

## The Periodic Table

**These practice questions can be used by students and teachers and is suitable for GCSE AQA Chemistry topic Questions 8462**

**Level: GCSE AQA Chemistry 8462**

**Subject: Chemistry**

**Exam board: GCSE AQA**

**Topic: The Periodic Table**

**Q1.**

The halogens are elements in Group 7.

- (a) Bromine is in Group 7.

Give the number of electrons in the outer shell of a bromine atom.

\_\_\_\_\_ (1)

- (b) Bromine reacts with hydrogen. The gas hydrogen bromide is produced.

What is the structure of hydrogen bromide?

Tick **one** box.

Giant covalent

Ionic lattice

Metallic structure

Small molecule

(1)

- (c) What is the formula for fluorine gas?

Tick **one** box.

F

F<sub>2</sub>

F<sup>2</sup>

2F

(1)

A student mixes solutions of halogens with solutions of their salts.

The table below shows the student's observations.

	Potassium chloride (colourless)	Potassium bromide (colourless)	Potassium iodide (colourless)
Chlorine (colourless)		Solution turns orange	Solution turns brown
Bromine (orange)	No change		Solution turns brown
Iodine (brown)	No change	No change	

(d) Explain how the reactivity of the halogens changes going down Group 7.

Use the results in the table above.

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(3)

A company uses chlorine to produce titanium chloride from titanium dioxide.

(e) What is the relative formula mass ( $M_r$ ) of titanium dioxide,  $TiO_2$ ?

Relative atomic masses ( $A_r$ ): O = 16    Ti = 48

Tick **one** box.

64

80

128

768

(1)

- (f) The company calculates that 500 g of titanium dioxide should produce 1.2 kg of titanium chloride.

However, the company finds that 500 g of titanium dioxide only produces 900 g of titanium chloride.

Calculate the percentage yield.

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Percentage yield = \_\_\_\_\_ %

(2)

(Total 9 marks)

## Q2.

This question is about elements in Group 1.

A teacher burns sodium in oxygen.

- (a) Complete the word equation for the reaction.

sodium + oxygen → \_\_\_\_\_

(1)

- (b) What is the name of this type of reaction?

Tick **one** box.

- Decomposition
- Electrolysis
- Oxidation
- Precipitation

(1)

- (c) The teacher dissolves the product of the reaction in water and adds universal indicator.

The universal indicator turns purple.

What is the pH value of the solution?

Tick **one** box.

1	4	7	13
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(1)

- (d) The solution contains a substance with the formula NaOH

Give the name of the substance.

\_\_\_\_\_

(1)

- (e) All alkalis contain the same ion.

What is the formula of this ion?

Tick **one** box.

- H<sup>+</sup>
- Na<sup>+</sup>
- OH<sup>-</sup>

O<sup>2-</sup>



(1)

- (f) A solution of NaOH had a concentration of 40 g/dm<sup>3</sup>

What mass of NaOH would there be in 250 cm<sup>3</sup> of the solution?

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Mass = \_\_\_\_\_ g

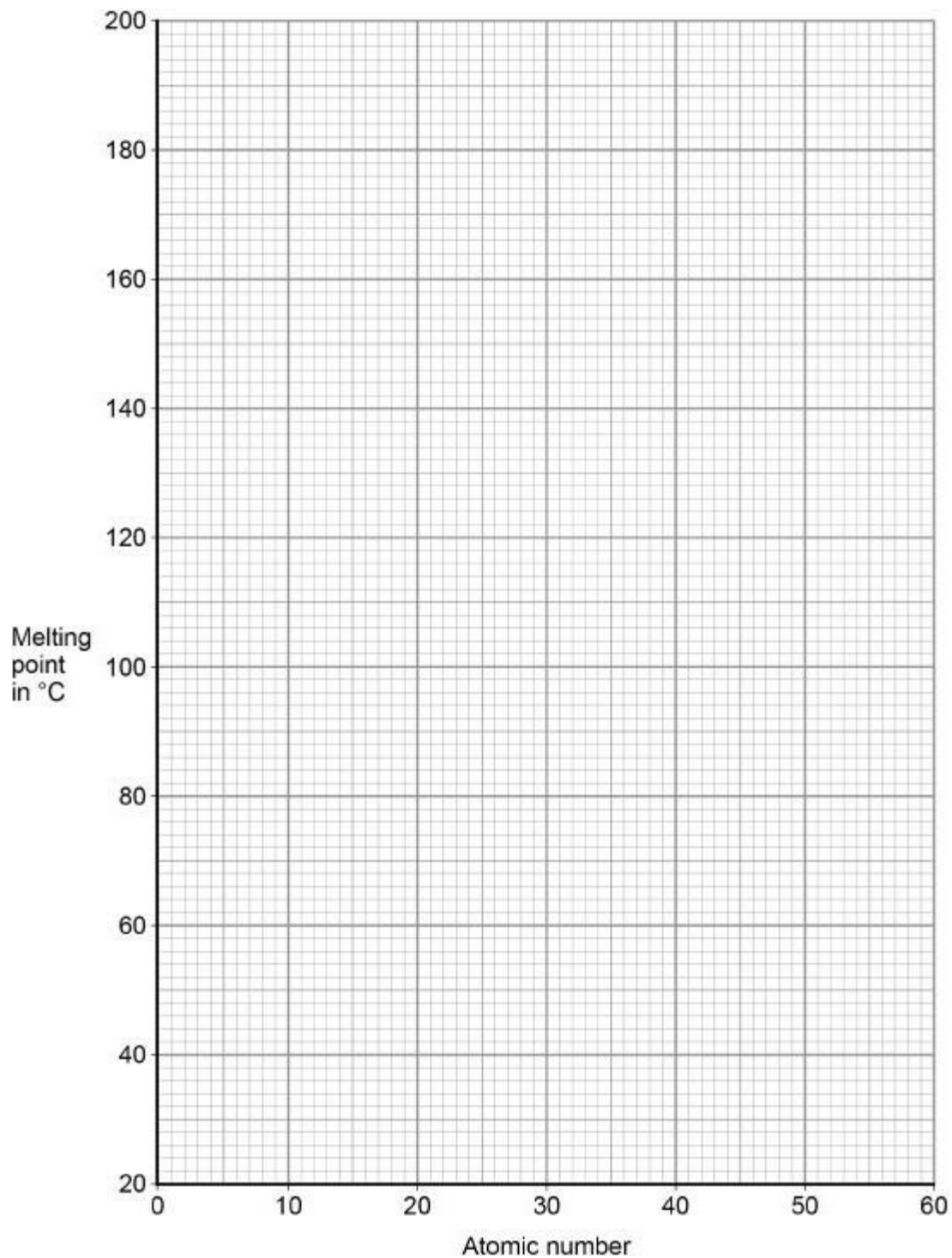
(2)

- (g) The melting points of the elements in Group 1 show a trend.

The table below shows the atomic numbers and melting points of the Group 1 elements.

Element	Atomic number	Melting point in °C
Lithium	3	181
Sodium	11	98
Potassium	19	63
Rubidium	37	X
Caesium	55	29

Plot the data from the table on the graph below.



(2)

(h) Predict the melting point, **X**, of rubidium, atomic number 37

Use the graph above.

Melting point = \_\_\_\_\_ °C

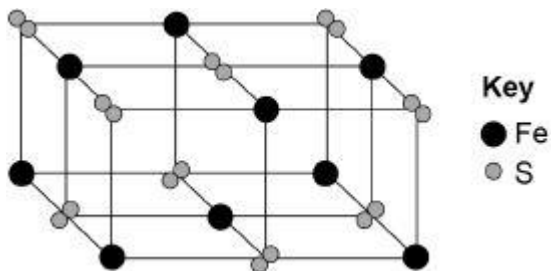
(1)  
(Total 10 marks)

**Q3.**

This question is about metals and metal compounds.

- (a) Iron pyrites is an ionic compound.

The diagram below shows a structure for iron pyrites.



Determine the formula of iron pyrites.

Use the diagram above.

\_\_\_\_\_

(1)

- (b) An atom of iron is represented as  ${}^{56}_{26}\text{Fe}$

Give the number of protons, neutrons and electrons in this atom of iron.

Number of protons \_\_\_\_\_

Number of neutrons \_\_\_\_\_

Number of electrons \_\_\_\_\_

(3)

- (c) Iron is a transition metal.

Sodium is a Group 1 metal.

Give **two** differences between the properties of iron and sodium.

1.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



\_\_\_\_\_

2.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2)

Nickel is extracted from nickel oxide by reduction with carbon.

(d) Explain why carbon can be used to extract nickel from nickel oxide.

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\_\_\_\_\_

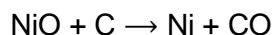
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(2)

(e) An equation for the reaction is:



Calculate the percentage atom economy for the reaction to produce nickel.

Relative atomic masses ( $A_r$ ): C = 12 Ni = 59

Relative formula mass ( $M_r$ ): NiO = 75

Give your answer to 3 significant figures.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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Percentage atom economy = \_\_\_\_\_ %

**(3)**

**(Total 11 marks)**

**Q4.**

This question is about Group 7 elements.

Chlorine is more reactive than iodine.

- (a) Name the products formed when chlorine solution reacts with potassium iodide solution.

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**(1)**

- (b) Explain why chlorine is more reactive than iodine.

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**(3)**

- (c) Chlorine reacts with hydrogen to form hydrogen chloride.

Explain why hydrogen chloride is a gas at room temperature.

Answer in terms of structure and bonding.

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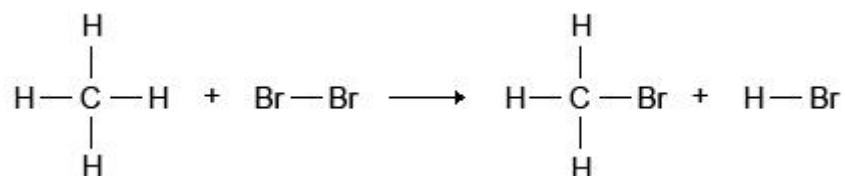


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(3)

(d) Bromine reacts with methane in sunlight.

The diagram below shows the displayed formulae for the reaction of bromine with methane.



The table below shows the bond energies and the overall energy change in the reaction.

	C—H	Br—Br	C—Br	H—Br	Overall energy change
Energy in kJ/mol	412	193	X	366	-51

Calculate the bond energy X for the C—Br bond.

Use the diagram and the table above.

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Bond energy X = \_\_\_\_\_ kJ/mol

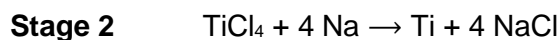
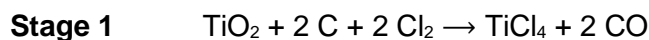
(4)

(Total 11 marks)

**Q5.**

Titanium is a transition metal.

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



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

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(1)

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

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

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(1)

- (c) Suggest why the reaction in **Stage 2** is carried out in an atmosphere of argon

and **not** in air.

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(2)

(d) Titanium chloride is a liquid at room temperature.

Explain why you would **not** expect titanium chloride to be a liquid at room temperature.

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(3)

In **Stage 2**, sodium displaces titanium from titanium chloride.

(e) Sodium atoms are oxidised to sodium ions in this reaction.

Why is this an oxidation reaction?

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Mass of titanium = \_\_\_\_\_ kg

(2)

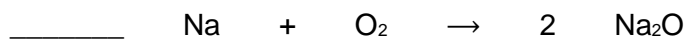
(Total 15 marks)

**Q6.**

This question is about metal oxides.

When sodium is heated in oxygen, sodium oxide is produced.

(a) Balance the equation for the reaction.



(1)

(b) Why is this an oxidation reaction?

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(1)

(c) Sodium oxide is added to water and shaken.

Universal indicator is added.

The pH of the solution is 14

What is the colour of the universal indicator?

Tick (✓) **one** box.

Green

Purple

Red

Yellow

(1)

(d) Aluminium oxide reacts with hydrochloric acid to produce a salt.

What is the name of the salt produced?

Tick (✓) **one** box.

Aluminium chloride

Aluminium nitrate

Aluminium sulfate

Aluminium sulfide

(1)

A student investigates the solubility of four metal oxides and four non-metal oxides in water.

The student tests the pH of the solutions formed.

The table shows the student's results.

Type of oxide	Oxide	Solubility in water	pH of solution
Metal oxides	Sodium oxide	Soluble	14
	Calcium oxide	Soluble	10
	Magnesium oxide	Slightly soluble	9
	Zinc oxide	Insoluble	No solution formed
Non-metal oxides	Carbon dioxide	Soluble	5
	Sulfur dioxide	Soluble	2
	Phosphorus oxide	Soluble	1





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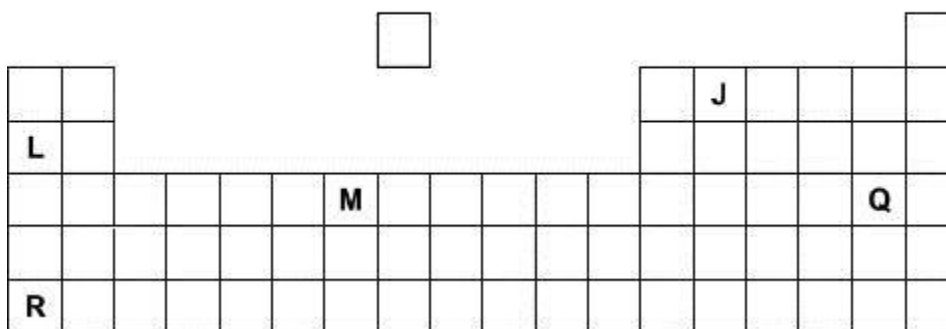
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(2)  
(Total 9 marks)

**Q7.**

**Figure 1** shows an outline of the modern periodic table.

**Figure 1**



**J, L, M, Q** and **R** represent elements in the periodic table.

(a) Which element has four electrons in its outer shell?

Tick (✓) **one** box.

**J**    
 **L**    
 **M**    
 **Q**    
 **R**

(1)

(b) Which **two** elements in **Figure 1** are in the same period?

\_\_\_\_\_ and \_\_\_\_\_

(1)

(c) Which element reacts with potassium to form an ionic compound?

Tick (✓) **one** box.

J     L     M     Q     R

(1)

(d) Which element forms ions with different charges?

Tick (✓) **one** box.

J     L     M     Q     R

(1)

(e) Which element has three electron shells?

Tick (✓) **one** box.

J     L     M     Q     R

(1)

(f) In the 1860s scientists were trying to organise elements.

**Figure 2** shows the table published by John Newlands in 1865.

The elements are arranged in order of their atomic weights.

**Figure 2**

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

**Figure 3** shows the periodic table published by Dmitri Mendeleev in 1869.

**Figure 3**

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	Fe	Co	Ni		
Rb	Ag	Sr	Cd	Y	In	Zr	Sn	Nb	Sb	Mo	Te	?	I	Ru	Rh	Pd

Mendeleev's table became accepted by other scientists whereas Newlands' table was not.

Evaluate Newlands' and Mendeleev's tables.

You should include:

- a comparison of the tables
- reasons why Mendeleev's table was more acceptable.

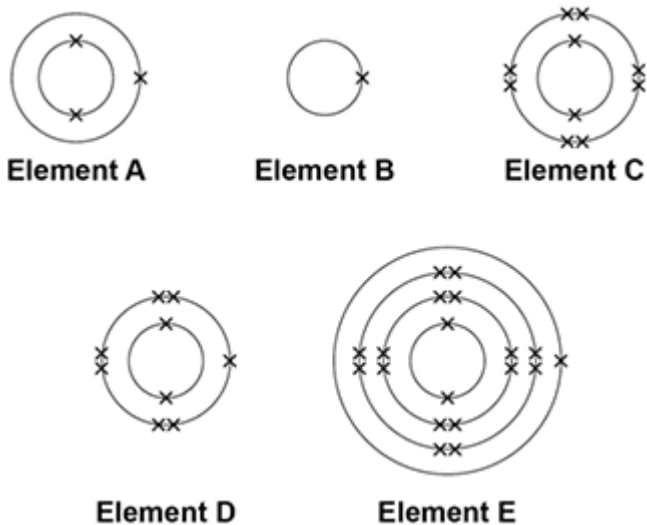
Use **Figure 2** and **Figure 3** and your own knowledge.

(6)  
(Total 11 marks)

**Q8.**

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.

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

**(4)**

**(Total 8 marks)**

**Q9.**

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?

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**(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.



**Q10.**

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.

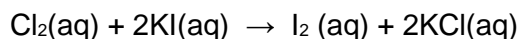
\_\_\_\_\_

\_\_\_\_\_

(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

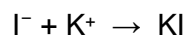
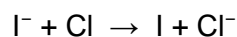
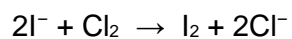
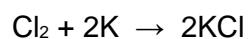
Pale green

Colourless

(1)

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

Tick **one** box.



(1)

(e) Why does potassium iodide solution conduct electricity?

Tick **one** box.

It contains a metal

It contains electrons which can move

It contains ions which can move

It contains water

(1)

(f) What are the products of electrolysis of potassium iodide solution?

Tick **one** box.

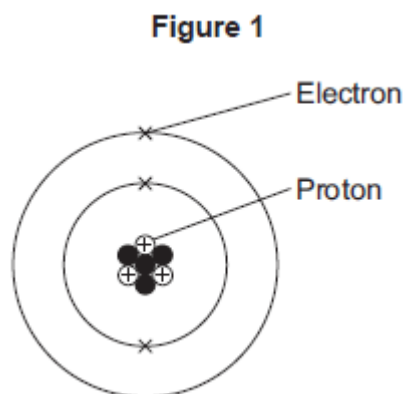
Product at cathode	Product at anode	
hydrogen	iodine	<input type="checkbox"/>
hydrogen	oxygen	<input type="checkbox"/>
potassium	iodine	<input type="checkbox"/>
potassium	oxygen	<input type="checkbox"/>

(1)  
(Total 6 marks)

**Q11.**

There are eight elements in the second row (lithium to neon) of the periodic table.

(a) **Figure 1** shows a lithium atom.



(i) What is the mass number of the lithium atom in **Figure 1**?

Tick (✓) **one** box.

3	<input type="checkbox"/>
4	<input type="checkbox"/>
7	<input type="checkbox"/>

(1)

(ii) What is the charge of an electron?

Tick (✓) **one** box.

-1	<input type="checkbox"/>
0	<input type="checkbox"/>
+1	<input type="checkbox"/>

(1)

(iii) Protons are in the nucleus.

Which other sub-atomic particles are in the nucleus?

Tick (✓) **one** box.

ions	<input type="checkbox"/>
molecules	<input type="checkbox"/>
neutrons	<input type="checkbox"/>

(1)

(b) What is **always** different for atoms of different elements?

Tick (✓) **one** box.

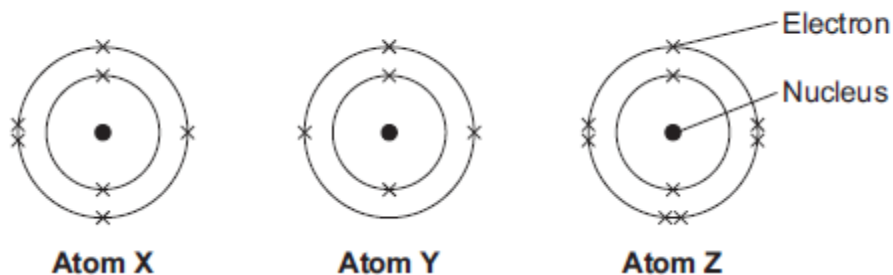
number of neutrons	<input type="checkbox"/>
number of protons	<input type="checkbox"/>
number of shells	<input type="checkbox"/>

(1)

(c) **Figure 2** shows the electron arrangements of three different atoms, **X**, **Y** and **Z**.

These atoms are from elements in the second row (lithium to neon) of the periodic table.

**Figure 2**



Which atom is from an element in Group 3 of the periodic table?

Tick (✓) **one** box.

**Atom X**

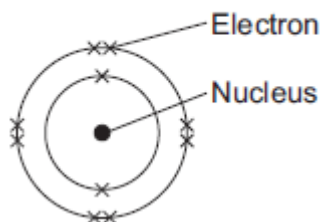
**Atom Y**

**Atom Z**

(1)

- (d) **Figure 3** shows the electron arrangement of a different atom from an element in the second row of the periodic table.

**Figure 3**



- (i) Give the chemical symbol of this element.

\_\_\_\_\_

(1)

- (ii) Why is this element unreactive?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(1)

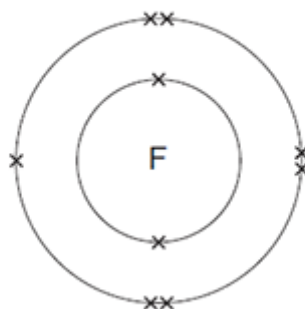
(Total 7 marks)

**Q12.**

This question is about fluorine.

(a) **Figure 1** shows the arrangement of electrons in a fluorine atom.

**Figure 1**



(i) In which group of the periodic table is fluorine?

Group \_\_\_\_\_

(1)

(ii) Complete the table below to show the particles in an atom and their relative masses.

Name of particle	Relative mass
Proton	
Neutron	1
	Very small

(2)

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

<b>alkalis</b>	<b>alloys</b>	<b>isotopes</b>
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Atoms of fluorine with different numbers of neutrons are called \_\_\_\_\_ .

(1)

(b) Sodium reacts with fluorine to produce sodium fluoride.

- (i) Complete the word equation for this reaction.

sodium + \_\_\_\_\_ → \_\_\_\_\_ (1)

- (ii) Complete the sentence.

Substances in which atoms of two or more different elements are chemically

combined are called \_\_\_\_\_ . (1)

- (iii) The relative formula mass ( $M_r$ ) of sodium fluoride is 42.

Use the correct answer from the box to complete the sentence.

ion	mole	molecule
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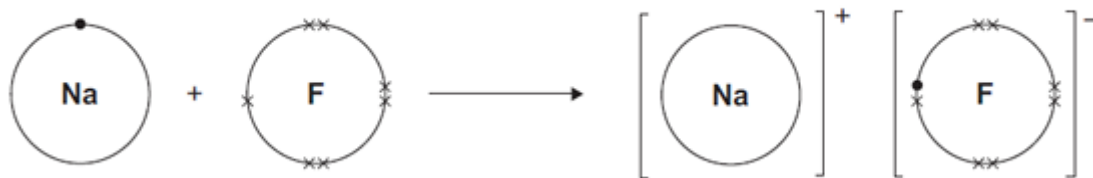
The relative formula mass ( $M_r$ ), in grams, of sodium fluoride is one \_\_\_\_\_ of the substance.

