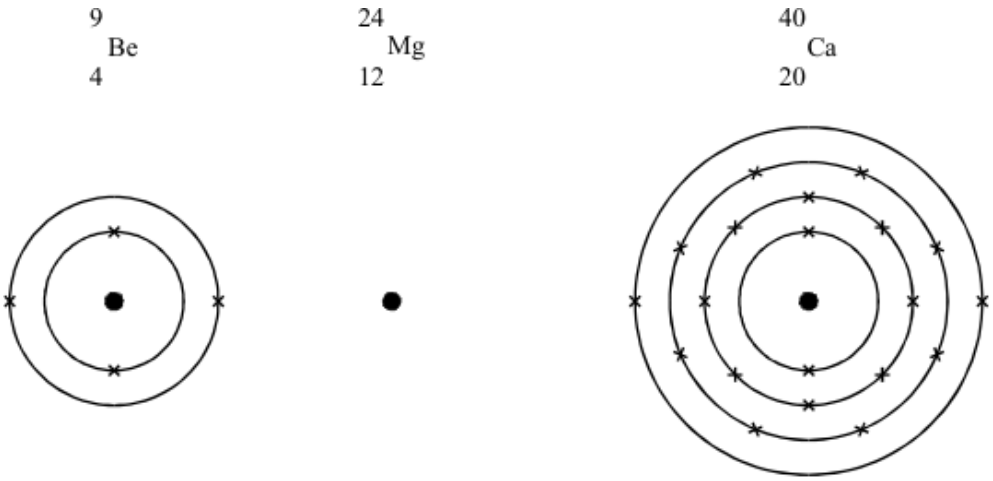
Q1. Three elements in Group 2 of the periodic table are beryllium (Be), magnesium (Mg) and calcium (Ca). Their mass numbers and proton numbers are shown below. The electronic structure is shown for beryllium and calcium.



(a) In a similar way, draw the electronic structure for magnesium.

(3)

(b)
- The three elements have similar chemical properties
- The reactivity of these elements with non-metals, increases from beryllium to magnesium to calcium.

Explain these two statements in terms of atomic structure.

.....

.....

.....

.....

.....

.....

(6)
(Total 9 marks)

Q2. Part of the Periodic Table is shown below. Use the information to help you answer the questions which follow.

H							He
Li	Be	B	C	N	O	F	Ne
Na	Mg	Al	Si	P	S	Cl	Ar

(a) Write the symbol for:

(i) chlorine; .....

(ii) sodium. .....

(2)

(b) (i) What is the symbol of the element which is in Group 2 and Period 3?

.....

(ii) What name is given to Group 7?

.....

(2)

(c) The arrangement of electrons in sulphur (S) is 2.8.6.

Write the arrangement of electrons for:

(i) neon (Ne); .....

(1)

(ii) aluminium (Al). .....

(1)

(d) The Periodic Table is an arrangement of elements in order of increasing atomic number.
What is the atomic number of an element?

.....

(1)

(e) What is the name of the uncharged particle in the nucleus of an atom?

.....

(1)

(Total 8 marks)

Q3. Complete the table which shows some of the physical properties of bromine, chlorine and iodine.

	Melting point in °C	**Boiling point in °C**	**Physical state at 23 °C**	**Colour of vapour**
Bromine	–7	58	……..	……..
Chlorine	–101	–34	……..	greenish
Iodine	–114	183	……..	……..

(Total 2 marks)

Q4. Use the periodic table on the Data Sheet to answer these questions.

The table below gives the electronic structures of four elements, **W**, **X**, **Y** and **Z**.

Element	**Electronic structure**
W	2,5
X	2,7
Y	2,8,8
Z	2,8,8,1

(a) Which element **W**, **X**, **Y** or **Z**:

(i) is a Group 0 gas? .....

(ii) is nitrogen? .....

(iii) is a Group 7 gas? .....

(iv) reacts violently with water? .....

(3)

(b) Which **two** Groups of the periodic table do **not** contain any non-metals?

.....

(1)

(Total 4 marks)

Q5. Part of the Periodic Table which Mendeleev published in 1869 is shown below.

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

Use the Data Sheet to help you to answer this question.

(a) Name **two** elements in Group 1 of Mendeleev's Periodic Table which are not found in Group 1 of the modern Periodic Table.

..... and .....

(2)

(b) Which group of elements in the modern Periodic Table is missing on Mendeleev's table?

.....

