaction of lithium with water.



- (a) Describe, as fully as you can, what you would see as the lithium reacts with the water in this experiment.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

.....

.....

.....

.....

.....

(3)

- (b) The reaction has two products. Complete the word equation for this reaction by choosing the correct substances from the box.

hydrogen	lithium hydride	lithium hydroxide
lithium oxide		oxygen

lithium + water → +

(2)

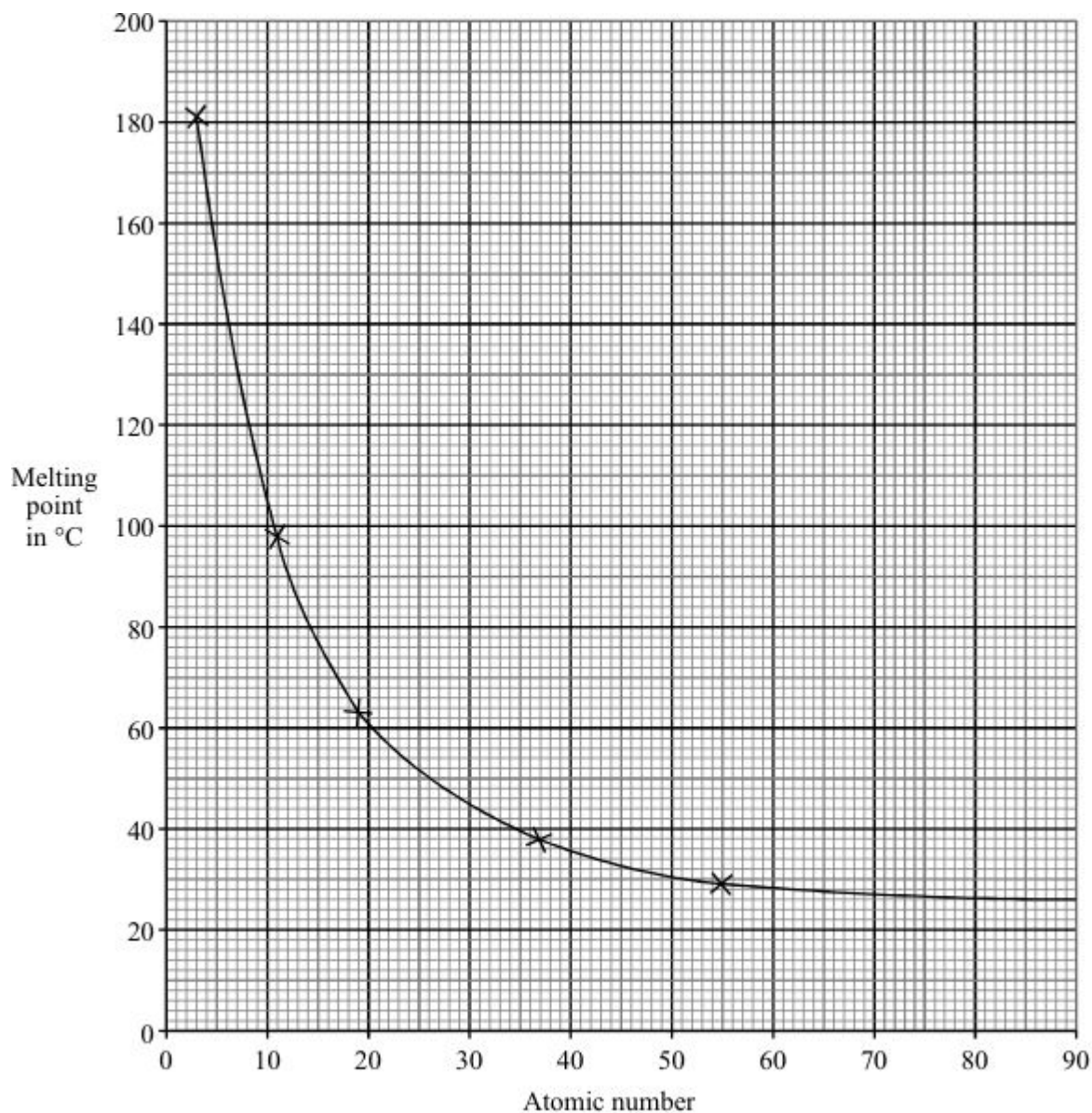
- (c) Caesium is lower down in Group 1 of the periodic table than lithium. Suggest how the reaction of caesium with water might be different from lithium's reaction.

.....

.....

(1)

(d) The graph shows the melting points of the Group 1 metals plotted against their atomic numbers.



(i) Describe fully how the melting points change as the atomic number increases.

.....

.....

.....

(2)

- (ii) Francium has an atomic number of 87.
Use the graph to estimate the melting point of francium.

Estimate of melting point °C

(1)

(Total 9 marks)

56

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.

.....

.....

.....

.....

.....

.....

.....

(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)