(1)

- (iv) **Figure 2** shows what happens to the electrons in the outer shells when a sodium atom reacts with a fluorine atom.

The dots (•) and crosses (x) represent electrons.

**Figure 2**



Use **Figure 2** to help you answer this question.

Describe, as fully as you can, what happens when sodium reacts with fluorine to produce sodium fluoride.

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(4)

(v) Sodium fluoride is an ionic substance.

What are **two** properties of ionic substances?

Tick (✓) **two** boxes.

Dissolve in water

Gas at room temperature

High melting point

Low boiling point

(2)

(Total 13 marks)

### Q13.

This question is about elements and the periodic table.

(a) Use the correct answers from the box to complete the sentences.

<b>atoms</b>	<b>atomic weights</b>	<b>electrons</b>	<b>proton numbers</b>
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Newlands' and Mendeleev's periodic tables show the elements in order of their \_\_\_\_\_ .

Following the discovery of protons and \_\_\_\_\_, the modern periodic

table shows the elements in order of their \_\_\_\_\_.

(3)

(b) **Figure 1** shows the position of six elements in the modern periodic table.

**Figure 1**

Li														
Na														
K							Fe							
Rb														

(i) Which **one** of these six elements has the lowest boiling point?

\_\_\_\_\_

(1)

(ii) Complete the sentence.

In the periodic table, rubidium (Rb) is in Group \_\_\_\_\_.

(1)

(iii) Which of these three elements is the most reactive?

Tick (✓) **one** box.

Lithium (Li)

Sodium (Na)

Potassium (K)

(1)

(iv) Which **two** statements are correct?

Tick (✓) **two** boxes.

Iron has a higher density than potassium.



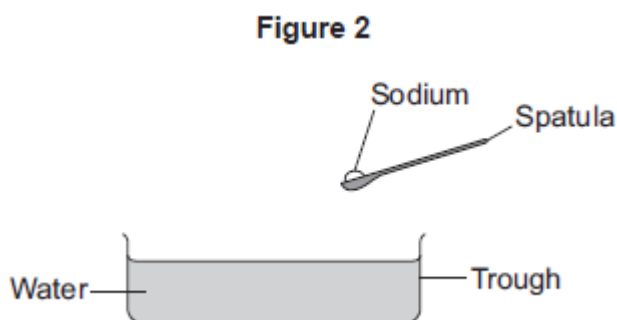
Iron is softer than potassium.

Iron reacts vigorously with water.

Iron forms ions that have different charges.

(2)

(c) **Figure 2** shows sodium being put into water.



Describe **three** observations that can be seen when sodium is put into water.

1.

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2.

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3.

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(3)

(Total 11 marks)

**Q14.**

This question is about elements and the periodic table.







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.

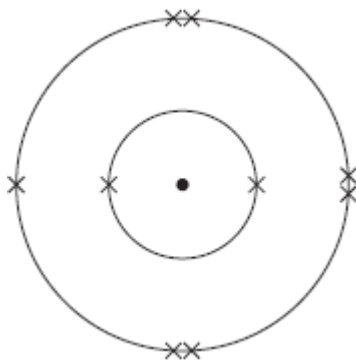
In order of increasing atomic number

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 the figure above to help you to answer this question.

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(2)

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

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**(2)**  
**(Total 9 marks)**

**Q17.**

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.

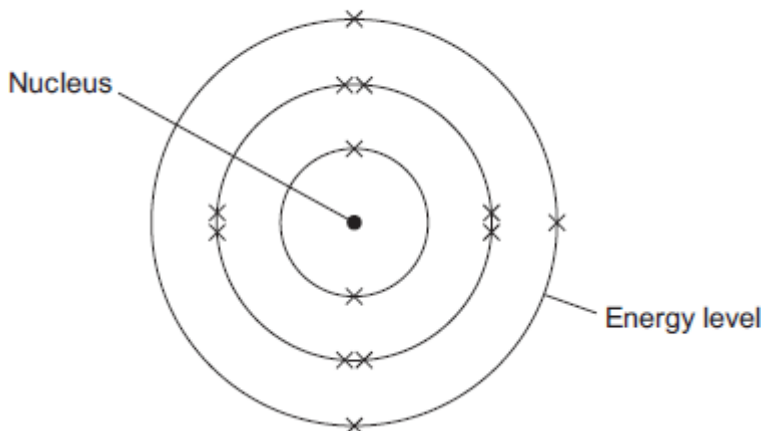
Aluminium is an element because aluminium is made of  
only one type of \_\_\_\_\_ .

**(1)**

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



**Figure 1**



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

<b>electrons</b>	<b>ions</b>	<b>protons</b>	<b>neutrons</b>	<b>shells</b>
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The nucleus of an aluminium atom contains \_\_\_\_\_ and \_\_\_\_\_ .

(2)

- (ii) Complete the sentence.

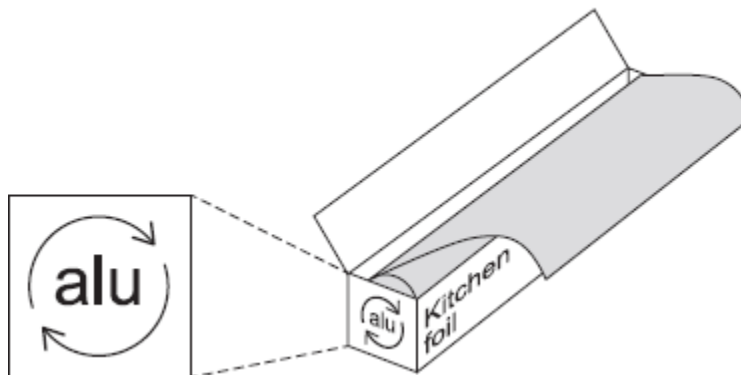
In the periodic table, aluminium is in Group \_\_\_\_\_ .

(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)

### Q18.

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

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(1)

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

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

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(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.

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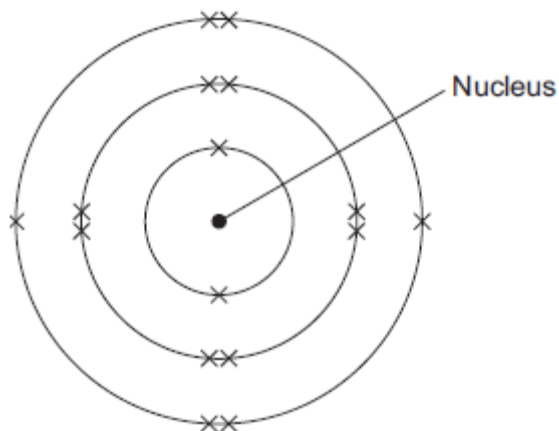
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(2)

(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)

### Q19.

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

Group	1	2											3	4	5	6	7	0	
																			He
	Na																		

- (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)**

### Q20.

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
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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.

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(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?

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(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

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(1)

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

Explain why.

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(2)  
(Total 5 marks)

**Q21.**

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?

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(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.

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(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?

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(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)

**Q22.**

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		

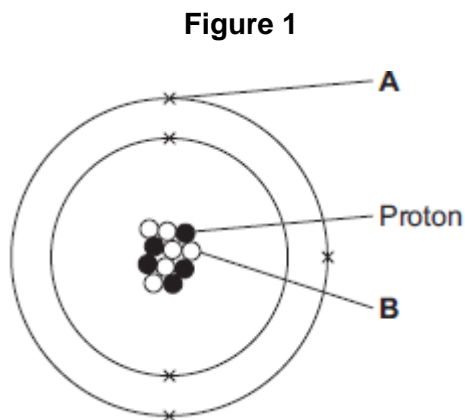
Choose the correct chemical symbols to complete each sentence.

- (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)**



**Q23.**

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



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**

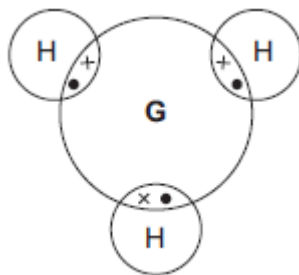
**carbon**

**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

**GH<sub>3</sub>**

**G<sub>3</sub>H**

**3HG**

(1)

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

**covalent**

**ionic**

**metallic**

(1)

(Total 6 marks)

**Q24.**

(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

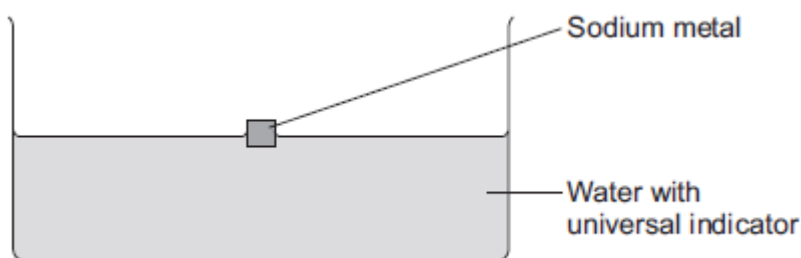
\_\_\_\_\_ (1)

(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**.

**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.

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2.

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3.

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(3)

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

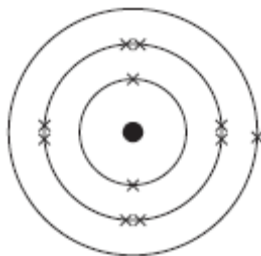
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(1)

(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)

**Q25.**

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



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.

<b>electrons</b> <b>molecules</b> <b>neutrons</b> <b>protons</b>
--

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)

### Q27.

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





- 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

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(1)

- (ii) sodium is soft

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(1)

- (iii) a gas was produced?

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(1)

(Total 6 marks)

### Q28.

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).

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



(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.

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(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.

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(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.

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(1)  
(Total 8 marks)

**Q30.**

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.

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\_\_\_\_\_

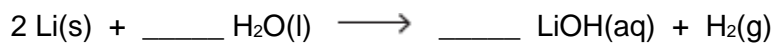
2.

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\_\_\_\_\_

(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.

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\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**(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.

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(3)

(Total 13 marks)

**Q31.**

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?

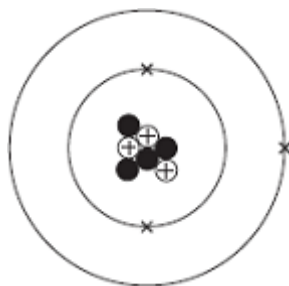
Group

(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.

<b>3</b>	<b>4</b>	<b>7</b>
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The mass number of this atom of lithium is

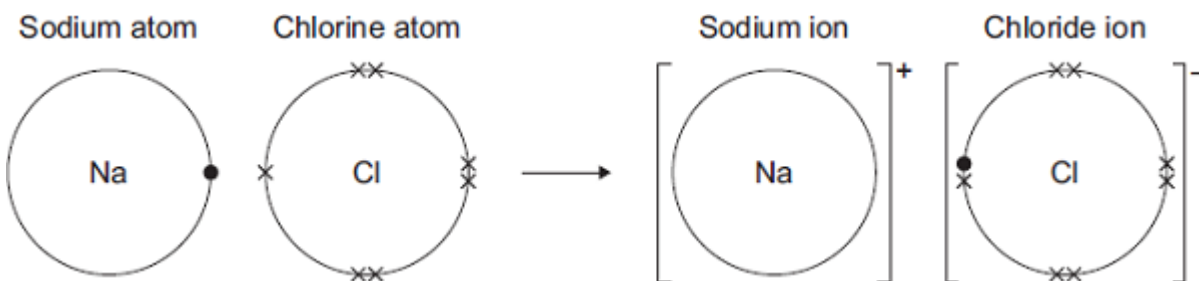
(1)

- (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 

gaining
losing
sharing

 an electron. (1)

- (ii) A sodium ion has 

a negative
no
a positive

 charge. (1)

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

covalent
electrostatic
magnetic

 forces. (1)

- (d) Sodium chloride is an ionic compound.

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

Property	Tick (✓)
Do <b>not</b> 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

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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?

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(1)

(Total 12 marks)

### Q32.

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.

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(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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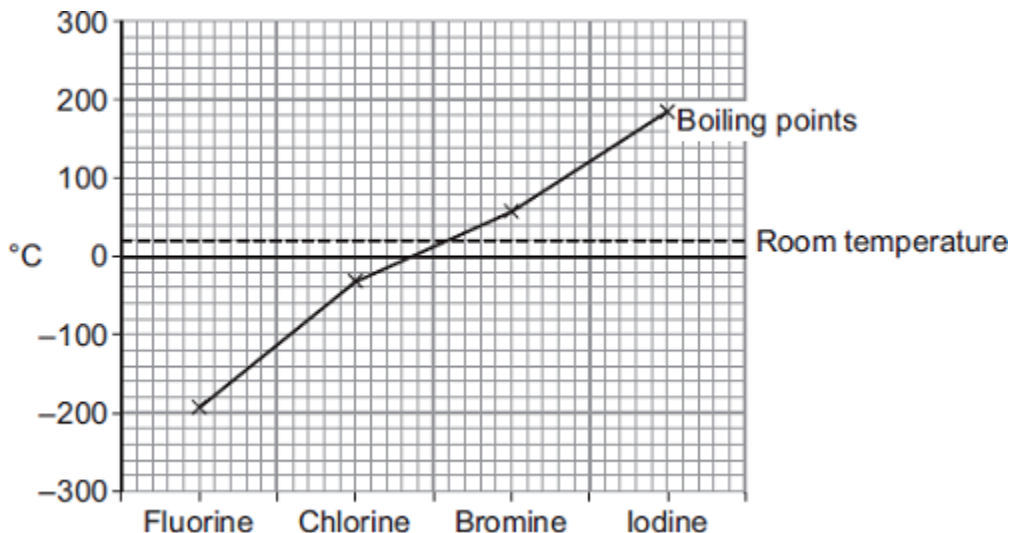
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(1)

(Total 6 marks)

**Q33.**

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?

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(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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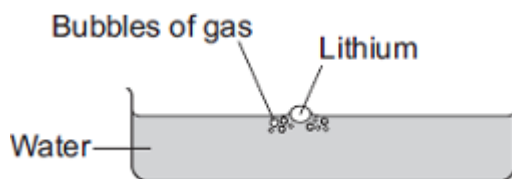
(1)

(Total 6 marks)

### Q34.

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.

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(1)

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

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(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.

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2.

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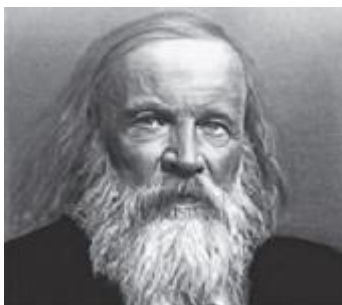
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(2)

(Total 4 marks)

### Q35.

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)



## Mark schemes

### Q1.

(a) 7 1

(b) small molecule 1

(c) F<sub>2</sub> 1

(d) the reactivity decreases (going down Group 7)  
*allow the reactivity decreases from chlorine to iodine* 1

(because) chlorine displaces bromine and iodine  
*allow (because) chlorine has two reactions*  
*allow (because) neither bromine nor iodine can displace chlorine* 1

(and) bromine displaces iodine **or** iodine does not react  
*allow (and) bromine has one reaction*  
*or iodine has no reactions*  
*allow (and) iodine cannot displace bromine* 1

(e) 80 1

(f) (1.2 kg =) 1200 (g)  
**or** (900 g =) 0.9 (kg) 1

$$\left(\frac{900}{1200} \times 100\right) = 75(\%)$$

**or**

$$\left(\frac{0.9}{1.2} \times 100\right) = 75(\%)$$

*allow an answer correctly calculated from:*

$$\left(\frac{900}{\text{incorrect attempt at conversion of 1.2}} \times 100\right)$$

**or**

$$\left(\frac{\text{conversion of 900}}{1.2} \times 100\right)$$

1

an answer of 75 (%) scores 2 marks

[9]

**Q2.**

- (a) sodium oxide  
*allow Na<sub>2</sub>O* 1
- (b) oxidation 1
- (c) 13 1
- (d) sodium hydroxide 1
- (e) OH<sup>-</sup> 1
- (f) (volume =)  $\frac{250}{1000}$  or  $\frac{1}{4}$   
or 0.25 (dm<sup>3</sup>) 1

**or**

(mass per cm<sup>3</sup> =)  $\frac{40}{1000}$  (g)  
or 0.04 (g)

( $\frac{250}{1000} \times 40 =$ ) 10 (g)

1

an answer of 10 (g) scores 2 marks

- (g) all points correct  
*allow a tolerance of  $\pm\frac{1}{2}$  a small square*  
*allow 1 mark for 3 points correct*  
*ignore any attempt at a line of best fit* 2
- (h) 39 °C  
*allow any value from 34 to 46 (°C)* 1

[10]

**Q3.**

- (a) FeS<sub>2</sub>  
*do not accept equations* 1

- (b) 26 1
- 30 1
- 26 1

*must be this order*

- (c) any **two** from:
- iron has a high(er) melting / boiling point
  - iron is dense(r)
  - iron is hard(er)
- allow iron is less malleable / ductile*
- iron is strong(er)
  - iron is less reactive
- allow specific reactions showing difference in reactivity*
- iron has ions with different charges
  - iron forms coloured compounds
  - iron can be a catalyst
- allow iron is magnetic*
- allow the converse statements for sodium*
- allow transition metal for iron*
- allow Group 1 metal for sodium*
- ignore references to atomic structure*
- ignore iron rusts*
- 2

- (d) carbon is more reactive (than nickel) 1
- allow converse*

(so) carbon will displace / replace nickel (from nickel oxide)

*allow (so) nickel ions gain electrons*

**or**

(so) carbon will remove oxygen (from nickel oxide)

*allow (so) carbon transfers electrons to nickel (ions)*

1

- (e) (total  $M_r$  of reactants =) 87 1

(percentage atom economy)

$$= \frac{59}{87} \times 100$$

*allow (percentage atom economy)*

$$= \frac{59}{\text{incorrectly calculated } M_r} \times 100$$

1

= 67.8 (%)

*allow an answer from an incorrect calculation to 3 sig figs*

1

*an answer of 67.8 (%) scores 3 marks*

*an answer of 67.8160919 (%) or correctly rounded answer to 2, 4 or more sig figs scores 2 marks*

*an incorrect answer for one step does not prevent allocation of marks for subsequent steps*

[11]

**Q4.**

- (a) potassium chloride **and** iodine

*either order*

*allow KCl for potassium chloride and I<sub>2</sub> for iodine*

1

- (b) (chlorine's) outer electrons / shell closer to the nucleus

*allow chlorine has fewer shells*

*allow chlorine atom is smaller than iodine atom*

*ignore chlorine has fewer outer shells*

1

(so) the chlorine nucleus has greater attraction for outer electrons / shell

*allow chlorine has less shielding*

*do **not** accept incorrect types of attraction*

1

(so) chlorine gains an electron more easily

1

***max 2** marks can be awarded if the answer refers to chloride / iodide instead of chlorine / iodine*

*allow converse statements*

*allow energy levels for shells throughout*

- (c) hydrogen chloride is made of small molecules

*allow hydrogen chloride is simple molecular*

1

(so hydrogen chloride) has weak intermolecular forces\*

1

(intermolecular forces) require little energy to overcome\*

1

*\*do **not** accept reference to bonds breaking unless applied to intermolecular bonds*

(d) (bonds broken =  $4(412) + 193 = 1841$ ) 1

(bonds formed =  $3(412) + 366 + X = 1602 + X$ ) 1

$-51 = 1841 - (1602 + X)$   
*allow use of incorrectly calculated values of bonds broken and / or bonds formed from steps 1 and 2 for steps 3 and 4* 1

$(X =) 290$  (kJ/mol)  
*allow a correctly calculated answer from use of  $-51 = \text{bonds formed} - \text{bonds broken}$*  1

**OR**

alternative method ignoring the 3 unchanged C–H bonds

$(412 + 193 =) 605$  (1)

$366 + X$  (1)

$-51 = 605 - (366 + X)$  (1)

$(X =) 290$  (kJ/mol) (1)  
*an answer of 290 (kJ/mol) scores 4 marks*  
*an answer of 188 (kJ/mol) scores 3 marks*  
*an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps*

[11]

**Q5.**

(a) chlorine is toxic 1  
*allow carbon monoxide is toxic*  
*allow poisonous for toxic*  
*ignore harmful / deadly / dangerous*  
*allow a poisonous gas is used / produced*  
*allow titanium chloride is corrosive*

(b) any **one** from:  
 • very exothermic reaction  
*allow explosive*  
*allow violent reaction*  
*ignore vigorous reaction*  
*ignore sodium is very reactive*  
 • produces a corrosive solution  
*allow caustic for corrosive*  
*ignore alkaline*

- produces hydrogen, which is explosive / flammable  
*allow flames produced*  
*ignore sodium burns* 1
  
- (c) argon is unreactive / inert  
*allow argon will not react (with reactants / products / elements)* 1
  
- oxygen (from air) would react with sodium / titanium  
**or**  
 water vapour (from air) would react with sodium / titanium  
*allow elements / reactants / products for sodium / titanium* 1
  
- (d) metal chlorides are usually ionic  
*allow titanium chloride is ionic* 1
  
- (so)(metal chlorides) are solid at room temperature  
**or**  
 (so)(metal chlorides) have high melting points  
*allow titanium chloride for metal chlorides* 1
  
- (because) they have strong (electrostatic) forces between the ions  
*ignore strong ionic bonds*

**or**  
 (but) must be a small molecule or covalent  
*allow molecular* 1

*allow alternative approach:*  
*titanium chloride must be covalent **or** has small molecules (1)*  
*with weak forces between molecules*  
*do **not** accept bonds unless intermolecular bonds(1)*  
*(but) metal chlorides are usually ionic (1)*
  
- (e) sodium (atoms) lose electrons  
*do **not** accept references to oxygen* 1
  
- (f)  $\text{Na} \rightarrow \text{Na}^+ + \text{e}^-$   
*do **not** accept e for e<sup>-</sup>* 1
  
- (g) ( $M_r$  of  $\text{TiCl}_4$  =) 190  
 $(\text{moles Na} = \frac{20\,000}{23} =) 870 \text{ (mol) }^*$

1

$$(\text{moles TiCl}_4 = \frac{40\,000}{190} =) 211 \text{ (mol) }^*$$

1

*\*allow 1 mark for 0.870 mol Na **and** 0.211 mol TiCl<sub>4</sub>*

*allow use of incorrectly calculated M<sub>r</sub> from step 1*

**either**

(sodium is in excess because) 870 mol Na is more than the 844 mol needed

**or**

(because) 211 mol TiCl<sub>4</sub> is less than the 217.5 mol needed

*the mark is for correct application of the factor of 4*

*other correct reasoning showing, with values of moles or mass, an excess of sodium or insufficient TiCl<sub>4</sub> is acceptable*

*allow use of incorrect number of moles from steps 2 and / or 3*

1

*alternative approaches:*

**approach 1:**

*(M<sub>r</sub> of TiCl<sub>4</sub> =) 190(1)*

*(40 kg TiCl<sub>4</sub> needs)*

$$\frac{40}{190} \times 4 \times 23 \text{ (kg Na) (1)}$$

*(=) 19.4 (kg) (1)*

*so 20 kg is an excess (1)*

**approach 2:**

*(M<sub>r</sub> of TiCl<sub>4</sub> =) 190(1)*

*(20 kg Na needs)*

$$\frac{20}{4 \times 23} \times 190 \text{ (kg TiCl}_4\text{) (1)}$$

*(=) 41.3 (kg) (1)*

*so 40 kg is not enough (1)*

(h)  $(\text{actual mass} =) \frac{92.3}{100} \times 13.5$

**or**

$(\text{actual mass} =) 0.923 \times 13.5$

1

$= 12.5 \text{ (kg)}$

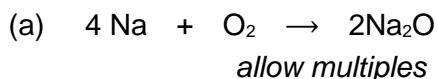
*allow 12 / 12.46 / 12.461 / 12.4605 (kg)*

1

*an answer 12.5 (kg) scores 2 marks*

[15]

**Q6.**



1

(b) (sodium) gains oxygen

1

(c) purple

1

(d) aluminium chloride

1

(e) **Level 2 (3-4 marks):**

Relevant reasons are identified, given in detail and logically linked to form a clear account.