(1)

(c) Mendeleev left several gaps in his Periodic Table. These gaps are shown as asterisks(*) on the table above.
Suggest why Mendeleev left these gaps.

.....

.....

.....

(1)

(d) Complete the following sentence.

In the **modern** Periodic Table the elements are arranged in the order of their

..... numbers.

(1)
(Total 5 marks)

Q6. Part of the Periodic Table which Mendeleev published in 1869 is shown below.

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

Use the Data Sheet to help you to answer this question.

(a) (i) Give the symbols of **two** elements in Group 1 of Mendeleev's Periodic Table which are **not** found in Group 1 of the modern Periodic Table.

..... and .....

(1)

(ii) Name these **two** elements.

..... and .....

(2)

(b) Which group of elements in the modern Periodic Table is missing on Mendeleev's table?

.....

(1)

(c) Mendeleev left several gaps in his Periodic Table. These gaps are shown as asterisks(*) on the table above.
Suggest why Mendeleev left these gaps.

.....

.....

.....

(1)

(d) Complete the following sentence.

In the **modern** Periodic Table the elements are arranged in the order of their

..... numbers.

(1)

(e) Mendeleev placed lithium, sodium and potassium in Group 1 of his Periodic Table.
This was because they have similar properties.
Some properties of elements are given in the table.
Four of them are properties of lithium, sodium and potassium. One of these properties has been ticked for you. Place a tick next to the other three properties.

PROPERTY	
They react with water to give alkaline solutions.	
They are gases.	
They are non-metals.	
They form an ion with a 1+ charge.	
They react with water and give off hydrogen.	✓
They form an ion with a 1– charge.	
They are metals.	
They react with water to give acidic solutions.	

(3)

(f) What happens when a small piece of sodium reacts with water?
You should describe what you would see and state what substances are formed.

.....

.....

.....

.....

.....

.....

(3)
(Total 12 marks)

Q7. Read the following information about an element X.

The element X melts above 600°C. It conducts electricity at room temperature. It burns in oxygen to form an oxide. When the oxide is mixed with water it turns Universal Indicator blue.

The oxide of X is a white solid at room temperature. It has the formula XO and contains the ion X^{2+}.

The element X reacts with chlorine to form a chloride with a high melting point. The chloride conducts electricity when molten and it is soluble in water.

(a) From the information give **three** pieces of evidence which suggest that X is a metal.

1 .....

.....

2 .....

.....

3 .....

.....

(3)

(b) In which Group of the Periodic Table should X be placed? Give a reason for your answer.

Group .....

Reason .....

.....

(2)

(c) Predict the formula for the chloride of X. .....

(1)

(Total 6 marks)

Q8. HYDROGEN FUEL OF THE FUTURE

It has been suggested that hydrogen could be used as a fuel instead of the fossil fuels that are used at present. The equation below shows how hydrogen burns in air.

$$2H_2 + O_2 \rightarrow 2H_2O + \text{heat}$$

The hydrogen would be made from water using energy obtained from renewable sources such as wind or solar power. The water splitting reaction requires a lot of energy.

(a) Hydrogen was successfully used as a fuel for a Soviet airliner in 1988.
Why would hydrogen be a good fuel for use in an aeroplane?

.....

.....

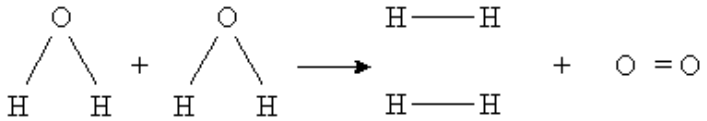
.....

.....

(2)

(b) The water splitting reaction is shown in the equation below.

$$2H_2O \rightarrow 2H_2 + O_2$$



Calculate the energy needed to split the water molecules in the equation into H and O atoms.

$$2H_2O \rightarrow 4H + 2O$$

.....

.....

(2)

(c) On the Periodic Table, hydrogen is placed on its own at the top and in the middle. It is difficult to position it because it has the properties of metals and non-metals.

(i) Where would you expect hydrogen to be placed on the periodic table on the basis of the arrangement of electrons in hydrogen atoms?

.....

.....

(1)

Explain your answer.

.....

.....

(1)

(ii) Give **one** way in which hydrogen behaves like a metal.

.....

.....

(1)

(iii) Give **one** way in which hydrogen behaves like a non-metal.

.....

.....

(1)

(Total 8 marks)

Q9. The Periodic Table contains groups of elements that have similar chemical properties.