**Level 1 (1-2 marks):**

Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

**Level 0**

No relevant content

**Indicative content**

**conclusion 1**

- pH values above 7 are alkaline
- sodium oxide, calcium oxide and magnesium oxide do form alkaline solutions (so correct for those)
- not all metal oxides form solutions (so incorrect for zinc oxide)

**conclusion 2**

- pH values below 7 are acidic
- carbon dioxide, sulfur dioxide and phosphorus oxide do form acidic solutions (so correct for those)
- not all non-metal oxides form solutions (so incorrect for silicon oxide)]

4

(f) metal oxides produce alkaline solutions if they dissolve in water  
*allow 1 mark for most metal oxides produce alkaline solutions*

2

[10]

**Q7.**

(a) J

1

(b) M and Q

*either order*

1

(c) Q



- 1
- (d) **M** 1
- (e) **L** 1
- (f) **Level 3 (5-6 marks):**  
 A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.
- Level 2 (3-4 marks):**  
 Some logically linked reasons are given. There may also be a simple judgement.
- Level 1 (1-2 marks):**  
 Relevant points are made. They are not logically linked.
- Level 0**  
 No relevant content

**Indicative content**

**comparative points**

- both tables have more than one element in a box
- both have similar elements in the same column
- both are missing the noble gases
- both arranged elements in order of atomic weight

**advantages of Mendeleev / disadvantages of Newlands**

- Newlands did not leave gaps for undiscovered elements
- Newlands had many more dissimilar elements in a column
- Mendeleev left gaps for undiscovered elements
- Mendeleev changed the order of some elements (e.g. Te and I)

**points which led to the acceptance of Mendeleev's table**

- Mendeleev predicted properties of missing elements
- elements with properties predicted by Mendeleev were discovered
- Mendeleev's predictions turned out to be correct
- elements were discovered which fitted the gaps

6

[11]

**Q8.**

- (a) **B** 1
- (b) **D** 1
- (c) **E** 1
- (d) **C** 1

- (e)  $92.5 \times 6$  and  $7 \times 7.5$  1
- $$\frac{607.5}{100}$$
1
- 6.075 1
- 6.08 1
- allow 6.08 with no working shown for 4 marks*

[8]

**Q9.**

- (a) 13 (protons) 1
- The answers must be in the correct order.  
if no other marks awarded, award 1 mark if number of  
protons and electrons are equal*
- 14 (neutrons) 1
- 13 (electrons) 1
- (b) has three electrons in outer energy level / shell 1
- allow electronic structure is 2.8.3*

- (c) **Level 3 (5–6 marks):**  
A detailed and coherent comparison is given, which demonstrates a broad knowledge and understanding of the key scientific ideas. The response makes logical links between the points raised and uses sufficient examples to support these links.

**Level 2 (3–4 marks):**  
A description is given which demonstrates a reasonable knowledge and understanding of the key scientific ideas. Comparisons are made but may not be fully articulated and / or precise.

**Level 1 (1–2 marks):**  
Simple statements are made which demonstrate a basic knowledge of some of the relevant ideas. The response may fail to make comparisons between the points raised.

**0 marks:**  
No relevant content.

**Indicative content**

Physical

Transition elements

- high melting points
- high densities
- strong
- hard

Group 1

- low melting points
- low densities
- soft

Chemical

Transition elements

- low reactivity / react slowly (with water or oxygen)
- used as catalysts
- ions with different charges
- coloured compounds

Group 1

- very reactive / react (quickly) with water / non-metals
- not used as catalysts
- white / colourless compounds
- only forms a +1 ion

6

[10]

**Q10.**

(a) The forces between iodine molecules are stronger

1

(b) anything in range +30 to +120

1

(c) Brown

1

(d)  $2 I^- + Cl_2 \rightarrow I_2 + 2 Cl^-$

1

(e) It contains ions which can move

1

(f) hydrogen iodine

1

[6]

**Q11.**

(a) (i) 7

1

(ii) -1

1

(iii) neutrons

1

(b) number of protons

- (c) atom Y 1
- (d) (i) Ne 1  
*allow neon* 1
- (ii) has a full outer shell  
*allow in Group 0*  
*allow a noble gas*
- or**
- full outer energy level  
*allow the shells are full*
- or**
- has 8 electrons in its outer shell  
*ignore in Group 8* 1

[7]

**Q12.**

- (a) (i) 7 / seven 1
- (ii) 1 1  
*do not accept -1* 1
- Electron 1
- (iii) isotopes 1
- (b) (i) (sodium + ) fluorine → sodium fluoride 1
- (ii) compounds 1
- (iii) mole 1
- (iv) sodium (atom) loses 1  
 fluorine (atom) gains 1  
 one electron 1  
 ions formed 1
- allow sodium forms positive (ion) or fluorine forms negative*

*(ion)*  
*allow form ionic bond*  
*allow to gain a full outer shell of electrons*  
*allow forms noble gas structure*  
**max 3** if reference to incorrect particle / bonding

- |     |                    |   |             |
|-----|--------------------|---|-------------|
| (v) | Dissolve in water  | 1 |             |
|     | High melting point | 1 |             |
|     |                    |   | <b>[13]</b> |

**Q13.**

- |     |   |  |   |
|-----|---|--|---|
| (a) | atomic weights  |  |   |
|     | <i>must be in this order</i>  |  | 1 |
|     | electrons   |  | 1 |
|     | proton numbers  |  | 1 |
| (b) | (i) H/hydrogen  |  |   |
|     | <i>allow H<sub>2</sub> or h</i>                                     |  | 1 |
|     | (ii) one / 1  |  |   |
|     | <i>allow alkali metals</i>  |  | 1 |
|     | (iii) Potassium (K)   |  | 1 |
|     | (iv) Iron has a higher density than potassium                       |  | 1 |
|     | Iron forms ions that have different charges                         |  | 1 |
| (c) | any <b>three</b> from:  |  |   |
|     | • melts   |  |   |
|     | • fizzes / bubbles / effervesces                                    |  |   |
|     | <i>allow gas produced</i>   |  |   |
|     | • sodium floats   |  |   |
|     | • size of the sodium decreases                                      |  |   |
|     | <i>allow dissolves / disappears</i>                                 |  |   |
|     | • sodium moves  |  |   |
|     | <i>allow two marks for moves around on the surface of the water</i> |  |   |
|     |   |  | 3 |

**[11]**

**Q14.**

- (a) (i) atomic weights  
*allow atomic masses* 1
- (ii) proton  
*allow proton number* 1
- (b) (i) F/fluorine  
*allow F<sub>2</sub>* 1
- (ii) any **one** from:
- copper has a higher density
  - copper is stronger
  - copper is harder
  - copper is less reactive
- allow named property*  
*ignore colour, conductivity, melting point and boiling point*  
*allow converse for potassium* 1
- (iii) relative distance from nucleus  
*allow more / fewer energy levels / shells or larger / smaller atom* 1
- relative attraction to nucleus  
*allow more / less shielding* 1
- relative ease of gain or loss of electron 1
- opposite explanation of ease of gain or loss of electron for other group 1
- max 3 marks if 'outer' not mentioned*

[8]

**Q15.**

- (a) Y 1
- (b) W 1
- (c) V 1
- (d) W 1
- (e) X 1

[5]

**Q16.**

- (a) (i) Proton 1
- (ii) Neutron 1
- (b) In order of increasing atomic number 1
- (c) (i) 9 1
- (ii) Gas 1
- (d) (i) gains (one) electron 1
- (to gain a) full outer energy level **or** noble gas configuration  
*allow because it has seven outer electrons* 1
- (ii) add sodium hydroxide (solution)  
*allow ammonia (solution) or ammonium hydroxide or any other soluble hydroxide or flame test* 1
- (forms a) blue precipitate  
*second mark dependent on suitable reagent being added  
allow blue-green / blue / green if flame test given* 1

[9]

**Q17.**

- (a) gold 1
- (b) atom (s) 1
- (c) (i) protons  
*any order  
allow proton* 1
- neutrons  
*allow neutron* 1
- (ii) 3 / three 1
- (d) (i) Al  
*ignore any numbers / charges*

- 1
- (ii) any **two** from:
- limited resource
  - expensive in terms of energy / mining
  - effects on the environment, such as, landfill, atmospheric pollution, quarrying
- allow uses a lot of energy to extract.*
- 2
- (e) resistant to corrosion
- 1
- does not react (with water or food)
- allow **one** mark for low density with a suitable reason given*
- 1

**[10]**

**Q18.**

- (a) (i) protons
- allow "protons or electrons", but do not allow "protons and electrons"*
- 1
- (ii) protons plus / and neutrons
- 1
- (b) (because the relative electrical charges are)  $- (1)$  for an electron and  $+ (1)$  for a proton
- allow electrons are negative and protons are positive*
- 1
- and the number of electrons is equal to the number of protons
- if no other mark awarded, allow 1 mark for the charges cancel out*
- 1
- (c) (the electronic structure of) fluorine is 2,7 and chlorine is 2,8,7
- allow diagrams for the first marking point*
- 1
- (so fluorine and chlorine are in the same group) because they have the same number of or 7 electrons in their highest energy level or outer shell
- if no other mark awarded, allow 1 mark for have the same / similar properties*
- 1
- (d) S
- 1
- (e) (i) ions
- 1
- (ii) molecules
- 1



[9]

**Q19.**

- |     |       |    |   |   |
|-----|-------|----|---|---|
| (a) | (i)   | Na | <i>allow sodium</i>   | 1 |
|     |       |    |   |   |
|     | (ii)  | Cu | <i>allow copper</i>   | 1 |
|     |       |    |   |   |
|     | (iii) | C  | <i>allow carbon</i>   | 1 |
|     |       |    |   |   |
|     | (iv)  | He | <i>allow helium</i>   | 1 |
|     |       |    |   |   |
| (b) | H     |    | <i>allow hydrogen</i><br><i>do <b>not</b> allow H<sub>2</sub></i> | 1 |

[5]

**Q20.**

- |     |   |  |   |
|-----|---|--|---|
| (a) | (iron) is a metal   | <i>accept transition element</i><br><i>allow (iron) had different properties (to oxygen and sulfur)</i><br><i>ignore electrons</i> | 1 |
|     |   |  |   |
| (b) | so that elements with similar properties could be placed together | <i>allow to make the pattern fit</i><br><i>ignore undiscovered elements</i>  | 1 |
|     |   |  |   |
| (c) | atomic number(s)  | <i>allow proton number(s)</i>  | 1 |
|     |   |  |   |
| (d) | all have one electron in the outer shell (highest energy level)   | <i>allow same number of electrons in the outer shell (highest energy level)</i>  | 1 |
|     |   |  |   |
|     | (so they) have similar properties                                 |  |   |
|     | <b>or</b>   |  |   |
|     | react in the same way   | <i>allow specific reactions e.g. with water</i>  | 1 |

[5]

**Q21.**

- (a) increase 1
- (b) (i)  $\text{Na}^+$  **and**  $\text{Br}^-$   
*both required* 1
- (ii) sodium chloride  
*allow NaCl*  
*do **not** allow sodium chloride* 1
- (iii) chlorine is more reactive than bromine  
*allow converse argument*  
*allow symbols Cl, Cl<sub>2</sub>, Br and Br<sub>2</sub>*  
*allow chlorine / it is more reactive*  
*do **not** allow chloride **or** bromide* 1
- (iv) fluorine  
*allow F / F<sub>2</sub>.*  
*do **not** allow fluoride.* 1
- [5]**

**Q22.**

- (a) Li **and** K  
*either order*  
*allow lithium **and** potassium* 1
- (b) Fe  
*allow iron* 1
- (c) N **and** As  
*either order*  
*allow nitrogen **and** arsenic* 1
- (d) Cu  
*allow copper* 1
- [4]**

**Q23.**

- (a) (i) an electron 1
- (ii) a neutron

- |     |       |                 |  |   |
|-----|-------|-----------------|--|---|
|     |       |                 |  | 1 |
|     | (iii) | 11              |  | 1 |
|     | (iv)  | boron           |  | 1 |
| (b) | (i)   | GH <sub>3</sub> |  | 1 |
|     | (ii)  | covalent        |  | 1 |

[6]

**Q24.**

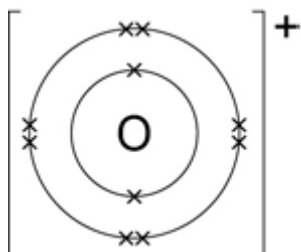
- |     |       |   |  |   |
|-----|-------|---|--|---|
|     |       |   |  |   |
| (a) | (i)   | Na  |  |   |
|     |       | <i>allow sodium / phonetic spelling</i>   |  |   |
|     |       | <i>if more than one answer is given apply list principle</i>  |  | 1 |
|     | (ii)  | Fe  |  |   |
|     |       | <i>allow iron / phonetic spelling</i>   |  |   |
|     |       | <i>if more than one answer is given apply list principle</i>  |  | 1 |
|     | (iii) | Na <b>or</b> S  |  |   |
|     |       | <i>allow sodium or sulfur / sulphur / phonetic spelling</i>   |  |   |
|     |       | <i>if more than one answer is given apply list principle</i>  |  | 1 |
|     | (iv)  | S   |  |   |
|     |       | <i>allow sulfur / sulphur / phonetic spelling</i>   |  |   |
|     |       | <i>if more than one answer is given apply list principle</i>  |  | 1 |
|     | (v)   | Na  |  |   |
|     |       | <i>allow sodium / phonetic spelling</i>   |  |   |
|     |       | <i>if more than one answer is given apply list principle</i>  |  | 1 |
| (b) | (i)   | any <b>three</b> from:  |  |   |
|     |       | <ul style="list-style-type: none"> <li>• effervescence / fizzing <b>or</b> bubbles <b>or</b> gas produced</li> <li><i>do <b>not</b> allow incorrectly named gas</i></li> <li>• sodium melts <b>or</b> turns into a ball</li> <li>• sodium moves (on the surface)</li> <li>• steam / mist / vapour is produced</li> <li><i>ignore heat / temperature / flame / spark</i></li> <li>• sodium gets smaller / disappears</li> <li><i>allow dissolves</i></li> <li>• colour of indicator is darker / more intense near the sodium</li> <li><i>Must be linked to near the sodium.</i></li> </ul> |  |   |

3

- (ii) hydroxide **or** OH<sup>-</sup>  
*allow OH without a charge*  
*do **not** allow OH<sup>+</sup>*

1

(c)



*diagram showing electron configuration of ion is 2,8*

1

*charge on ion is +*

*Bracket not necessary*

*[2,8]<sup>+</sup> is worth 1 mark as there is no diagram*

1

[11]

**Q25.**

- (a) (i) any **one** from:

- one electron in the outer shell / energy level
- form ions with a 1+ charge

1

- (ii) any **one** from:

- hydrogen is a non-metal
  - (at RTP) hydrogen is a gas
  - hydrogen does not react with water
  - hydrogen has only one electron shell / energy level
  - hydrogen can gain an electron **or** hydrogen can form a negative / hydride / H<sup>-</sup> ion
  - hydrogen forms covalent bonds **or** shares electrons
- accept answers in terms of the Group 1 elements*

1

- (b) (i) (bromine) gains electrons

*it = bromine*

*do **not** accept bromide ion gains electrons*

*ignore loss of oxygen*

1

- (ii) I<sub>2</sub>

*must both be on the right hand side of the equation*

1

+ 2e<sup>-</sup>

$2F - 2e^- \rightarrow I_2$  for 2 marks

1

- (iii) fluorine is the smallest atom in Group 7 **or** has the fewest energy levels in Group 7 **or** has the smallest distance between outer shell and nucleus  
*the outer shell **must** be mentioned to score 3 marks*

1

fluorine has the least shielding **or** the greatest attraction between the nucleus and the outer shell

1

therefore fluorine can gain an electron (into the outer shell) more easily

1

[8]

**Q26.**

- (a) (i) atomic weight

1

- (ii) groups

1

- (iii) left a gap

1

- (iv) had not been discovered by 1869

1

- (b) protons

*must be in correct order*

1

electrons

1

- (c) sodium and nickel are both metals

1

sodium is more reactive than nickel

1

- (d) (i) bromine

*allow Br<sub>2</sub> / Br*

*do **not** allow bromide*

1

- (ii) iodine is less reactive (than bromine)

*it = iodine*

*allow converse*

*do **not** allow bromide*

1

[10]

**Q27.**

- (a) (i) E 1
- (ii) C 1
- (iii) A 1
- (b) (i) quickly melted  
*allow melts in contact with water,*  
*allow bp 100 °C (of water) shows mp is low*  
*ignore one other piece of information* 1
- (ii) easily cut  
*ignore one other piece of information* 1
- (iii) effervescence / fizzing / bubbling  
*ignore named gas*  
*ignore one other piece of information* 1

[6]

**Q28.**

- (a) similar properties  
*allow same properties*  
*allow correct example of property*  
*ignore answers in terms of atomic structure* 1
- (b) (i) in order of atomic / proton number  
*allow increasing number (of protons)* 1
- (ii) elements in same group have same number (of electrons) in outer shell  
**or** highest energy level  
*allow number (of electrons) increases across a period* 1
- (c) any **two** from:  
*statements must be comparative*
- stronger / harder  
*ignore higher densities*
  - less reactive
  - higher melting points  
*ignore boiling point*
- 2
- (d) reactivity increases down group

*allow converse throughout*  
*for next three marks, outer electron needs to be mentioned*  
*once otherwise max = 2*

1

*outer electron is further from nucleus*  
*allow more energy levels / shells*  
*allow larger atoms*

1

*less attraction between outer electron and nucleus*  
*allow more shielding*

1

*therefore outer electron lost more easily*

1

[9]

**Q29.**

- (a) if placed consecutively, then elements would be in wrong group / have wrong properties

*allow some elements didn't fit pattern*

1

left gaps

1

- (b) (elements placed in) atomic / proton number order

1

(elements in ) same group have same number of outer electrons

1

any **one** from:

- number of protons = number of electrons
- reactions/(chemical) properties depend on the (outer) electrons
- number of shells gives the period

*allow number of shells increases down the group*

1

- (c) (i) (transition elements usually) have same / similar number of outer / 4th shell electrons

*allow 2 electrons in outer shell*

1

(because) inner (3rd ) shell / energy level is being filled

*ignore shells overlap*

1

- (ii) 2<sup>nd</sup> shell / energy level can (only) have maximum of 8 electrons

*accept no d-orbitals*

or  
2<sup>nd</sup> shell / energy level cannot have 18 electrons

1

[8]

**Q30.**

(a) (i) any **two** from:

- bubbles / effervescence / fizzing  
*ignore hydrogen / gas produced*
- lithium disappears / gets smaller  
*allow dissolves*  
*do **not** allow melts / burns*
- lithium moves on the surface of the water  
*ignore floats*
- (universal indicator) turns blue / purple

2

(ii) 2

*left-hand side correct*

1

2

*right-hand side correct*

*allow multiples for full credit*

1

(iii) light / burn, which will give a (squeaky) pop / explosion

1

(iv) all have 1 electron in their outer shell / energy level

*allow have the same number of electrons in their outer shell / energy level*

1

(b) They react with oxygen

1

They have low melting points

1

(c) (i) electronic structure [2,8,8] is drawn

*incomplete inner shells scores a maximum of 1 mark*

1

charge is +

*allow [2,8,8]<sup>+</sup> for 1 mark*

1

(ii) because (in potassium) the outer shell electron is further away from the nucleus **or** because potassium atoms are larger than sodium atoms

*it should be clear that the candidate is referring to the outer shell electron: if this is not clear a maximum of 2 marks can be awarded*



1

therefore the outer shell electron is less strongly attracted to the nucleus **or** is more shielded from the attraction of the nucleus and so the outer shell electron in potassium is more easily lost

1

**3 marks can be scored for answering the question in terms of sodium**

1

[13]

**Q31.**

(a) 1 / one

1

(b) (i) protons

1

(ii) neutrons

1

(iii) 7

1

(c) (i) losing

1

(ii) a positive

1

(iii) electrostatic

1

(d) high melting points

1

strong bonds

1

(e) (i) 58.5

1

(ii) mole

1

(f) very small (particles) **or**

*ignore tiny / small / smaller / microscopic etc.*

1-100nm in size **or**

(particle with a) few hundred atoms

1

[12]

**Q32.**

(a) number

- |     |  |   |
|-----|--|---|
|     |  | 1 |
|     | 0  |   |
|     | <i>allow 8</i>   |   |
|     |  | 1 |
| (b) | beryllium <b>or</b> magnesium <b>or</b> strontium <b>or</b> barium <b>or</b> radium<br><i>allow correct symbols</i>  | 1 |
| (c) | (i) an alkali metal  | 1 |
|     | (ii) a transition metal  | 1 |
| (d) | for undiscovered elements<br><i>accept so elements with similar properties were in the same groups</i><br><i>accept so elements fitted the pattern of properties</i> | 1 |

**[6]**

**Q33.**

- |     |   |   |
|-----|---|---|
|     | (a) (i) gas   | 1 |
|     | (ii) Increases  | 1 |
| (b) | (i) -1<br><i>allow Cl<sup>-</sup></i><br><i>allow -</i><br><i>allow negative</i>  | 1 |
|     | (ii) sodium + chlorine → sodium chloride<br><i>allow correct symbol equation</i>  | 1 |
| (c) | reduce microbes<br><i>accept sterilise</i><br><i>accept prevent diseases</i><br><i>allow disinfect</i><br><i>allow kill bacteria / germs / microbes / micro-organisms</i><br><i>allow to make it safe to drink</i><br><i>ignore get rid of bacteria</i> | 1 |
| (d) | any <b>one</b> from:<br><br>• no freedom of choice<br><i>allow unethical</i>  |   |

- fluoride in toothpaste
- too much can cause fluorosis  
     *allow too much can cause damage to teeth*

1

[6]

**Q34.**

- (a) (i) hydrogen

*accept H<sub>2</sub>*

*allow H*

1

- (ii) hydroxide

*accept OH<sup>-</sup>*

*allow OH*

*do **not** accept lithium hydroxide*

1

- (b) any **two** from:

*'it' = potassium*

potassium:

*accept converse for lithium*

- reacts / dissolves faster  
     *allow reacts more vigorously / quickly / violently / explodes*  
     *ignore reacts more*
- bubbles / fizzes faster  
     *allow fizzes more*  
     *allow more gas*
- moves faster (on the surface)  
     *allow moves more*
- melts  
     *allow forms a sphere*
- produces (lilac / purple) flame  
     *allow catches fire / ignites*  
     *do **not** accept other colours*

2

[4]

**Q35.**

- (a) groups

1

- (b) it is a non-metal

*allow it is not a metal*

1

- (c) to the right of column 7 / Group 7  
*accept in Group 0*  
*ignore Group 8 / noble gases*

1

- (d) (atomic) number  
*allow proton number*

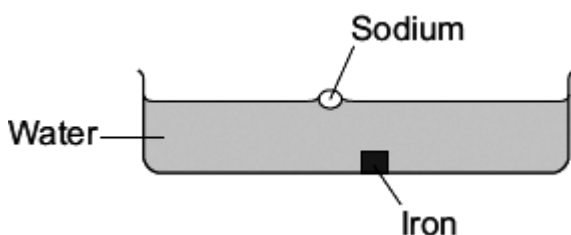
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**[4]**

**Q1.**

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

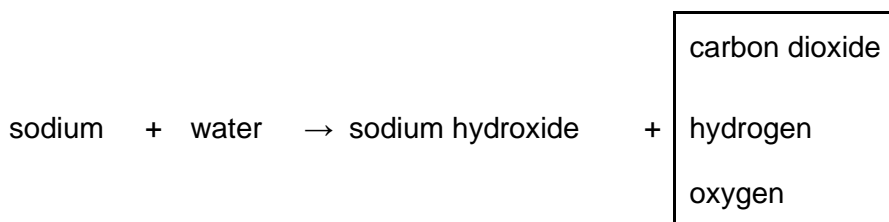
- (a) Tick (✓) **two** properties of sodium compared with iron that are shown by the student's observations.

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.



(1)

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

Sodium hydroxide is an alkali because it produces 
 

H <sup>+</sup> (aq)
OH <sup>-</sup> (aq)
Na <sup>+</sup> (aq)

 ions

in aqueous solution.

(1)

(Total 4 marks)

## Q2.

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		



<b>Period 4</b>	<b>K</b> Cu	<b>Ca</b> Zn	–	–	<b>Ti</b> As	<b>V</b> Se	<b>Cr</b> Br	<b>Mn</b>	<b>Fe Co Ni</b>
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- (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

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(1)

(ii) explain why sodium is more reactive than lithium.

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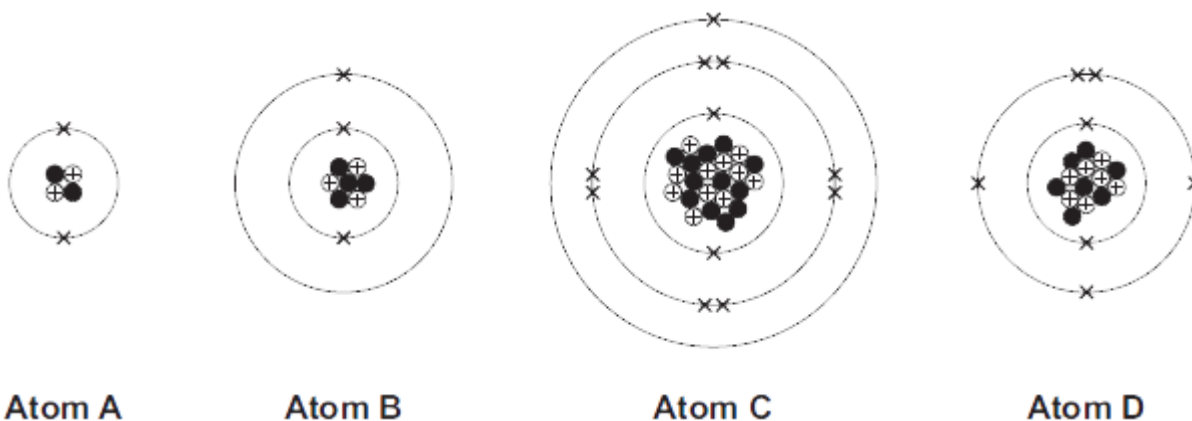
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(3)

(Total 10 marks)

**Q3.**

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)

#### Q4.

The table shows some properties of gases in dry air

Gas in dry air	Density in kg/m <sup>3</sup>	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.

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(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.

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(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.

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(2)  
(Total 6 marks)

**Q5.**

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.	<input type="checkbox"/>
These metals have low melting points.	<input type="checkbox"/>
These metals do not react with water.	<input type="checkbox"/>

These metals have low densities.	
----------------------------------	--

(2)

(Total 3 marks)

**Q6.**

The halogens are in Group 7 of the periodic table.

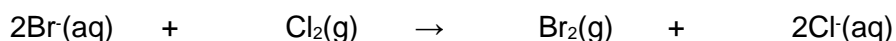
- (a) Why, in terms of electrons, are the halogens in Group 7?

---

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(1)

- (b) Sea water contains bromide ions ( $\text{Br}^-$ ).  
The bromide ions can be changed to bromine by bubbling chlorine gas into sea water.  
Chlorine is able to displace bromine from sea water because chlorine is more reactive than bromine.



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

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(3)

(Total 4 marks)

**Q7.**

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.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



(iii) an alkali metal

(1)

(iv) the element with atomic (proton) number of 47

(1)

(v) an element with seven electrons in its outer shell?

(1)

(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.	

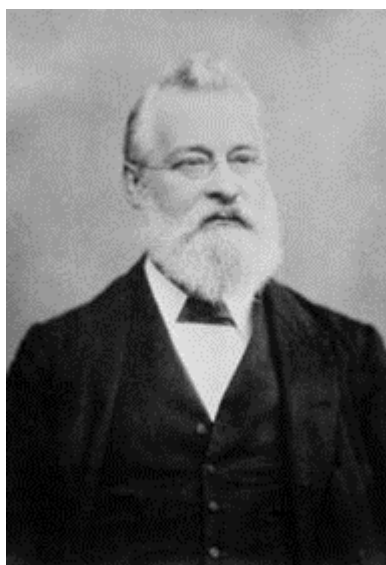
(2)

(Total 9 marks)

**Q9.**

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.

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(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
<b>Chlorine</b>		Solution turned orange-brown	Solution turned brown



<b>Bromine</b>	No reaction		Solution turned brown
<b>Iodine</b>	No reaction	No reaction	

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

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(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.

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(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.

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(3)

**Q10.**

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.

<b>Sb</b>	<b>Se</b>	<b>Si</b>	<b>Sn</b>	<b>Sr</b>
-----------	-----------	-----------	-----------	-----------

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)

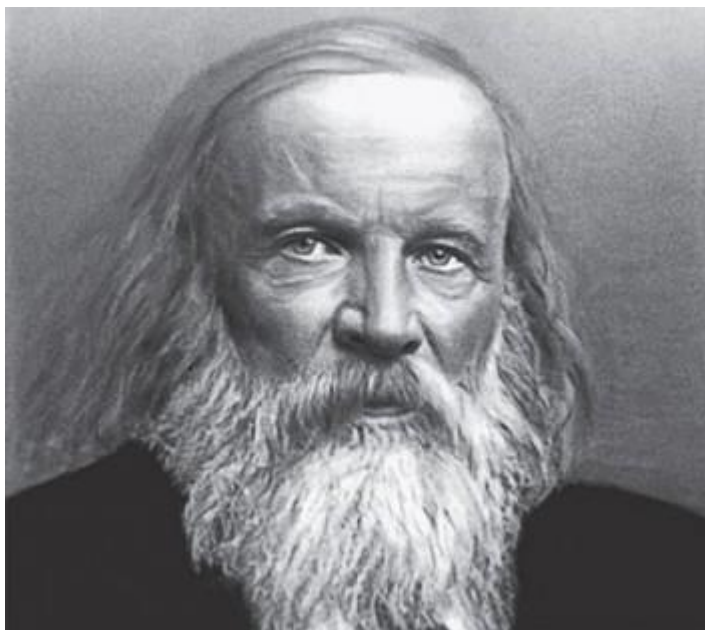
- (iii) the element with atomic (proton) number of 50

(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.

compounds

Mendeleev left gaps for

elements

that had not been discovered.

mixtures

(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)

### Q11.

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.

---



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(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.

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(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.

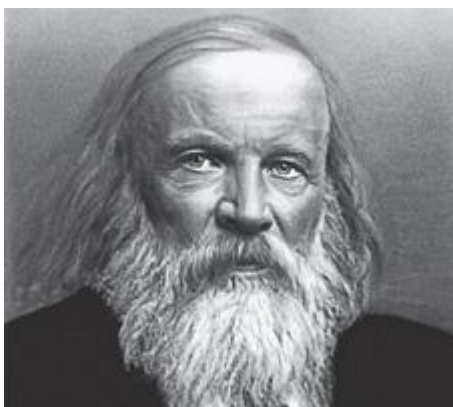
Property 1 \_\_\_\_\_

Property 2 \_\_\_\_\_

(2)  
(Total 6 marks)

**Q12.**

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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- (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?

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(1)

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

Suggest **three** reasons why.

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(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.

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(2)  
(Total 7 marks)

**Q13.**

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

Part of the periodic table is shown below.

	<b>B</b>						<b>C</b>						<b>A</b>			
															<b>D</b>	
<b>E</b>																

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:

(i) an alkali metal    Letter

(1)

(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:

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

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(1)

(ii) sodium is soft

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(1)

(iii) a gas was produced?

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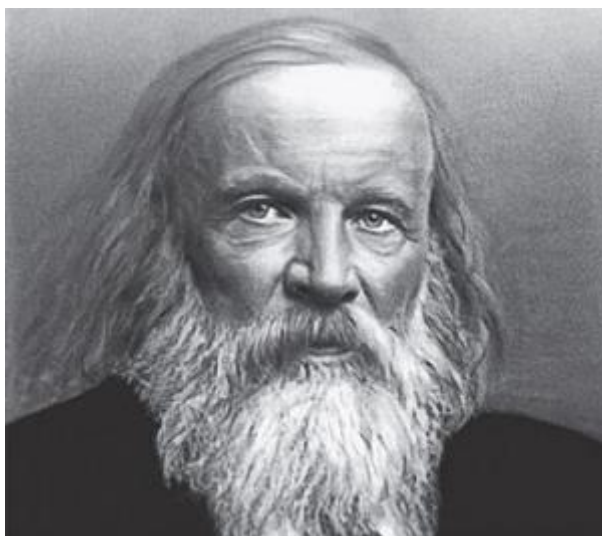
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(1)

(Total 7 marks)

**Q14.**

- (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?

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**(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.

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(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.

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(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.

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(1)

(Total 8 marks)

**Q15.**

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

Part of the periodic table is shown below.

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

										A														
B												C												
										D														
																						E		
																						F		

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

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

- (i) hydrogen Letter  (1)
- (ii) a Group 3 element Letter  (1)
- (iii) a halogen Letter  (1)
- (iv) the element with atomic (proton) number of 7 Letter  (1)
- (v) an element with one electron in its outer shell? Letter  (1)

- (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  → 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	<input type="checkbox"/>
They have lower densities than Group 1 metals	<input type="checkbox"/>
They have higher melting points than Group 1 metals	<input type="checkbox"/>
They are more reactive with water than Group 1 metals	<input type="checkbox"/>
They often form coloured compounds but Group 1 compounds are usually white	<input type="checkbox"/>

(3)

(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.

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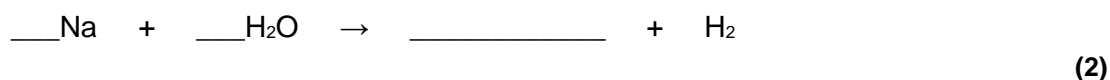
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\_\_\_\_\_ (3)

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



(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.

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)

Dimitri Mendeleev attempted to classify

compounds.
elements.
mixtures.

(1)

(ii)

He arranged them in order of their

atomic weight.  
boiling point.  
electrical conductivity.

(1)

(iii)

They are now arranged in order of their

atomic (proton) number.  
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)

**Q18.**

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.

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(1)

- (b) Suggest why Döbereiner's ideas were replaced by those of Mendeleev.

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(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.

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(2)

(d) In terms of electronic structure, explain why:

(i) elements in the same group of the periodic table have similar chemical properties

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(1)

(ii) transition elements have similar properties even though they are not in the same group

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(2)

(iii) in Group 1, lithium is **less** reactive than potassium.

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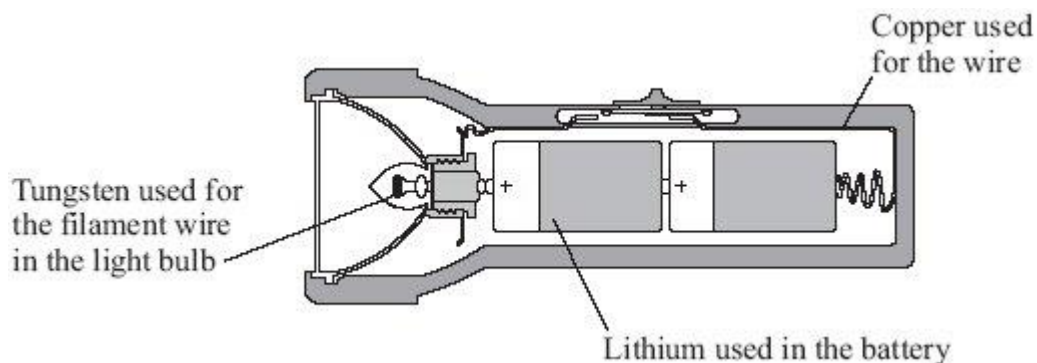
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(2)

(Total 9 marks)

**Q19.**

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

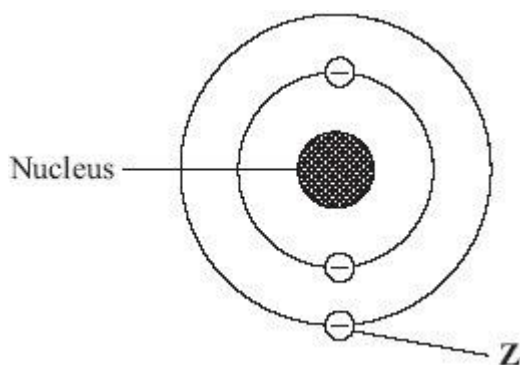


(a) Why is copper used for the wire?

---

(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 <b>slowly</b> to form a thin oxide layer on surface
Lithium	179	1317	Reacts <b>rapidly</b> to form oxide
Tungsten	3370	5930	Reacts <b>only</b> 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** \_\_\_\_\_

- (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)

**Q20.**

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.
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(1)

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

groups. periods. rows.
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(1)

(c) He left gaps for elements that were

insoluble. unreactive. undiscovered.
--

(1)

(d) He did **not** put water, H<sub>2</sub>O, into the periodic table because water is a

compound. liquid. mixture.
----------------------------------

(1)

(Total 4 marks)

**Q21.**

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
<b>Fluorine</b>	-220	-188	2, 7
<b>Chlorine</b>	-101	-35	2, 8, 7
<b>Bromine</b>	-7	58	2, 8, 18, 7
<b>Iodine</b>	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.

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(2)

(Total 8 marks)

**Q22.**

Chlorine and bromine are important Group 7 elements.

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

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(1)

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

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(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.

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(1)

(d) In terms of electronic structure:

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

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(1)

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

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(3)

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

(i) chloride ions

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(1)

(ii) bromide ions?

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(1)

(Total 10 marks)

**Q23.**

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).

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(1)

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

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

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(1)

- (c) In the 1890s a new group of elements (Group 0) was discovered.

Suggest why they were easily fitted into Mendeleev's table.

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(1)

(Total 3 marks)

**Q24.**

- (a) The periodic table on the Data Sheet may help you to answer this question.

Part of the periodic table is shown below.

														A
B												C		
		D												
E														

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

Which letter, **A** to **E**, represents:

(i) sodium

Letter \_\_\_\_\_ (1)

(ii) a non-metal

Letter \_\_\_\_\_ (1)

(iii) a Group 2 element

Letter \_\_\_\_\_ (1)

(iv) a transition element?

Letter \_\_\_\_\_ (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

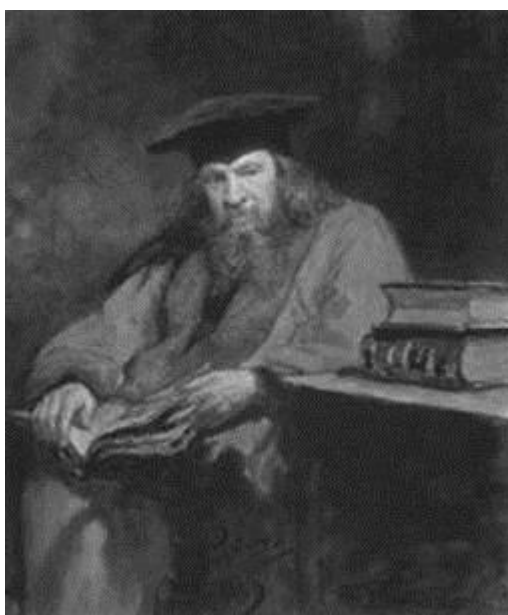
in their outer shell (energy level).

(1)

(Total 8 marks)

**Q25.**

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.

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(1)

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

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(1)

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

Explain how.

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(3)

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

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(1)

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

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(3)

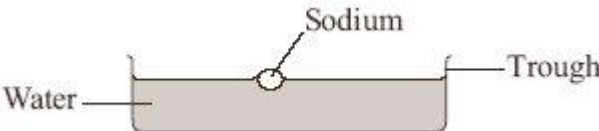
(Total 9 marks)

**Q26.**

- (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

identical
the same

similar

properties occur at regular intervals.

(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)

### Q27.

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".

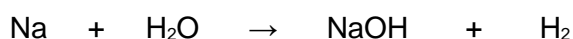
(a) Group 1 metals are stored under oil.

Suggest why.

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(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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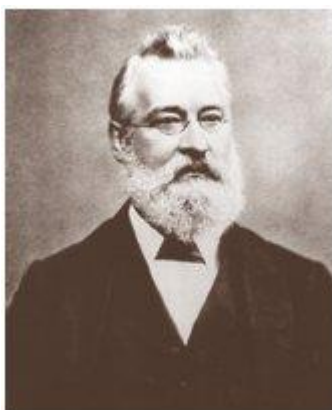
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(3)

(Total 6 marks)

**Q28.**

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
<p>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.</p>						

*Reproduced courtesy of the library and information centre Royal Society of Chemistry*

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)

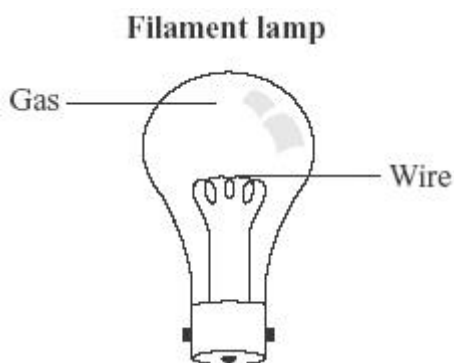
(c) Suggest **two** reasons why other chemists did not accept Newlands' ideas.  
 1. \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 2. \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ (2)

(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.  
 \_\_\_\_\_  
 \_\_\_\_\_ (1)

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

**Q29.**

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.

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(2)

(b) The table shows some gases.

Gas
Argon
Carbon dioxide
Oxygen
Sulfur dioxide



Which gas in the table should be used in a filament lamp?

Give a reason for your answer.

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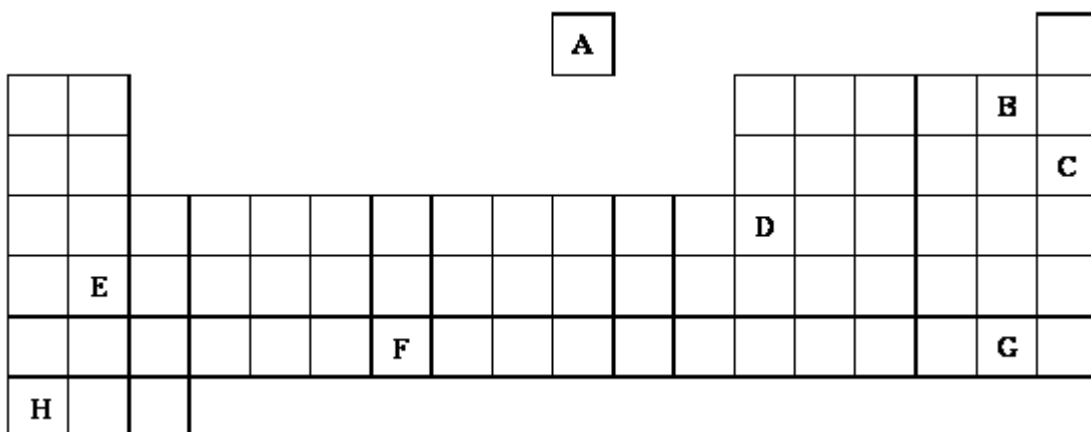
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(2)  
(Total 4 marks)

**Q30.**

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

The diagram shows an outline of the periodic table.



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)

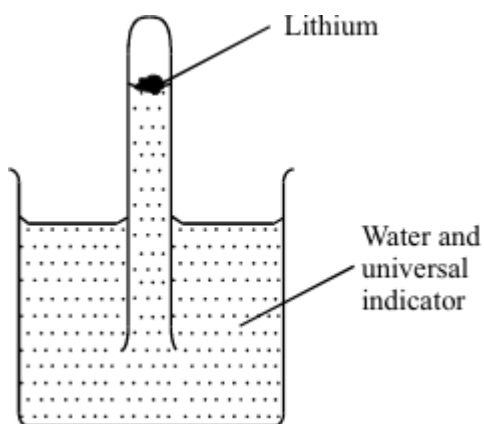
(e) is the most reactive metal?