(a) The halogens are in Group 7 of the Periodic Table.

(i) Complete the table. Iodine has been done for you.

Halogen	**Colour of vapour**
chlorine	
	red-brown
iodine	purple

(2)

(ii) Why do the halogens have similar chemical properties?

.....

.....

(1)

(b) The alkali metals are in Group 1 of the Periodic Table. State what is formed when any alkali metal reacts with water.

.....

.....

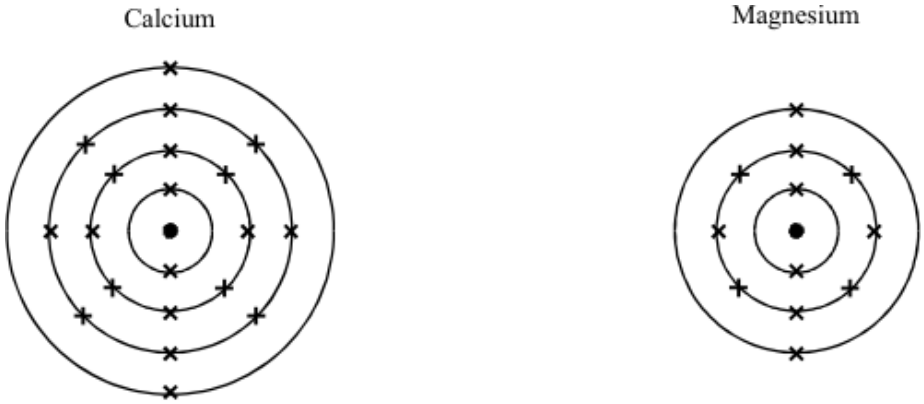
.....

.....

.....

(2)
(Total 5 marks)

Q10. The electron arrangements of calcium and magnesium atoms are shown.



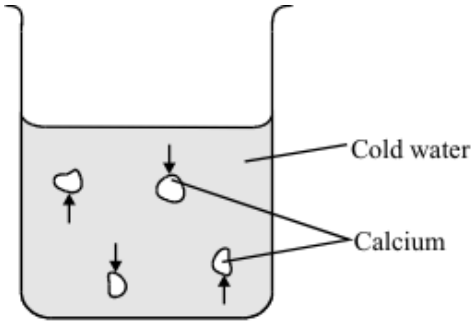
(a) Which group of the Periodic Table contains calcium and magnesium? Give a reason for your answer.

.....

.....

(2)

(b) Small pieces of calcium in cold water move up and down as in the diagram.



(i) Suggest why the calcium does this.

.....

.....

(1)

(ii) Predict what happens when magnesium is added to cold water.

.....

.....

(1)

(c) Magnesium burns in air to form a white solid. When water is added to the solid a cloudy alkaline solution of magnesium hydroxide is formed.

(i) Name the white solid.

.....

(1)

(ii) Suggest the pH of the magnesium hydroxide solution.

.....

(1)

(iii) Why is the solution cloudy?

.....

(1)

(iv) Complete the balanced chemical equation for the formation of the magnesium hydroxide from the white solid.

..... + H_2O → .....

(2)
(Total 9 marks)

Q11. This question is about the Periodic Table.

(a) Dimitri Mendeleev was a Russian scientist who, in 1869, helped to develop the Periodic Table. He made his table with the known elements arranged in order of increasing atomic mass. He started new rows so that elements with similar chemical properties would be in the same column. Mendeleev sometimes had to leave gaps in his table.

(i) Complete the sentences.

The Periodic Table is now the arrangement of the elements in order

of increasing atomic ..... . The rows are called .....

and the columns are called ..... .

(3)

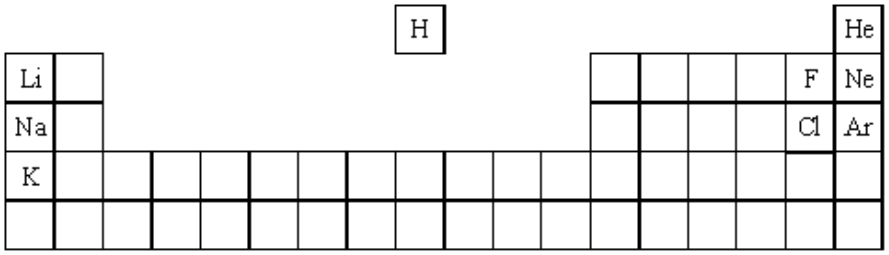
(ii) Suggest why Mendeleev had to leave gaps in his table.