Letter \_\_\_\_\_ (1)

**(Total 5 marks)**

**Q31.**

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.*

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**(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.

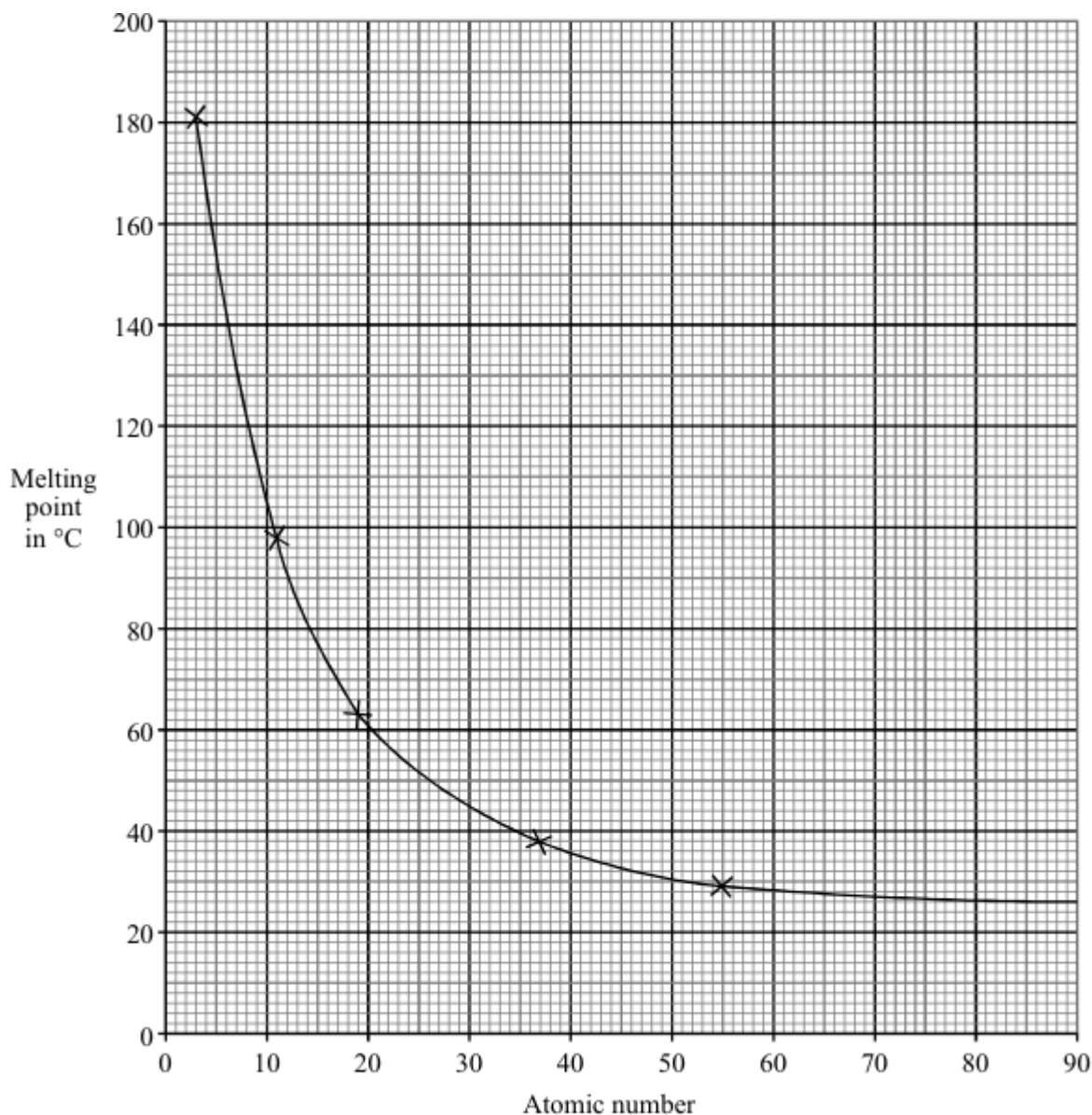
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(1)

- (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.

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(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)

**Q32.**

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

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

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

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(3)

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

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Period 1	H							
Period 2	Li	Be	B	C	N	O	F	
Period 3	Na	Mg	Al	Si	P	S	Cl	
Period 4	K Cu	Ca Zn	? ?	Ti ?	V As	Cr Se	Mn Br	Fe Co Ni
Period 5	Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	? I	Ru Rh Pd

This table became accepted by other scientists.

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

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

(2)  
(Total 5 marks)

**Q33.**

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.

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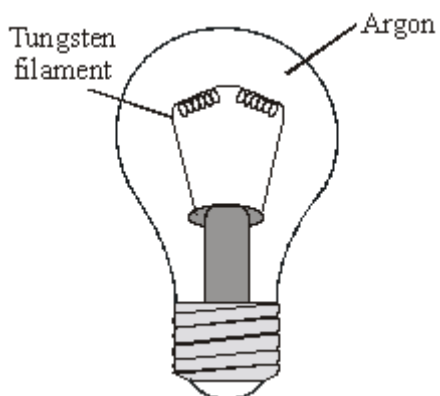
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(2)  
(Total 4 marks)

**Q34.**

The diagram shows an electric light bulb.



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

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

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(1)

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

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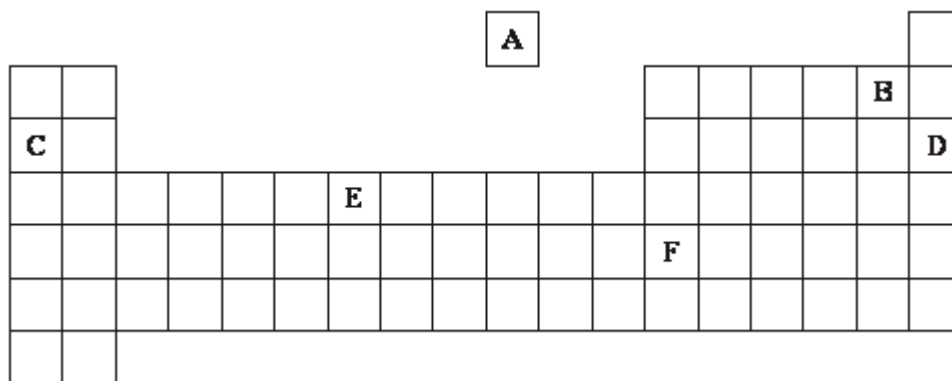
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(3)  
(Total 4 marks)

**Q35.**

The diagram shows an outline of the periodic table.



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

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

Which element, **A** to **F**:

- (a) is in Group 3;

\_\_\_\_\_ (1)

- (b) is a metal which floats on water and reacts violently to make an alkaline solution and hydrogen gas;

\_\_\_\_\_ (1)

- (c) is a gas which burns with a squeaky pop?

\_\_\_\_\_ (1)

**(Total 3 marks)**

## Mark schemes

### Q1.

- (a) sodium has a lower density 1
- sodium is more reactive 1
- (b) hydrogen 1
- (c) OH-(aq) 1

[4]

### Q2.

- (a) (i) *incorrect or no element = 0 marks*
- hydrogen 1  
*allow H / H<sub>2</sub>*
- all the other elements are metals  
*allow hydrogen is a not an (alkali / group 1) metal*  
*ignore hydrogen is a gas*
- OR**
- copper (1)  
*allow Cu*
- (copper) is not an alkali metal (1)  
*allow Cu is a transition element / metal*  
*allow any valid specific chemical property eg Cu does not react with water*  
*ignore references to electronic structure*  
*ignore physical properties* 1
- (ii) Group 0 / noble gases 1  
*ignore Group 8*
- (b) (i) scandium / gallium / germanium 1  
*accept Sc / Ga / Ge*  
*allow Krypton / Kr*
- (ii) predicted they were metals



- 1
- 1
- (c) (i) (both) have one / an electron in the outer energy level / shell  
*ignore form single plus ions* 1
- (ii) *accept shell for energy level*  
*accept converse explanation for lithium*  
*if 'outer' not mentioned, max 2 marks*  
*ignore sodium reacts more easily*
- sodium loses one outer electron more easily (than lithium) 1
- because outer electrons/energy level further from the nucleus in sodium  
**or** because sodium has more shells (than lithium)  
*do **not** accept 'more outer shells'*  
*allow sodium (atom) is larger* 1
- because forces/attraction to hold outer electron are weaker in sodium  
 (than lithium)  
*accept more shielding in sodium (than lithium)* 1
- [10]**
- Q3.**
- (a) (i) nucleus 1
- (ii) protons 1
- (b) protons / + / positive  
 electrons / – / negative  
*both words needed in any order for 1 mark* 1
- (c) nitrogen  
*allow N or N<sub>2</sub>* 1
- (d) **B and C**  
*both letters needed in any order for 1 mark*

*allow Li **and** Na*

1

(both) have one electron **or** same number of electrons in the outer energy level / shell

*allow both are in Group 1*

*allow both are alkali metals*

*allow both can lose only one electron **or** become +1 ions*

*allow this mark if no letters given in boxes*

1

[6]

**Q4.**

- (a) because the nitrogen from dry air contained noble/Group 0 gases

*ignore other gases*

**or**

(because the nitrogen from dry air) contained argon / krypton / xenon

*ignore helium and neon*

1

and three / some of these gases, (argon, krypton, xenon) have a greater density than nitrogen

*ignore helium and neon*

**or**

and argon / krypton / xenon has a greater density than nitrogen

1

- (b) (i) carbon dioxide would form / is a solid

*accept carbon dioxide freezes or its freezing point is > – 200°C*

*ignore melting point*

**or**

(solid) carbon dioxide would block pipes

1

- (ii) helium (**and**) neon

*both needed for 1 mark*

*accept He and Ne*

1

- (iii) argon (**and**) oxygen

*accept Ar and O<sub>2</sub>*

1

because there is only a difference of 3°C in their boiling points

*accept because they have boiling points that are almost the same*

1

[6]

**Q5.**

- |     |                                      |   |
|-----|--------------------------------------|---|
| (a) | transition elements                  | 1 |
| (b) | These metals do not react with air   | 1 |
|     | These metals do not react with water | 1 |

[3]

**Q6.**

- |     |  |   |
|-----|--|---|
| (a) | all have seven electrons in their outer shell / energy level   | 1 |
| (b) | <i>must be comparative in all points or converse</i>   |   |
|     | chlorine atom is smaller than bromine atom   |   |
|     | <b>or</b>  |   |
|     | chlorine atom has fewer shells than bromine atom   | 1 |
|     | outer shell / energy level of chlorine has stronger (electrostatic) attraction to the nucleus than bromine |   |
|     | <b>or</b>  |   |
|     | outer shell of chlorine is less shielded from the nucleus than bromine                                     | 1 |
|     | so chlorine more readily <u>gains</u> an extra electron  | 1 |

[4]

**Q7.**

- |     |   |   |
|-----|---|---|
| (a) | any <b>two</b> from:  |   |
|     | <ul style="list-style-type: none"> <li>• <u>react with water</u> <b>or</b> <u>very reactive</u></li> <li>• (react with water) releasing gas / hydrogen / fizzing</li> <li>• (react with water) to form an alkaline / hydroxide solution</li> <li>• form ions with a <u>1+</u> charge</li> </ul> |   |
|     | <i>allow lose one electron from the outer shell</i><br><i>ignore other references to electronic structure</i><br><i>ignore physical properties</i>  |   |
|     |   | 2 |

(b) any **three** from:

- some boxes contain two elements  
*allow specific examples:*  
*Co, Ni or Ce, La or Di, Mo or Ro, Ru or Ba, V or Pt, Ir*
- groups / columns contain elements with different properties  
*allow groups / columns contain both metals and non-metals*  
*ignore examples*
- Newlands not a well-known / respected scientist  
*ignore references to sugar factory*
- new idea (not readily accepted by other scientists)  
*allow musical scales thought to be silly by some scientists*

3

(c) one for improvement **and** one for explanation from:

- left gaps (for undiscovered elements) (1)
  - so that elements were in their correct group (1)  
*allow so the elements fitted the pattern of properties*
- or**
- did not always follow order of relative atomic weights / masses (1)  
*ignore references to atomic number / electronic structure*
  - so that elements were in their correct group (1)  
*allow so the elements fitted the pattern of properties*

2

[7]

**Q8.**

(a) (i) B

1

(ii) E

1

(iii) F

1

(iv) D

1

(v) C

1

(b) (i) Br

*do not accept BR or br or bR*

*ignore numbers*  
*allow written in table if answer blank*

1

(ii) I Br Cl

*allow iodine, bromine, chlorine*

*allow I,B,C*

*allow capitals or lower case*

*allow 184, 58, -34*

*ignore numbers*

1

(c) they are halogens

1

they become less reactive down Group 7

1

[9]

**Q9.**

(a) (i) a correct link between any two named elements eg same group / column  
 same properties / number of outer electrons

*allow some link between any two elements in the same  
 group (in both Newlands and or the modern periodic table)*

1

(ii) any **two** from:

*ignore statements about lack of evidence / proof*

- elements still being discovered

**or**

no gaps for undiscovered elements

- some boxes have 2 elements in them
- metals and non-metals in same column / mixed up  
*accept some elements in same column have different  
 properties.*

*allow any sensible suggestion about misplaced elements eg  
 copper in group 1 elements*

- pattern for first 16 or so elements only  
*allow did not work for all elements*

2

(b) (i) Cl > Br > I

*accept reactivity / it decreases down the group*

**or**

I < Br < Cl

1

Cl has 2 reactions, Br has 1 reaction, I doesn't react

*owtte*

*allow Cl has most / more reactions and I has least / less reactions (must be clear about where Br fits in)*

1

(ii) Br<sub>2</sub>

*allow multiples / fractions if correctly completed and balanced*

1

(iii) (they) have 7 outer electrons

*allow (they) have 7 electrons in highest occupied (energy) level / shells / rings*

1

(c)

*outer / last / final must be mentioned once in correct context, otherwise max 2 marks comparative required on all three points accept converse ie less reactive up group*

down group (atom / elements) bigger

**or**

outer electrons (level / shell / ring) further from nucleus / centre  
*ignore more electrons*

**or**

more shells / level / rings

*do **not** accept more outer shells for this mark*

1

force(s) / attraction(s) are weaker

*allow electron(s) attracted less easily*

*allow electron(s) less under influence (of nucleus)*

**or**

more shielding

**or**

1

attracts less

*do **not** accept magnetic / gravitational / intermolecular forces*

electron(s) lost more easily

*allow electron(s) more likely to be lost*

*allow easier to give away*

1

[10]

**Q10.**

- |     |       |               |   |
|-----|-------|---------------|---|
| (a) | (i)   | Sb            | 1 |
|     | (ii)  | Se            | 1 |
|     | (iii) | Sn            | 1 |
|     | (iv)  | Si            | 1 |
| (b) | (i)   | elements      | 1 |
|     | (ii)  | potassium (K) | 1 |
|     | (iii) | 0             | 1 |

[7]

**Q11.**

- |     |      |  |   |
|-----|------|--|---|
| (a) | (i)  | <i>it = copper</i>   |   |
|     |      | (copper) stops barnacles / seaweed (sticking)<br><i>accept lead doesn't stop barnacles / seaweed (sticking)</i><br><i>ignore all other properties</i>  | 1 |
|     | (ii) | <i>it = Muntz Metal</i>  |   |
|     |      | (Muntz Metal) is less expensive / cheaper / cheapest<br><i>must be a comparison</i><br><i>accept copper is more expensive</i><br><i>ignore other properties</i>  | 1 |
| (b) | (i)  | atomic absorption spec(troscopy) / spectrometry <b>or</b> mass spec(trometry) / spectroscopy<br><i>accept spectroscopy / spectrometry alone</i><br><i>allow AAS / MS</i><br><i>do <b>not</b> allow NMR spectroscopy</i><br><i><b>or</b> IR spectrometry <b>or</b> chromatography</i> | 1 |
|     | (ii) | <i>it = instrumental method</i>  |   |
|     |      | sensitive <b>or</b> detect (very) small amounts<br><b>or</b> only small sample needed<br><i>allow (more) precise</i><br><i>ignore accurate</i><br><i>allow converse for chemical method</i><br><i>ignore metal contains small amount / low concentration of</i>                      |   |

iron

1

(c) any **two** from:

*transition elements (= they)*

- unreactive / not very reactive  
*allow does not corrode*  
*ignore reference to rust*
- strong / hard  
*ignore tough / durable / hard wearing*
- malleable / easy to shape  
*ignore ductile / density / melting point*

2

[6]

### Q12.

(a) Group O / 8

*accept transition elements / metals*

**or** noble / rare / inert gases

*apply list principle*

1

(b) (chemically) similar elements (now) in the same group / column

*accept iodine has properties of Group 7 / halogens*

**or** *iodine does not have group 6 properties*

**or** *converse for tellurium*

*ignore 'it fits the pattern' or any reference to proton / atomic numbers / atomic structure*

1

(c) any **three** from:

*ignore not enough evidence / proof **or** Mendeleev not respected*

- (some) boxes had two elements  
*allow two correctly identified elements together (in the same box)*
- Group 1: copper / silver unreactive (not like the others)  
*allow copper / silver not alkali metals / Group 1*
- there are non-metals and metals in the same group / box  
*accept named examples*
- Mendeleev left spaces / gaps  
*accept (some chemists thought) there were no more elements to discover*



- Medeleev reversed the order (for some elements) 3

(d) any **two** from:

*ignore mass number / atomic weight / neutrons throughout*

- elements arranged in proton / atomic number order  
*allow number of protons / electrons increases across period*
- group: elements in same group / column have same number of outer electrons
- elements in same period / row have same number of (electron) shells / energy levels  
*allow number of (electron) shells / energy level increase down group*  
*allow electron rings*  
*allow orbits*

2

[7]

**Q13.**

- (a) (i) E 1
- (ii) B 1
- (iii) C 1
- (iv) A 1
- (b) (i) quickly melted 1  
*allow melts in contact with water,*  
*allow bp 100 °C (of water) shows mp is low*  
*ignore one other piece of information*
- (ii) easily cut 1  
*ignore one other piece of information*
- (iii) effervescence / fizzing / bubbling 1  
*ignore named gas*  
*ignore one other piece of information*

[7]

**Q14.**

- (a) left gaps 1

if placed consecutively, then elements would be in wrong group / have wrong properties / owtte

*allow some elements didn't fit pattern*

1

(b) (elements placed in) atomic / proton number order

1

(elements in) same group have same number of outer electrons

1

any **one** from:

- number of protons = number of electrons
- reactions (chemical) properties depend on the (outer) electrons
- number of shells gives the period

*allow number of shells increases down the group*

1

(c) (i) (transition elements usually) have same / similar number of outer / 4<sup>th</sup> shell electrons

1

inner (3<sup>rd</sup>) shell / energy level is being filled

*ignore shells overlap*

1

(ii) 2<sup>nd</sup> shell / energy level can (only) have maximum of 8 electrons

**or**

2<sup>nd</sup> shell / energy level cannot have 18 electrons

1

**[8]**

**Q15.**

(a) (i) **A**

1

(ii) **F**

1

(iii) **E**

1

(iv) **C**

1

(v) **A or B**

1

(b) (i) Rb K Na

*allow rubidium, potassium, sodium*

*do **not** accept RB or NA*

- 1
- (ii) decrease
- or**
- become lower / smaller / less  
*allow from 180° C to 27° C*
- 1
- (c) They are harder than Group 1 metals.
- 1
- They have higher melting points than Group 1 metals.
- 1
- They often form coloured compounds but Group 1 compounds are usually white.
- 1

[10]

**Q16.**

- (a) (i) UI / solution turns blue / purple  
*allow violet / lilac*
- 1
- any **two** from:
- floats
  - melts / forms a sphere
  - moves  
*note: moves on surface = 2 marks (points 1 and 3)*
  - effervescence / fizz / bubbles / gas  
*ignore the name of the gas*
  - (yellow) flame  
*ignore sparks / ignites / burns*  
*allow dissolves*
  - reduces in size  
*ignore 'reacts violently' unqualified*  
*ignore reference to exothermic / heat evolved*
- 2
- (ii)  $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$   
*correct equation = 2 marks*  
*allow correct multiples / fractions*  
*if this equation is unbalanced,*  
*allow 1 mark for NaOH*
- 2
- (b) *it = francium*

*outer electron / shell / energy level must be mentioned once for all 3 marks*

biggest atom **or** (outer) shell / energy level / electron furthest from nucleus **or** most (number of) shells

1

least attraction (to nucleus) **or** most shielding

*allow the attraction is very weak*

*do **not** allow less magnetic / gravitational attraction*

1

(outer) electron more easily lost / taken

*ignore francium reacts more easily / vigorously*

1

(c) any **two** from:

*ignore other properties / specific reactions*

*they / it = transition elements*

transition elements:

*allow if state group 1 elements*

- high melting point **or** high boiling point
  - *low melting point or low boiling point*
- high density
  - *low density*
- strong / hard
  - *weak / soft*
- not very reactive
  - *reactive*
- catalysts
  - *not catalysts*
- ions have different charges
  - *+1 ions*
- coloured compounds
  - *white compounds*

2

**[10]**

**Q17.**

(a) (i) elements

1

(ii) atomic weight

1

- (iii) atomic (proton) number 1
- (b) (i) transition metals 1
- (ii) has a higher melting point is harder 2

[6]

**Q18.**

- (a)  $40 (\text{Ca}) + 137 (\text{Ba}) \div 2 = 88.5$   
*accept a recognition that the average is near 88*  
*or it is the average of the other two*  
*accept Sr is midway between Ca and Ba* 1
- (b) eg newly discovered elements / atoms didn't fit (into triads) **or** didn't apply to all elements / atoms **or** lot of exceptions  
*he = Döbereiner*  
*ignore Mendeleev left spaces or not enough evidence* 1
- (c) any **two** from:
- fizzes / bubbles / gas  
*hydrogen alone is insufficient*  
*ignore incorrect name if 'gas' stated*
  - violent / vigorous / explodes / very fast reaction  
*accept container explodes*  
*ignore strong reaction*
  - floats / on surface  
*ignore sinks*
  - moves (very quickly)
  - melts (into a ball)
  - bursts into flame  
*accept (bright) light*  
*ignore colour / glow*
  - gets smaller / (reacts to) form a solution / dissolves / disappears etc
  - steam / gets hot (owtte)  
*ignore alkaline solutions or change in colour etc* 2
- (d) (i) same number of electrons in outer shell  
*accept energy level for shell*

*accept a correct reference to a specific group  
eg (all) have one electron in outershell / (all) lose one  
electron (when they react)*

1

- (ii) electrons fill an inner / 3<sup>rd</sup> shell  
*accept energy level for shell  
accept d-level being filled  
accept specific reference to 3rd shell  
accept descriptions in terms of 3d & 4s etc*

1

(usually) same number of outer / 4<sup>th</sup> shell electrons

1

- (iii)  
*it = lithium  
accept energy level for shell **or** converse reasoning for  
potassium*

outer shell electron closer to nucleus  
*accept fewer shells / smaller atom*

1

more (electrostatic) attraction (to nucleus) / electrons  
less likely to be lost  
*accept less shielding / isn't much shielding  
ignore nucleus has more influence but accept nucleus has  
more influence over the outer electron(s)  
do **not** accept magnetic / gravitational attraction*

1

[9]

**Q19.**

- (a) conducts (electricity) **or**  
*accept flexible*

allows electrons / current to flow  
*ignore conducts heat*

1

- (b) electron

1

- (c) (i) lithium>copper>tungsten **or**  
 Li>Cu>W  
*all correct  
allow 1 mark for one metal in the correct position*

2

- (ii) has high / highest melting point

*accept has high / highest boiling point*

**or**

can withstand the highest temperature

1

(d) unreactive

1

**[6]**

**Q20.**

(a) Mendeleev

1

(b) groups

1

(c) undiscovered

1

(d) compound

1

**[4]**

**Q21.**

(a) (i) Halogens

1

(ii) They consist of molecules

1

They have coloured vapours

1

(b) (i) 7 / seven

1

(ii) liquid

1

(iii) astatine

*allow obvious mis-spelling*

*ignore At*

1

(c) chlorine reacts with (the) bromide [owtte]

1

chlorine reacts with (the) iodide [owtte]

*allow chlorine reacts with both*

**or**

*chlorine has more reactions for 2 marks*

**or**

*bromine reacts with one **and** iodine does not react at all for 2 marks*

1

**Q22.**

- (a) kills bacteria / sterilises (water)

*allow kills microorganisms / microbes / germs  
allow 'makes (water) safe (to drink)' **or** disinfectant  
ignore cleans water **or** removes impurities / bacteria*

1

- (b) goes colourless / decolourised (from red / red-brown / brown / yellow / orange)

*allow colour disappears  
ignore 'goes clear' **or** discoloured  
do **not** accept incorrect initial colour  
do **not** accept precipitate*

1

- (c) (i) Br<sub>2</sub> **and** 2Cl<sup>-</sup>

*allow multiples / fractions if whole equation balanced*

1

- (ii) changes to red / red-brown / brown / yellow / orange

*do **not** accept effervescence / fizzing / precipitate / gas given off  
ignore vapour / temperature changes / ignore initial colour*

1

- (d) (i) 7 outer electrons **or**

*same number of outer electrons  
allow last / final shell for outer  
allow energy level / orbit / ring for shell  
allow 'need to gain 1 e<sup>-</sup> to have a full outer shell'  
ignore 'similar number of outer electrons'*

1

- (ii) bromine / it (atom) is bigger **or**

*must be a comparison*

*outer electrons (level / shell) further from nucleus **or** more shells*

*do **not** accept more outer shells  
ignore more electrons*

*forces / attractions are weaker **or** more shielding **or** attracts less*

*do **not** accept magnetic / gravitational / intermolecular forces  
allow 'electron(s) attracted less easily'*

*electron(s) gained less easily*

*"outer / last / final" must be mentioned once, otherwise max 2 marks.*

*accept converse for chlorine throughout where clearly stated*



- |     |   |   |
|-----|---|---|
|     |   | 3 |
| (e) | (i) white precipitate <b>or</b> white solid<br><i>ignore names of chemicals</i>   | 1 |
|     | (ii) cream precipitate <b>or</b> cream solid<br><i>allow <u>pale</u> yellow / off-white precipitate / solid<br/>ignore names of chemicals</i> | 1 |

**[10]**

**Q23.**

- |     |   |   |
|-----|---|---|
|     |   |   |
| (a) | potassium / it is an alkali metal <b>or</b> it is in group 1 <b>or</b> it is reactive<br><i>it = potassium<br/>allow argon is a noble gas / unreactive / group 0<br/>ignore references to atomic structure<br/>ignore references to correct physical properties</i> | 1 |
| (b) | group 4 / they are metals and non-metals<br><i>accept element missing or gap left<br/>ignore differences in properties</i>  | 1 |
| (c) | it / they fitted at the beginning / end of the table<br><i>ignore left gaps / spaces</i>  | 1 |

**[3]**

**Q24.**

- |     |                            |   |
|-----|----------------------------|---|
|     |                            |   |
| (a) | (i) B                      | 1 |
|     | (ii) A                     | 1 |
|     | (iii) E                    | 1 |
|     | (iv) D                     | 1 |
| (b) | (i) Mendeleev and Newlands | 1 |
|     | (ii) atomic weight         | 1 |
|     | (iii) chemical reactions   | 1 |
|     | (iv) electrons             | 1 |

**Q25.**

- (a) (i) undiscovered elements owtte 1
- (ii) they would be in the wrong group / have the wrong / different properties / don't fit the pattern owtte  
*allow atomic weights may have been wrong* 1
- (b) (i) any **three** from:
- elements arranged in proton / atomic number order  
*ignore mass number / atomic weight / neutrons throughout*
  - group: elements in the same group / column have same number of outer electrons owtte
  - group: number of shells increase down group
  - period: elements in the same period / row have the same number of shells / energy levels
  - period: number of protons / electrons increase across period
  - atomic number: link of atomic number to number of protons
  - atomic number gives number of electrons 3
- (ii) it would mean splitting a proton / electron
- or**
- implication of splitting proton / electron 1
- (c) *must be a comparison*
- (outer) electron closer (to nucleus)  
*accept fewer (electron) shells / energy levels*  
*fluorine is the smaller/est* 1
- stronger/est attraction (to nucleus) owtte  
*do **not** allow magnetic / intermolecular forces*
- or**
- less screening (by inner electrons) 1
- electron gained more easily  
*need some indication of outer electron shell somewhere in explanation otherwise max of **2** marks* 1

**Q26.**

- (a) (i) floated / (moved on) surface  
*accept does not sink*  
*ignore it melted* 1
- (ii) melted / molten  
*ignore heat is given off* 1
- (iii) hydrogen  
*allow H<sub>2</sub>* 1
- (b) (i) potassium / rubidium / caesium / francium  
*accept: K / Rb / Cs / Fr* 1
- (ii) they are metals 1
- they form ions with a 1+ charge 1
- (c) (i) atomic weight 1
- (ii) similar 1
- (iii) groups 1
- (d) left gaps owtte 1

[10]

**Q27.**

- (a) acts as barrier between sodium and air / oxygen / water (vapour)  
*accept because they are reactive*  
*ignore oil will not react* 1
- (b)  $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$   
*allow multiples / fractions* 1
- (c) these metals react with water producing an alkaline solution  
**or**  
produce solution with pH greater than 7 / high pH  
*owtte*  
*allow produce OH. ions*

***not** these metals are / form alkalis  
ignore 'strong' pH*

1

- (d) *it = potassium  
outer electron must be mentioned once for all **3** marks*

bigger atom

**or**

outer shell electron further from nucleus

**or**

more shells

**or**

*converse argument for sodium less reactive provided sodium is specified*

1

less attraction to nucleus

**or**

more shielding

***not** less magnetic attraction*

1

outer electron more easily lost

***ignore** potassium reacts more easily*

1

[6]

**Q28.**

- (a) B

1

- (b) eg link between Li, Na, K, (Rb, Cs)

**or** Mg, Ca, (Sr, Ba)

**or** F, Cl, Br, I

*allow any **two** elements in the same group (in both Newland's **and** the modern periodic table)*

1

linked appropriate comment about that link eg similar physical / chemical properties **or** similar specific reactions **or** same number of outer electrons

*if no elements identified, allow **1** mark for a general comment about elements **in the same column** having similar properties*

*"every eighth element has similar properties" = **1** mark*

1

- (c) any **two** from:

- no gaps for undiscovered elements **or** elements still being discovered
- some boxes have 2 elements

- metals and non-metals in same column / mixed up / some elements in the same column had different properties
- pattern for first 16 or so elements only
- any sensible suggestion about misplaced elements eg copper in group 1 metals

2

- (d) alkanes are not elements **or** alkanes are compounds  
*ignore molecule / molecular*

1

**[6]**

**Q29.**

- (a) tungsten

1

has the high(est) melting point

*accept that metals other than tungsten are likely to melt*

1

- (b) argon

1

is an unreactive gas

*accept that gases other than argon are reactive  
 accept that argon is a noble gas or in Group 0*

1

**[4]**

**Q30.**

- (a) D

1

- (b) B

1

- (c) F

1

- (d) G

1

- (e) H

1

**[5]**

**Q31.**

- (a) **Quality of Written Communication**

The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be

considered in crediting points in the mark scheme.  
*maximum 2 marks if ideas not well expressed*

any **three** from:

*do not accept flames*

floats

fizzes / bubbles or produces a gas

*ignore reference to heat*

indicator goes blue / purple / violet (alkaline colour)

3

water level in test tube goes down **or** gas fills the test tube

lithium 'dissolves' (owtte)

moves around (on surface of water)

steam

(b) lithium hydroxide

1

hydrogen

1

(c) more violent / reactive

*accept a description of the reaction which indicates greater violence*

1

(d) (i) decreases

1

and then slows down **or** levels off

1

(ii) 26(°C)

1

[9]

### Q32.

(a) comment + relevant example gets **1 + 1** marks  
 third marking point can be **either** a comment **or** an example unrelated to first comment i.e. 3 comments would be max **2** marks

max 3

(could be many answers)

*ignore references to music*

e.g. many elements in the groups have very dissimilar properties e.g. Cu + K  
 (= 2 marks)

two elements in one place on the table e.g.  
Ce or La  
(= 2 marks)

no clear division between metals and non-  
metals **or** metals and non-metals  
jumbled / mixed up (could give example from table)

Newlands didn't allow spaces for new elements

(b) any **two** from:

elements with dissimilar properties are  
separated **or** grouped elements with similar properties

gaps left for elements to be added when discovered

relative atomic mass order not followed in  
all cases (so that elements go in groups  
with other similar elements) **or**  
Mendeleev in proton number order

groups related to electronic structure **or**  
group number equals number of outer electrons

new groups created **or** iron, cobalt nickel  
in a group **or** eight groups instead of seven

correct elements in periods 2 and 3

reactivity trends in groups **or** reactivity trends across periods

separates metals and non-metals

2

[5]

### Q33.

(a) (i) argon **and** potassium **or** tellurium **and** iodine **or** cobalt **and** nickel  
*accept correct symbols*  
*allow argon **and** calcium*

1

(ii) it would place them in incorrect groups (owtte)  
*idea of not being placed with elements which have similar  
properties **or** converse argument*  
*accept would not have same number of electrons in outer  
shell*  
*allow it would put them in wrong period if linked to argon and  
potassium / calcium*  
*do **not** accept reasons based just on protons*  
*do **not** accept metals and non-metals mixed up*

1

(b) any **two** from:

- each successive atom has one more electron
- atoms in the same group have the same number of electrons in their outer shells / energy levels  
*number of electrons in outer shell = group number*
- across a period an energy level / shell is being filled
- in the next period the next energy level / shell is being filled  
*accept period number = shell number*

2

[4]

**Q34.**

- (a) react with oxygen / oxidise / burn in oxygen / burning / combustion **or** tungsten to tungsten oxide **or** makes an oxide

*key idea is oxidation*

*ignore breaking ignore fire / flames / exothermic*

*ignore react with air*

1

- (b) it is (very) unreactive / not reactive / inert / does not react with tungsten **or** it is a noble gas **or** it is in group 0 or 8 or 18

*do **not** accept unreactive / inert metal **or** argon is not very reactive*

1

full outer shell (of electrons) / 8 electrons in outer shell

1

does not need to gain / lose / swap / transfer / share electrons **or** does not need to form bonds

*does not bond ionically / covalently*

1

[4]

**Q35.**

- (a) F

*accept indium / In*

1

- (b) C

*accept sodium / Na*

1

- (c) A

*accept hydrogen / H / H<sub>2</sub>*

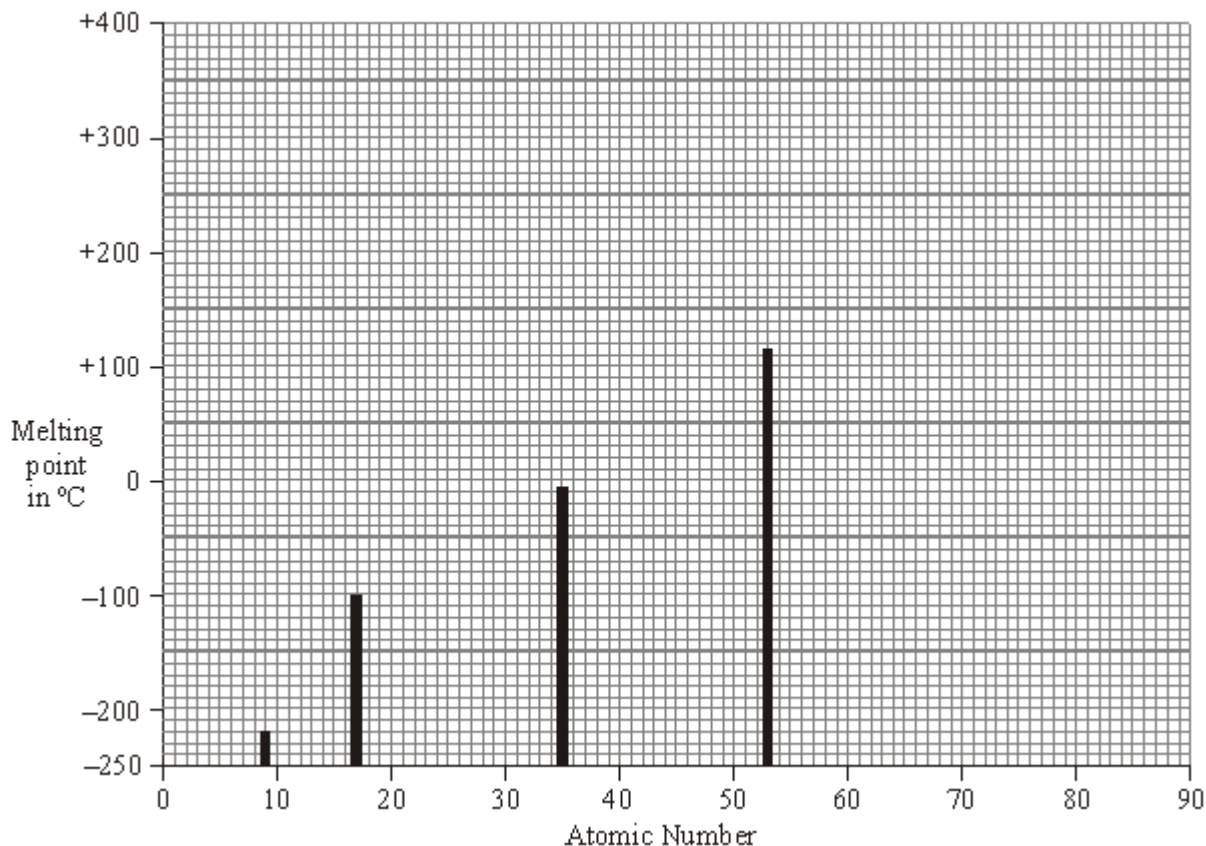
1

[3]

**Q1.**



- (a) The bar graph shows the melting points of the elements in Group 7 plotted against their atomic numbers.



- (i) How do the melting points of the Group 7 elements change as the atomic number increases?

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---

(1)

- (ii) The melting point of astatine (atomic number = 85) is not shown on the bar graph. Estimate the melting point of astatine.

\_\_\_\_\_ °C

(1)

Draw a bar for this value on the bar graph.

(1)

- (b) The water from wells in Japan contains bromide ions.

Bromine is extracted from this water. The bromine is displaced by adding another Group 7 element.

- (i) Place a tick (✓) next to the name of **one** Group 7 element that could be used to displace bromine from this water.

	<b>Group 7</b>	(✓)
	Fluorine	
	Chlorine	
	Bromine	
	Iodine	
	Astatine	

Most reactive

↑

Least reactive

(1)

(ii) State why you have chosen this element.

---



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(1)

(iii) One sample of this water contained 2 g of bromine per litre of water.

How many litres of this water would be needed to make 1 kg of bromine?  
 (1 kg = 1000 g)

---

\_\_\_\_\_ litres

(1)

**(Total 6 marks)**

**Q2.**

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**

<b>Boron</b>
<b>Aluminium</b>
<b>?</b>
<b>Indium</b>
<b>Thallium</b>

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.

	<b>Appearance</b>	<b>Metal or non-metal</b>	<b>Boiling point in °C</b>	<b>Density in g per cm<sup>3</sup></b>	<b>Relative atomic mass</b>
<b>Aluminium</b>	silvery white	metal	2467	2.7	27
<b>Predicted properties of gallium</b>	silvery white	metal	?	?	68
<b>Indium</b>	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)

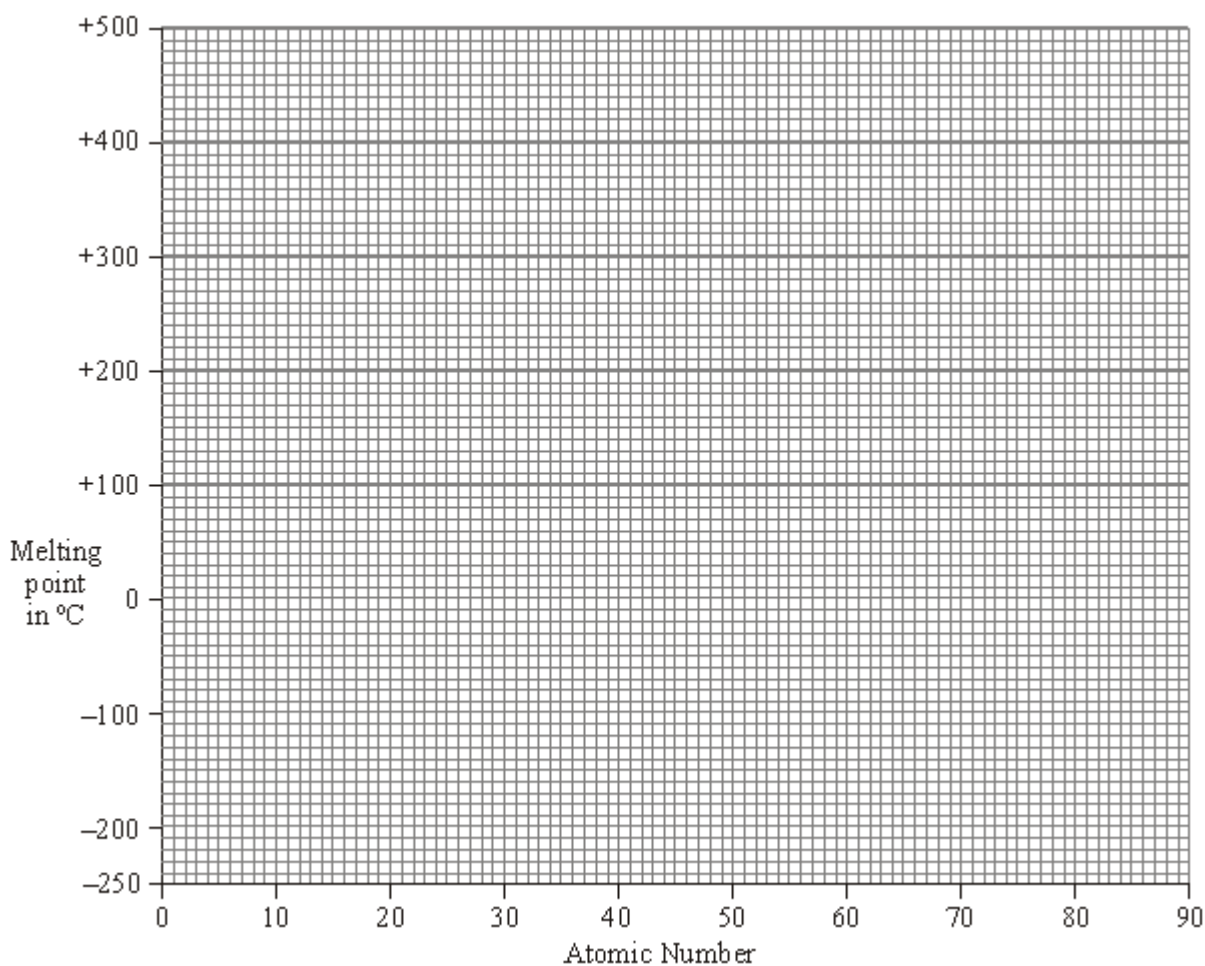
(Total 3 marks)

**Q3.**

(a) The table gives the melting points of some of the elements of Group 7.

Element	Atomic number	Melting point in °C
Fluorine	9	-220
Chlorine	17	-101
Bromine	35	-7
Iodine	53	114
Astatine	85	?

(i) Plot a graph of the melting point against atomic number.



Draw a line of best fit.  
 Extend your line to estimate a value for the melting point of astatine.

(2)

(ii) Estimate the melting point of astatine. \_\_\_\_\_ °C

(1)

(iii) Which of the Group 7 elements are solids at 20 °C?

---

(b) (i) Draw a diagram to show the arrangement of electrons in an atom of fluorine. (1)

(ii) The elements of Group 7 have similar chemical properties. (1)  
Explain, in terms of electrons, why they have similar chemical properties.

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(1)

(c) Xenon is a very unreactive element.

(i) Explain, in terms of electrons, why xenon is so unreactive. (2)

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(ii) Fluorine reacts with xenon but iodine does not. (3)  
Explain, in terms of atomic structure, why fluorine is more reactive than iodine.