.....

.....

(1)

(b) This section of the Periodic Table shows the positions of some elements.



(i) Give the chemical symbol for **one** of the noble gases.

.....

(1)

(ii) Draw the arrangement of electrons around the nucleus for the noble gas that you chose in (i).

(1)

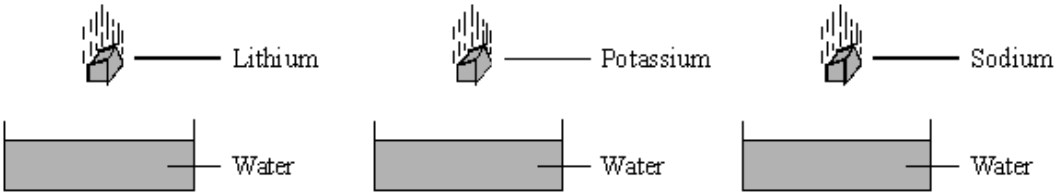
(iii) Why do the electron arrangements of lithium, sodium and potassium make them react in a similar way?

.....

.....

(1)

(iv) Small pieces of lithium, potassium and sodium are added to water.



What is the order of reactivity for these three metals? Put the most reactive metal first.

.....

.....

(1)

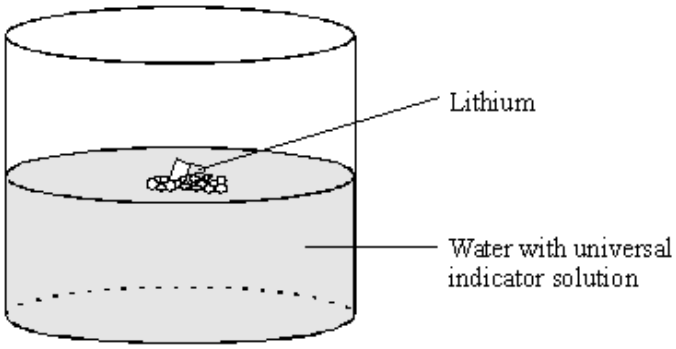
(v) Complete and balance the chemical equation for the reaction of sodium with water.

$2Na(s) + 2H_2O(l) \rightarrow$ .....NaOH(aq) + ...(g)

(2)
(Total 10 marks)

Q12. Lithium is a very reactive metal.

(a) Lithium reacts with cold water.



(i) Which **physical** property of lithium is seen during this reaction?

.....

(1)

(ii) Which **chemical** property of lithium will be shown by the universal indicator?

.....

(1)

(b) Complete the sentence by writing in the missing numbers.

Lithium has an atomic number of 3 and a mass number of 7.

This means that an atom of lithium has ..... protons ..... electrons

and ..... neutrons.

(3)
(Total 5 marks)

Q13. 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)

Q14. The periodic table on the Data Sheet may help you to answer this question.

(a) Newlands and Mendeleev both designed periodic tables in which the elements were put in the order of their relative atomic masses.

When the elements are put in this order a few of them are placed incorrectly when compared with a modern periodic table.

(i) Give **one** example of a pair of elements that would be placed incorrectly if they were in the order of their relative atomic masses.

..... and .....

(1)

(ii) Explain why placing these two elements in the order of their relative atomic masses would **not** be correct.

.....

.....

(1)

(b) In the modern periodic table the elements are put in order of their atomic (proton) numbers.

Explain how the positions of the elements in the periodic table are linked to the electronic structure of their atoms.

.....

.....

.....

.....

(2)
(Total 4 marks)

Q15. 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.

$$Cl_2 + 2Br^- \rightarrow \text{.....} + \text{.....}$$

(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)

Q16. 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.

.....

.....

.....

.....

.....

.....

(3)

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

.....Na + ...H_2O → ..... + H_2

(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 .....