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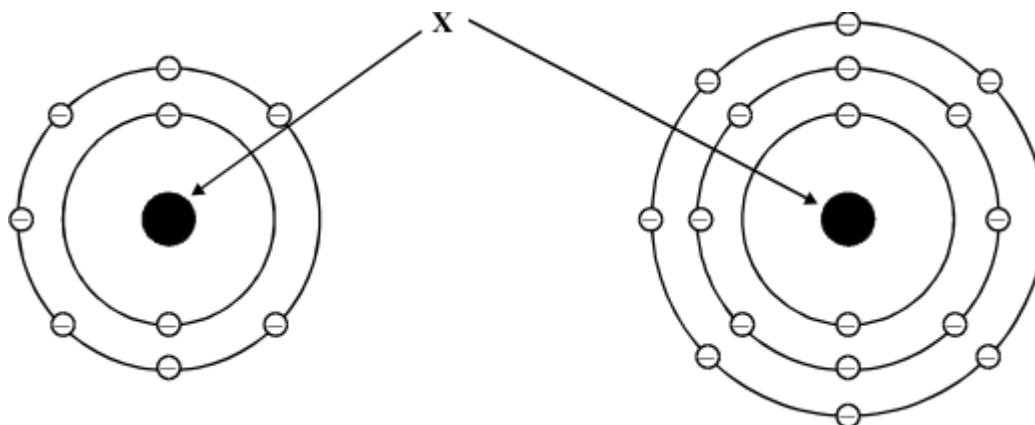
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(3)

(Total 11 marks)

**Q4.**

The diagrams show the electronic arrangement of the atoms of two elements.



- (i) Name the part of the atoms labelled **X**.

\_\_\_\_\_ (1)

- (ii) Why are these two elements in the same group of the Periodic Table?

\_\_\_\_\_  
 \_\_\_\_\_ (1)  
 (Total 2 marks)

**Q5.**

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

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

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

\_\_\_\_\_ (1)

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

\_\_\_\_\_ (1)

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

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

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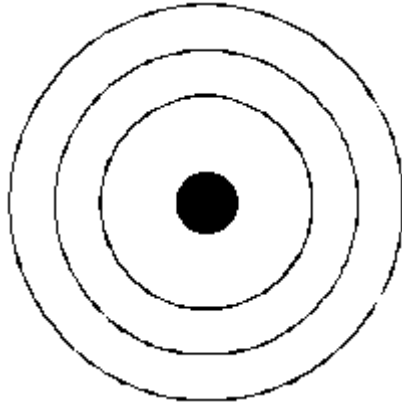
(2)

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

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(1)

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



(2)

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

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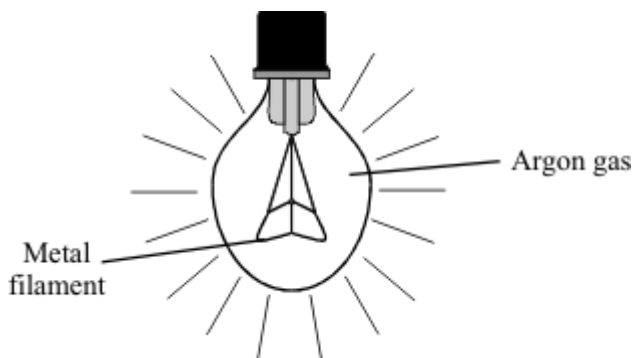
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(3)

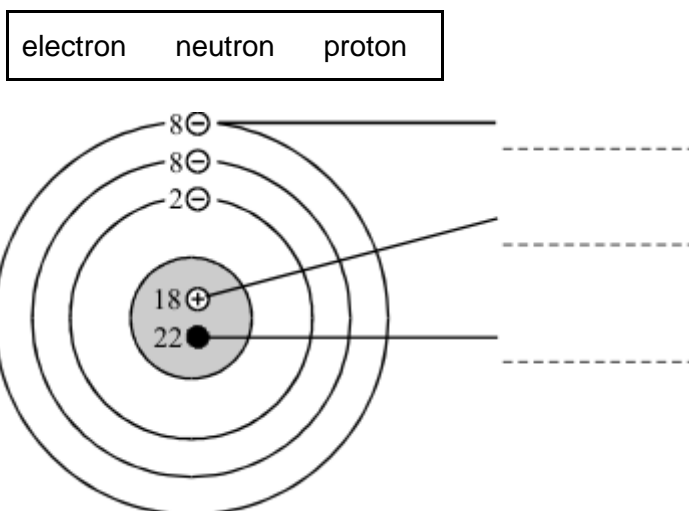
(Total 10 marks)

**Q6.**

The diagram shows a light bulb.



- (a) (i) An argon atom has the structure shown. Use the words in the box to label the particles in the atom. Each word should only be used **once**.



(2)

- (ii) Argon is unreactive. Why?

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(1)

- (b) Oxygen would **not** be a suitable gas to use in a light bulb. Explain why.

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(2)

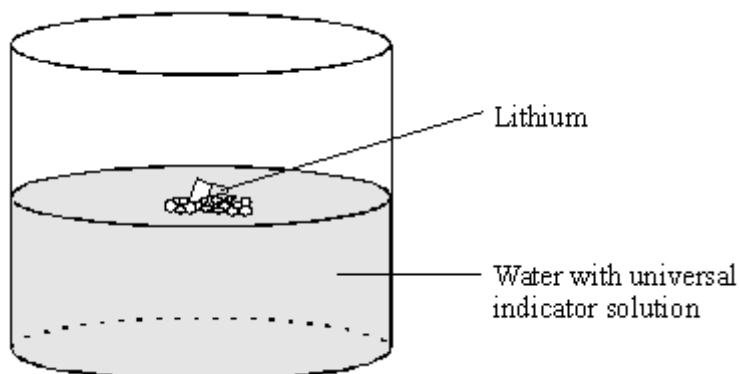
(Total 5 marks)

### Q7.

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)

**Q8.**

The elements in Mendeleev's periodic table were arranged in order of increasing atomic mass. Part of the modern Periodic Table is shown.

		H							He				
Li <small>3</small>	Be <small>4</small>							B <small>5</small>	C <small>6</small>	N <small>7</small>	O <small>8</small>	F <small>9</small>	Ne <small>10</small>
Na <small>11</small>	Mg <small>12</small>							Al <small>13</small>	Si <small>14</small>	P <small>15</small>	S <small>16</small>	Cl <small>17</small>	Ar <small>18</small>
K <small>19</small>	Ca <small>20</small>												

(a) Complete the sentence by writing in the missing words.

The modern Periodic Table is arranged in order of increasing

\_\_\_\_\_ . (1)



Nucleus



(1)

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

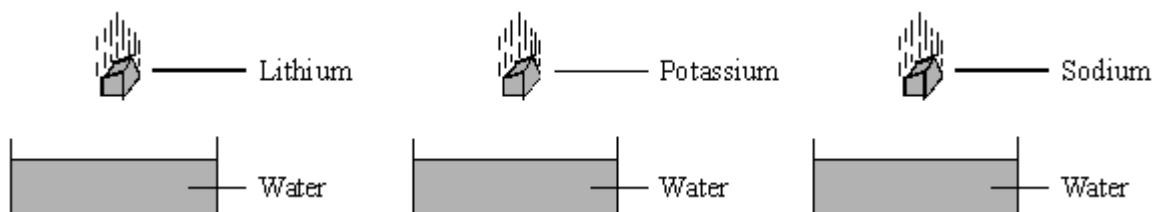
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(1)

- (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.

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(1)

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



(2)

(Total 10 marks)

### Q10.

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?

---

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(1)

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

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(2)

(Total 5 marks)

### Q11.

Fluorine is a very useful element. It is placed in group 7 of the Periodic Table.

Use your knowledge of the elements in group 7 to help you answer these questions. You may find that information in the Data Sheet may help you with this question.

(a) Name another element in group 7 of the Periodic Table.

---

(1)

(b) Cylinders filled with fluorine molecules are commercially available. What would you expect the formula of a fluorine molecule to be?

---

(1)

(c) Fluoride ions are added to drinking water to help prevent tooth decay. What is the charge on fluoride ions in the water?

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(1)

(d) Fluorine reacts with the non-metal sulphur to make sulphur hexafluoride ( $\text{SF}_6$ ).

- (i) What type of bonding would you expect in sulphur hexafluoride?

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(1)

- (ii) Explain the reason for your answer to part (i).

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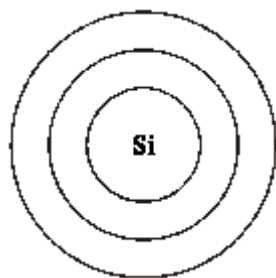
(1)

(Total 5 marks)

### Q12.

Silicon is an extremely important element. More than a million tonnes of silicon are produced each year. Silicon is made by reducing silicon oxide (sand) with carbon (coke).

- (a) (i) Complete the diagram below to show the arrangement of electrons in an atom of silicon. The Data Sheet may help you with this question.



(2)

- (ii) Which electrons in the silicon atom take part in chemical reactions with other atoms?

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(1)

- (iii) What features of all the atoms of the elements in group 4 of the Periodic Table might give them similar chemical properties?

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(1)

- (b) Silicon is difficult to classify as a metal or a non-metal because it has properties which resemble both. Some of the properties of silicon are listed below.

- Silicon is a shiny blue/grey solid.
- Silicon is placed in Group 4 of the Periodic Table.
- Silicon has a relative atomic mass of 28.

- Silicon has a very high melting point (1410°C).
- Silicon has a very high boiling point (2355°C).
- Silicon conducts electricity.
- Silicon oxide will neutralise alkalis.
- Silicon forms compounds in which the silicon atoms are bonded to other atoms by covalent bonds.

(i) Select **two** properties from the list above in which silicon resembles a metal.

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

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

(2)

(ii) Select **two** properties from the list above in which silicon resembles a non-metal.

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

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

(2)

(Total 8 marks)

### Q13.

Fluorine is the most reactive element in group 7 of the Periodic Table. Fluorine reacts with all the other elements in the Periodic Table except some of the noble gases. It does not react with helium, neon and argon, but it does react with xenon. Many substances burst into flames when exposed to fluorine.

(a) (i) The electronic structure of chlorine is 2.8.7. What is the electronic structure of fluorine?

\_\_\_\_\_

(1)

(ii) What is the electronic structure of the chloride ion Cl<sup>-</sup>?

\_\_\_\_\_

(1)

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

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(4)

(b) (i) What does the information at the start of this question suggest about the

reactivity of the elements in group 0?

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(1)

- (ii) A chemist did an experiment to find out if fluorine reacts with xenon. The two gases were mixed in a glass container. The only product detected was silicon fluoride. Explain what happened.

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(2)

- (iii) The experiment was repeated many years later but the gases were mixed in a different type of container. A white solid was obtained which was xenon fluoride.

Predict whether you think (1) krypton and (2) radon will react with fluorine. Explain the reasons for your predictions.

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(5)

(Total 14 marks)

### Q14.

Use the Periodic Table on the Data Sheet to help you to answer this question.

- (a) State **one** similarity and **one** difference in the electronic structure of the elements:

- (i) across the Period from sodium to argon;

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(2)

- (ii) down Group 7 from fluorine to astatine.

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(2)

(b) (i) State the trend in reactivity of the Group 1 elements.

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(1)

(ii) Explain this trend in terms of atomic structure.

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(3)

(c) Hydrogen is an element which is difficult to fit into a suitable position in the Periodic Table. Give reasons why hydrogen could be placed in either Group 1 or Group 7.

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(3)

(Total 11 marks)

**Q15.**

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<sup>2+</sup>.

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)**

**Q16.**

- (a) Why do the elements in Group 1 of the Periodic Table have similar chemical properties?
- \_\_\_\_\_  
\_\_\_\_\_
- (1)**
- (b) Explain why the reactivity of the elements in Group 1 increases down the group.
- \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- (2)**
- (Total 3 marks)**

**Q17.**

Calcium and magnesium are elements. They are found in the Earth's crust as compounds, often carbonates and sulphates. Magnesium is also found as its chloride.

- (a) Calcium and magnesium are in the same Group in the Periodic Table. State which Group this is.

\_\_\_\_\_ (1)

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

- (i) Write the chemical formula of magnesium chloride.

\_\_\_\_\_ (1)

- (ii) Name the type of bonding in magnesium chloride.

\_\_\_\_\_ (1)

**(Total 3 marks)**

### Q18.

X is an element with the following properties:

- melts at  $-220^{\circ}\text{C}$  and boils at  $-188^{\circ}\text{C}$ ;
- does not conduct electricity at room temperature;
- forms molecular compounds with non-metals;
- forms ionic salts with metals in which its ion has a 1–charge.

- (a) Would you expect X to be a solid, a liquid or a gas at  $20^{\circ}\text{C}$ ?

\_\_\_\_\_ (1)

- (b) Predict the formula of the product formed when X reacts with aluminium. (The aluminium ion is  $\text{Al}^{3+}$  and the X ion is  $\text{X}^{-}$ .)  
Select your answer from the list below.

**AIX      AIX<sub>2</sub>      AIX<sub>3</sub>      Al<sub>3</sub>X      Al<sub>2</sub>X<sub>3</sub>**

Predicted formula \_\_\_\_\_ (1)

- (c) To which Group of the Periodic Table does the element X belong?

\_\_\_\_\_ (1)

**(Total 3 marks)**

### Q19.

Sodium and potassium are both in Group 1 of the Periodic Table.

- (a) Explain, by reference to their electronic structures, why both elements are placed in Group 1.

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(1)

- (b) Use the Data Sheet to help you to answer this question.  
The diagrams below represent the electronic structures of some atoms and ions.



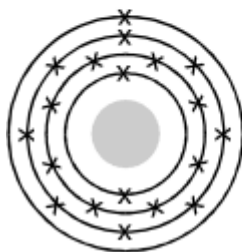
**A**



**B**



**C**



**D**



**E**



**F**

Which one of the structures, **A - F**

- (i) represents a sodium **atom**, \_\_\_\_\_

(1)

- (ii) represents a potassium **ion**? \_\_\_\_\_

(1)

- (c) Sodium and potassium both react with cold water.

- (i) The word equation represents the reaction of sodium with water.



Complete and balance the symbol equation for this reaction.



(2)

- (ii) How does the reactivity of potassium with water differ from that of sodium with water?

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Explain this difference in reactivity by reference to the electronic structures of the potassium and sodium atoms.

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(4)  
(Total 9 marks)

**Q20.**

One definition of an element is:

“A substance that cannot be broken down into simpler substances by chemical methods”

The table below shows some of the ‘substances’ which Antoine Lavoisier thought were elements. He divided the ‘substances’ into four groups. He published these groups in 1789.

The modern names of some of the ‘substances’ are given in brackets.

ACID-MAKING ELEMENTS	GAS-LIKE ELEMENTS	METALLIC ELEMENTS		EARTHY ELEMENTS
sulphur	light	cobalt	mercury	lime (calcium oxide)
phosphorus	caloric (heat)	copper	nickel	magnesia (magnesium oxide)
charcoal (carbon)	oxygen	gold	platina (platinum)	barytes (barium sulphate)
	azote (nitrogen)	iron	silver	argilla (aluminium oxide)
	hydrogen	lead	tin	silex (silicon dioxide)
		magnese	tungsten	
		zinc		

Dmitri Mendeleev devised a Periodic Table of the elements in 1869. A modern version of this table is shown on the Data Sheet.

Give **two** ways in which Mendeleev's table is more useful than Lavoisier's.

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

\_\_\_\_\_

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

\_\_\_\_\_

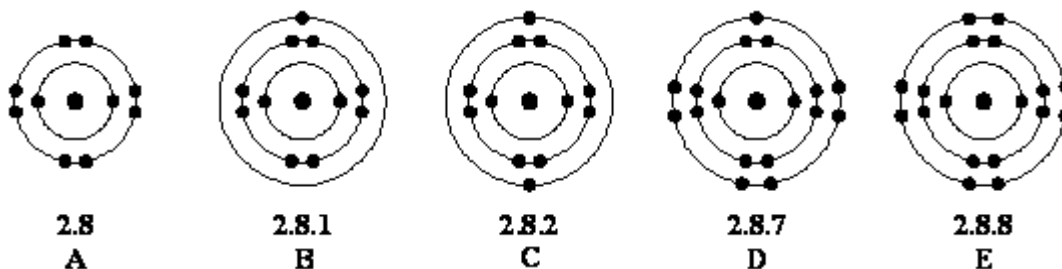
(Total 2 marks)

**Q21.**

Use the Data Sheet to help you answer this question.

When sodium reacts with water it forms sodium ions.

The diagrams below represent the electron arrangements of some atoms and ions.



Which of the diagrams, **A** to **E**, represents the electron arrangement of each of the following?

(i) A sodium atom, Na \_\_\_\_\_

(ii) A sodium ion, Na<sup>+</sup> \_\_\_\_\_

(Total 2 marks)

**Q22.**

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.

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(3)

(Total 12 marks)

### Q23.

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?

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(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.

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(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)

#### Q24.

- (a) What is the name given to the block of elements in the middle of the Periodic Table which includes vanadium?

---

(1)

- (b) Some of the properties of vanadium are shown in this list.

- It has a high melting point.
- It is a solid at room temperature.
- It is a conductor of electricity.
- It is a good conductor of heat.
- It forms coloured compounds.
- It forms crystalline compounds.
- It forms compounds that are catalysts.

Select **two** properties, from the list above, which are **not** typical of a Group 1 metal.

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

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

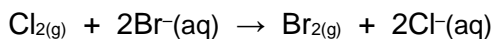
(2)

(Total 3 marks)



**Q25.**

In sea water the bromine is present as bromide ions ( $\text{Br}^-$ ). The equation below shows how chlorine can be used to displace bromine from sea water.



Explain, as fully as you can, why chlorine can displace bromine from sea water. To obtain full marks your answer should refer to electronic structure.

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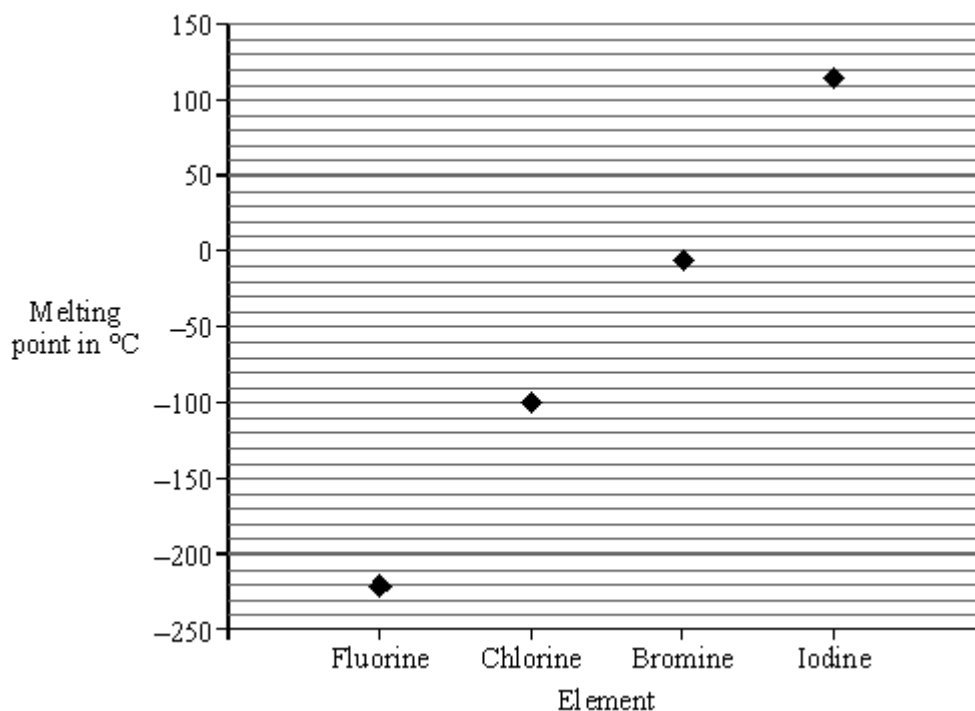
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**(Total 3 marks)**

**Q26.**

The graph shows the melting point of four elements in Group 7 of the periodic table.



(a) What is the melting point of fluorine?

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(1)

(b) Room temperature is 20°C.

Which element is solid at room temperature?

\_\_\_\_\_

(1)

(c) Look at the periodic table on the Data Sheet.

Using data from the graph, describe the trend of melting points of the elements in Group 7.

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

(2)

(d) The elements in Group 7 are non-metals.

Which **two** of the following are properties of non-metals?

Place a tick (✓) in the box against each correct property.

Brittle (if solid)

Good conductor of heat

High boiling point

Poor conductor of electricity

(2)

(Total 6 marks)

**Q27.**

The elements in Group 1 are known as the alkali metals.

Which **three** of the following are properties of alkali metals?

Place a tick (✓) in the box against each correct property.

Hard, tough and strong

Low density

- Form hydroxides that dissolve in water
- React quickly with water
- Used as catalysts
- Used to make electric cables

(Total 3 marks)

**Q28.**

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
<b>W</b>	2,5
<b>X</b>	2,7
<b>Y</b>	2,8,8
<b>Z</b>	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?

\_\_\_\_\_

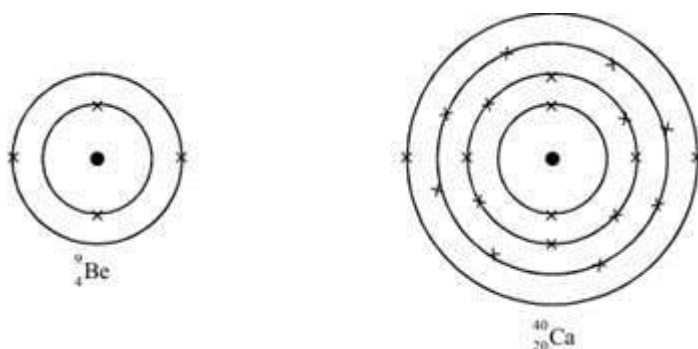
(1)

(Total 4 marks)

**Q29.**

Beryllium and calcium are metals in Group 2 of the periodic table.

The diagrams show their electronic structures.



- (a) Why do beryllium and calcium have similar chemical properties?

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(1)

- (b) Calcium is more reactive than beryllium.

Suggest an explanation for this in terms of the electronic structure of the two elements.

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(2)

(Total 3 marks)

**Q30.**

- (a) Helium is used to fill party balloons.

Which **two** of the following are properties that make helium suitable for filling party balloons?

Place a tick (✓) in the box against each suitable property.

Coloured

Exists as individual atoms

Less dense than air

Poor conductor of heat

Very unreactive

(2)

(b) The table shows the names of some gases.

Use the correct formulae from the box to complete the table. The first one has been done for you.

CH <sub>4</sub>	CO <sub>2</sub>	H <sub>2</sub>	HCl	NH <sub>3</sub>	O <sub>2</sub>
-----------------	-----------------	----------------	-----	-----------------	----------------

Gas	Formula
Oxygen	O <sub>2</sub>
Carbon dioxide	
Hydrogen chloride	
Ammonia	

(3)

(Total 5 marks)

**Q31.**

Use the Periodic Table of Elements on the Data Sheet to help you to answer this question.