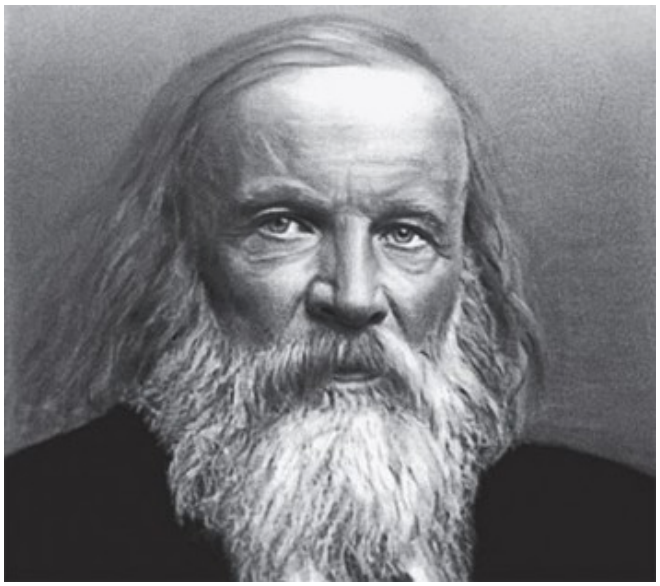
.....

2 .....

.....

(2)
(Total 10 marks)

Q17. 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 Cu	Ca Zn	# #	Ti #	V As	Cr Se	Mn Br
Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	# I

The gaps Mendeleev left are shown by #.

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

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)

(d) In the 20th century, the arrangement of elements in the periodic table was explained in terms of atomic structure.

Describe the links between atomic structure and the periodic table.

.....

.....

.....

.....

.....

.....

(2)
(Total 7 marks)

Q18. 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 .....

.....

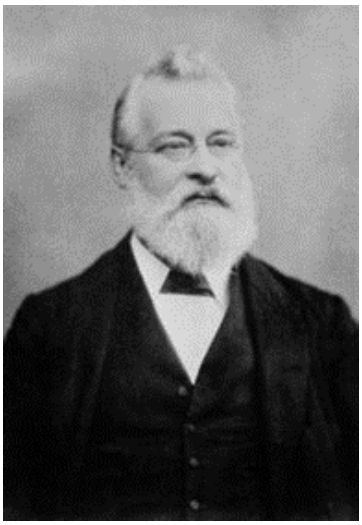
Property 2 .....

.....

(2)
(Total 6 marks)

Q19. 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&#x2019s; 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.

$$Cl_2 \quad + \quad 2KBr \longrightarrow \quad ..... \quad + \quad 2KCl$$

(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)

Q20. Platinum and gold are transition elements. They can both be used to make wedding rings.

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

(a) Platinum and gold are good materials for making wedding rings.

Use your knowledge of the properties of transition elements to suggest why.

.....

.....

.....

.....

(2)

(b) Explain, in terms of electronic structure, why transition elements have similar chemical properties.

.....

.....

.....

.....

.....

.....

(2)
(Total 4 marks)

Q21. 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.

.....

.....

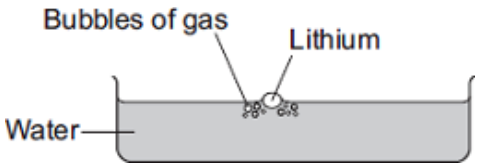
.....

.....

(2)
(Total 7 marks)

Q22. 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 .....

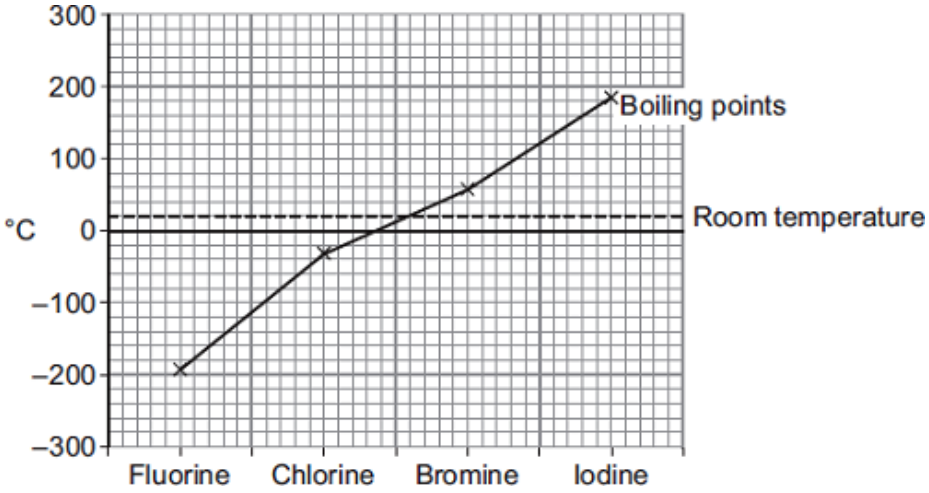
.....

2 .....

.....

(2)
(Total 4 marks)

Q23. 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)