Francium (Fr) is a very rare element. It is estimated that there is only 25 g of francium in the Earth's crust. Francium is radioactive and has a half-life of only a few minutes.

Mendeleev predicted the existence of francium in the 1870s but the element was not discovered until 1939.

(a) Explain why Mendeleev was able to predict the existence of francium in the 1870s.

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(2)

(b) Suggest why there is not much experimental evidence for the properties of francium.

---

- 
- (1)
- (c) (i) If you could react francium with water, how would the reaction compare with that of sodium with water?
- 
- 
- (1)
- (ii) Explain the reason for your answer.
- 
- 
- 
- 
- (2)
- (Total 6 marks)**

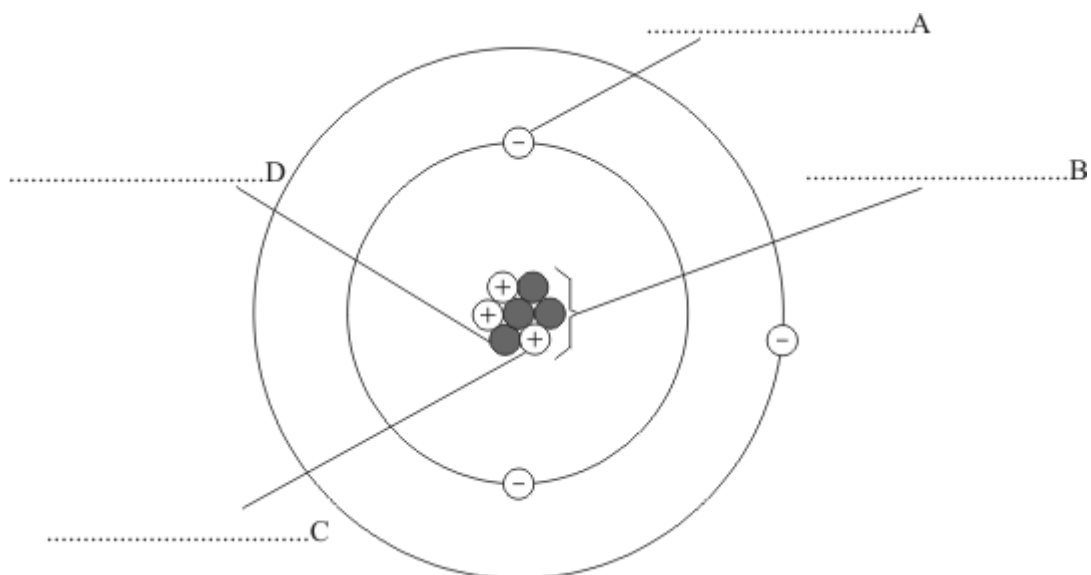
**Q32.**

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

- (a) Write the symbol for helium.
- 
- (1)
- (b) Write the name of an element in Group 4.
- 
- (1)
- (c) Write the name of the element which has a relative atomic **mass** of 64.
- 
- (1)
- (d) Write the name of the element with the next highest atomic number after Te (tellurium) in the periodic table.
- 
- (1)
- (Total 4 marks)**

**Q33.**

The diagram shows an atom.



(a) On the diagram, write the names of structures **A**, **B**, **C** and **D**. (4)

(b) To which Group of the periodic table does this atom belong?

\_\_\_\_\_

Give **one** reason for your answer.

\_\_\_\_\_

\_\_\_\_\_

(c) Name the element which is made up of this type of atom. (2)

\_\_\_\_\_

(1)  
(Total 7 marks)

**Q34.**

The table shows some properties of four Group 7 elements.

Element	Boiling point in °C	Melting point in °C	State at room temperature	Reaction with hydrogen	
				Description	Product
Fluorine	- 218	- 188	gas	Explosive reaction in dim light	Hydrogen fluoride
Chlorine	- 34	- 101	gas	Explosive reaction in	Hydrogen chloride

				sunlight	
Bromine	+ 59	- 7		Reacts if heated	
Iodine	+ 185	+ 114		Reacts if heated strongly	Hydrogen iodide

(a) What is the state at room temperature of:

(i) bromine; \_\_\_\_\_

(ii) iodine? \_\_\_\_\_

(2)

(b) Which **one** of the four elements is most reactive?

\_\_\_\_\_

(1)

(c) Name the compound formed when hydrogen reacts with bromine.

\_\_\_\_\_

(1)

(Total 4 marks)

### Q35.

The table shows how Group 7 elements react with hydrogen.

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

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

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



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(Total 2 marks)

## Mark schemes

### Q1.

- (a) (i) melting point increases as atomic number increases  
*accept 'increase' / higher / bigger / larger* 1
- (ii) 200 to 350 °C 1
- exactly on  $85 \pm \frac{1}{2}$  square
- up to their value  $\pm \frac{1}{2}$  square 1
- (b) (i) chlorine **or** fluorine  
*accept if both chlorine and fluorine ticked, otherwise list principle* 1
- (ii) chlorine / fluorine are more reactive (than bromine)  
*accept chlorine / fluorine are higher (up group 7)*  
*accept a more reactive halogen will displace a less reactive halogen* 1
- (iii) 500 (litres) 1

[6]

### Q2.

- (i) any **two** sensible ideas such as:
- (why) put in order of mass  
*accept other equally valid orders, eg alphabetical*
  - he left gaps **or** table not complete
  - no evidence for undiscovered elements  
**or** they believed all the elements had been discovered  
*accept predictions could not be backed by evidence*  
*accept why change previous ideas*
  - he changed the order of some elements  
**or** there were exceptions to the rule(s)
  - he put metals and non-metals together  
*accept they didn't like his groupings / groups*

- he did not explain his ideas clearly (owtte)  
*do **not** accept modern explanations, eg proton number etc*
2

- (ii) (the properties of gallium) fitted the predictions (owtte) **or** predictions were correct **or** (properties) would make it fit in the gap **or** (properties) would make it fit in group 3
- do **not** accept gallium fitted his theory*  
*accept finding gallium proved there were new elements to be discovered*

[3]

**Q3.**

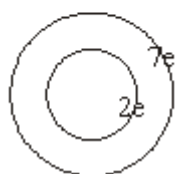
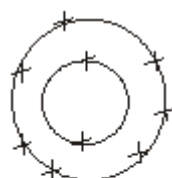
- (a) (i) all points plotted to  $\pm \frac{1}{2}$  square 1

sensible line of best fit extended  
*could be curve*  
*must **not** join dots, ie zig zag*  
*if they draw 2 lines then lose second mark,*  
*but can still gain marks in (a)(ii)* 1

- (ii) as read from their graph  $\pm \frac{1}{2}$  square 1

- (iii) iodine **and** astatine /  $I^2$  /  $At/At^2$   
*must give **both*** 1

- (b) (i)



*ignore symbol*  
*ignore nucleus / lack of nucleus*  
*accept dots / crosses etc / e / e<sup>-</sup>*  
***not** 2.7 alone* 1

- (ii) same number of electrons in outer shell **or**

- seven electrons in **outer** shell (owtte)  
*accept missing one electron in outer shell / energy level / orbit*  
*accept trying to gain one electron*  
*accept they all form  $1^-$  ions*  
*do **not** accept orbital / rings* 1
- (c) (i) 8 electrons in outer shell **or** full outer shell / energy level 1
- does not need to lose / gain / share electrons **or** don't need to form bonds  
*accept don't bond ionically or covalently*  
*they do not react is **not** enough* 1
- (ii) fluorine atom is smaller / fewer shells (owtte) **or** outer shell closer to nucleus 1
- accept answers argued in terms of iodine*
- more strongly attracted (to nucleus) **or** less shielding  
*accept holds electrons tighter (to the nucleus)* 1
- gains electron(s) more easily  
*accept easier to gain electrons* 1
- [11]**

**Q4.**

- (i) nucleus 1
- (ii) they both have seven electrons in the outer shell  
*accept they both have the same number of electrons in the outer shell*  
*both need one electron to make full outer shell* 1

**[2]**

**Q5.**

- (a) group seven/7VII  
*accept halogens* 1
- (b) (i) in light **bulbs**/lasers  
*accept any other specified use as an inert atmosphere e.g. (argon)*

- welding, storing explosives, fluorescent lights* 1
- (ii) 2.8.8/has a full/8 in/outer shell 1
- electrons
- accept does not need to share/gain/lose electrons* 1
- (c) (i) any one from:
- disinfectant
- bleaching agent
- sterilising water/kills bacteria
- manufacture of HCl
- water treatment 1
- not: cleaning/in pools*
- purification of water*
- kills germs*
- warfare*
- antiseptic*
- (ii) inner shells 2,8 1
- outer shell 7 1
- (iii) fluorine:
- accept the converse reasons for chlorine*
- gains **one**/an electron easier/is more
- strongly attracted
- not more strongly held* 1
- less shielding of nucleus by inner electron shells 1
- less distance from (attraction of)
- nucleus/less shells 1

[10]

**Q6.**

- (a) (i) **all correct two marks one or two correct one mark**
- electron

proton  
neutron

2

(ii) (argon has) a full outer shell (of electrons)  
*accept energy level for shell*  
*accept does not lose or gain electrons*  
*do **not** accept does not form bonds*  
***or** react **or** is a noble **or** inert gas*

1

(b) oxygen would react (with metal)  
*accept oxygen is reactive*  
*do **not** accept metal would react (neutral)*

1

metal would burn  
*accept metal would be 'destroyed'*  
***or** metal oxide formed **or** metal is oxidised*  
*do **not** accept it would explode **or***  
*would not last long*  
*accept filament for metal*

1

[5]

**Q7.**

(a) (i) low density  
*accept floats (on water)*

1

(ii) forms an alkaline solution with water  
*accept alkali (metal) **or** basic*  
*do **not** accept group 1 metal*

1

(b) 3 **or** three (protons)

1

3 **or** three (electrons)

1

4 **or** four (neutrons)

1

[5]

**Q8.**

(a) atomic number or proton number

1

(b) (i) sodium **or** potassium **must** be name  
*accept rubidium **or** caesium **or** francium*

1

(ii) silicon **or** phosphorus **or** sulphur **or** chlorine **or** argon **must** be name

1

[3]

**Q9.**

(a) (i) number

1

periods

1

groups

1

(ii) some elements (**or** metals) had not been isolated

*accept some elements (**or** metals) had not been discovered (found)*

*do **not** accept matching properties*

*do **not** accept some elements were not known*

1

(b) (i) He **or** Ne **or** Ar

*accept Kr **or** Xe **or** Rn*

*accept correct names*

1

(ii) arrangement of electrons correct

*accept He 2*

*Ne 2 . 8*

*Ar 2 . 8 . 8*

*arrangement of electrons must match*

*correct answer if given in (i)*

*do **not** accept other elements*

1

(iii) (all) have one electron in the outer shell **or** energy level

*accept (all) have same number of electron(s) in the outer shell **or** energy level*

*accept all have to lose one electron*

*do **not** accept all in same group*

1

(iv) K Na Li

*accept names*

*accept correct indication of order of reactivity*

1

(v) H<sub>2</sub>

*do **not** accept H*

1

correctly balanced → 2 + 1

*must have H<sub>2</sub> correct to get balancing mark*

		1	
			[10]
<b>Q10.</b>			
(a)	(i) green		
	<i>accept 'green-yellow' but <b>not</b> 'yellow' alone</i>	1	
	bromine or Br or Br <sub>2</sub>		
	<i>do <b>not</b> accept bromide</i>	1	
	(ii) same number of electrons in outer energy level <b>or</b> <i>accept shell for energy level</i>		
	7 electrons in outer shell		
	<i>accept need to gain 1 electron</i>	1	
(b)	any <b>two</b> from:		
	• hydrogen <b>or</b> H <sub>2</sub>		
	<i>do <b>not</b> accept gas given off <b>or</b> fizzes</i>		
	• heat		
	<i>accept exothermic</i>		
	<i>do <b>not</b> accept flame</i>		
	• alkaline solution		
	<i>accept (metal) hydroxide <b>or</b> NaOH <b>or</b> OH<sup>-</sup></i>		
	<i>do <b>not</b> accept dissolves <b>or</b> forms a solution <b>or</b> floating</i>		
	<i>accept balanced chemical equation for <b>2</b> marks</i>	2	
			[5]
<b>Q11.</b>			
(a)	any (must be named)	1	
(b)	F <sub>2</sub>	1	
(c)	-/F <sup>-</sup>	1	
(d)	(i) covalent	1	
	(ii) made of molecules etc. type of bonding when non-metals react.	1	
			[5]



**Q12.**

- (a) (i) 14 electrons =  
*gets 1 mark*
- 2.8.4 =  
*gets 2 marks* 2
- (ii) outer shell electrons 1
- (iii) same number of electrons in outer shell 1
- (b) (1) shiny  
conducts electricity
- (2) oxide neutralises alkalis  
covalent bonds 4

[8]

**Q13.**

- (a) (i) 2.7 1
- (ii) 2.8.8 1
- (iii) gains an electron  
more easily than Cl  
because the higher the energy level  
the less easily an electron is gained  
*each for 1 mark* 4
- (b) (i) very unreactive **or** give reactivity trend 1
- (ii) fluorine reacted with silicon from glass  
*each for 1 mark* 2
- (iii) Reactivity increases down the group  
radon likely to react because lower in group than xenon  
more reactive than xenon  
Kr may or may not react  
higher in group than xenon  
less reactive than xenon  
*any 5 for 1 mark each* 5

[14]

**Q14.**

- (a) (i) same number of shells/2 full shells/3 shells/same number of energy levels  
*any 1 for 1 mark*
- increasing number of electrons/different number of electrons/  
 number of electrons same as group  
 number  
*(if electrons not specifically mentioned assume they are referring to electrons)*  
*any 1 for 1 mark* 2
- (ii) all have 7 electrons in outer shell/same number in outer shell/  
 each has one electron missing from outer shell  
 each can accept one electron  
*any 1 for 1 mark*
- number of shells/energy levels increases  
 increasing number of electrons  
*any 1 for 1 mark* 2
- (b) (i) increases down group/decreases up  
*for 1 mark* 1
- (ii) down group atoms get bigger/larger/have more shells/  
 more energy levels  
*for 1 mark*
- electrons further away from nucleus/more  
 shielding down group  
*for 1 mark*
- outer electron more easily lost/less  
 firmly held  
*for 1 mark* 3
- (c) H<sup>+</sup> or has positive ions/one electron in outer shell/can lose  
 one electron/H<sup>+</sup> ions discharged at negative electrode (max 2)  
 covalent bonds or compounds/forms diatomic mols. or example/  
 ability to form H<sup>-</sup> ions/non-conductor/  
 low Mt.Pt or low B.P. (max 2)  
*(overall max 3)* 3

[11]

**Q15.**

- (a) three from:  
 high mp/melts above 60 °C  
 conducts (electricity)

basic oxide /alkaline oxide  
 chloride has high mp  
 molten chloride conducts electricity  
 form positive ions/form ionic compound with non-metals  
 solid at room temperature

*any 3 for 1 mark each*

3

- (b) group 2  
 formula of oxide is XO/ion is  $X^{2+}$ /  
 oxide forms alkaline solution

*for 1 mark each*

2

- (c)  $XCl_2$ /  $X^{2+}(Cl^-)_2(X^{2+})(Cl^-)_2$   
 Symbol of any group 2 element instead of X  
 (b) → (c) error carried forward accepted.  
 e.g. Group 1 → XCl  
 Group 3 →  $XCl_3$

*for 1 mark*

1

[6]

**Q16.**

- (a) same number of electrons in outer shell/highest energy level  
**or** they all form 1+ ions  
 If number of electrons is given it must be correct  
 Allow loss of same number of electrons to give full shell  
**not** gain of electrons

*for 1 mark*

1

- (b) electrons are lost more readily/more easily  
 further from nucleus/bigger atom/more shielding/more energy levels/  
**not** just more electrons  
**not** just reduced attraction

*for 1 mark each*

2

[3]

**Q17.**

- (a) Group 2 / Alkaline Earth Metals

*for 1 mark*

1

- (b) (i)  $MgCl_2/Mg^{2+}(Cl^-)_2$   
 (or equation with correct answer)

*for 1 mark*

1

- (ii) ionic / electrovalent

*for 1 mark*

1

[3]

**Q18.**

- (a) gas  
*for 1 mark* 1
- (b)  $AlX_3$   
*for 1 mark* 1
- (c) 7 / halogens  
*for 1 mark* 1

[3]

**Q19.**

- (a) same number of electrons in outer shell / 1 / an electron in outer shell / lose one electron  
*for 1 mark* 1
- (b) (i) C  
*for 1 mark* 1
- (ii) E  
*for 1 mark* 1
- (c) (i)  $2Na + 2H_2O \rightarrow 2NaOH + H_2$   
symbols must be correct  
correct multiples / fractions accepted  
Balancing mark is independent  
*formulae gains 1 mark*  
*balancing gains 1 mark* 2
- (ii) Assume 'it' means potassium  
potassium more reactive / vigorous / faster reaction / violent (can be awarded in either section)  
potassium atom larger than sodium / higher outer energy level / outer shell further from nucleus / more shells (not just more electrons)  
electron in outer shell is less strongly attracted / greater shielding  
outer electron more easily lost  
*for 1 mark each* 4

[9]

**Q20.**

Mendeleev's table  
contains only elements

divides metals and non-metals  
 contains far more elements which were discovered later  
 groups elements according to chemical properties

puts elements in order of atomic number / atomic mass / table  
 includes these numbers

can use to work out / linked to electronic structures

left gaps for missing elements which had not been discovered

*other sensible answers*

*any two for 1 mark each*

[2]

**Q21.**

(i) B or 2, 8, 1

*for one mark*

1

(ii) A or 2, 8

*for one mark*

1

[2]

**Q22.**

(a) (i) H, Cu, Ag (rules of upper and lower case to be applied here)

*both for one mark*

1

(ii) hydrogen  
 copper  
 silver

*any two for 1 mark*

2

(b) Group 0 / Noble gases / Group 8 / Group 18 / Inert gases /  
 Rare gases / Transition elements / Metals

*for one mark*

1

(c) sensible suggestions based on their knowledge of the periodic table  
 left spaces for elements which had not been discovered  
 left gaps so that elements could be placed in columns with other  
 elements which had similar properties

*for one mark*

1

(d) proton (atomic)

*for one mark*

1

(e) they react with water to give alkaline solutions

they form an ion with a 1+ charge  
they are metals

*for 1 mark each*

3

- (f) maximum of 1 mark for description  
floats / surface  
may melt (*not* gets hot)  
moves around  
bubbles / steam / fumes / smoke / fizz  
dissolves / disappeared / gets smaller  
flame

*(ignore sounds / heat)*

*any one for 1 mark*

2 marks for correct product

sodium hydroxide or a solution containing sodium and hydroxide ions)  
NaOH / caustic soda hydrogen / H<sub>2</sub>  
*(if more than 2 products given subtract one for each incorrect to maximum -2)*

*three for 1 mark each*

3

[12]

**Q23.**

- (a) Copper  
Silver  
Hydrogen

*two correct symbols gains one mark. (√x)*

*any two for 1 mark each*

2

- (b) Group 0 / Noble gases / Group 8 / Group 18 / Inert gases / Rare gases  
/ Transition elements / metals

*for one mark*

1

- (c) sensible suggestions based on their knowledge of the Periodic Table  
left spaces for elements which had not been discovered  
left gaps so that elements could be placed in columns with other  
elements which had similar properties

*any one for 1 mark*

1

- (d) atomic (proton)

*for one mark*

1

[5]

**Q24.**

- (a) transition / transitional metals / elements / d-block

for one mark

1

- (b) coloured catalyst

(accept high melting point)

for 1 mark each

2

[3]

### Q25.

chlorine atom smaller than bromine atom / has fewer shells / chlorine is higher in the group than bromine so it is more reactive

the outer electron / extra electron is more strongly attracted with chlorine than bromine / bromide (owtte) / more shielding with bromine / less shielding with chlorine

an extra electron is more easily gained by chlorine **or** chlorine can take an electron from bromide ion (*not* bromine)

for 1 mark each

[3]

### Q26.

- (a)  $-220(^{\circ}\text{C})$

accept without unit  
do **not** credit if no minus sign  
no tolerance allowed

1

- (b) iodine

allow I or I<sub>2</sub>

1

- (c) increase down (the groups)

*N.B. must be **one** comparative or superlative for either position in group or melting point to obtain 2 marks*  
e.g. accept lowest in group has highest melting point for 2 marks  
accept highest in group has lowest melting point for 2 marks  
accept highest mass numbers or proton numbers or atomic numbers have highest melting point for 2 marks  
allow F has lower **or** lowest melting point for 1 mark  
allow 'Increase from F to 1',  
i.e. referring to graph rather than periodic table for 1 mark  
F has a low melting point no marks

2

- (d) brittle 1
- poor conductor of electricity
- maximum 1 mark if three boxes ticked  
no marks if all four boxes ticked*

1

**[6]**

**Q27.**

- low density 1
- form hydroxides that dissolve in water 1
- react quickly with water
- four ticks – max 2 marks  
five ticks – max 1 mark  
all boxes ticked – 0 marks*

1

**[3]**

**Q28.**

- (a) (i) Y or 2,8,8 or Argon or Ar 3  
*All correct gains 3 marks*
- (ii) W or 2,5  
*3 correct gains 1 mark*
- (iii) X or 2,7 or fluorine or F  
*2 or 1 correct gains 1 mark*
- (iv) Z or 2,8,8,1 or potassium or K  
*N.B. number of ticks on script must equal number of marks*
- (b) 1 and 2 (both needed) 1  
*do not credit if any other group listed  
'transition metals' neutral  
allow alkali metals and alkali earth metals*

3

1

**[4]**

**Q29.**

- (a) same number of outer electrons / have 2 outer electrons 1  
*do not accept inner electrons or 2Xs*
- (b) calcium (idea) outer electrons / shell  
further from nucleus

1



*do not credit lower down group*  
*do not credit larger / more shells*

1

more easily lost / attraction from nucleus less  
*accept screening of inner electrons*

1

**[3]**

**Q30.**

(a) less dense than air

*no marks if four or five box*

1

very unreactive

*maximum 1 mark if three boxes ticked*

1

(b) CO<sub>2</sub>

1

HCl

1

NH<sub>3</sub>

*do not penalise upper / lower case or  
superscript*

1

**[5]**

**Q31.**

(a) Mendeleev arranged known elements in order of mass or properties

*reject explanation in terms of electrons and / or atomic  
number*

1

gaps in Periodic Table / group 1

1

(b) does not last long enough to experiment / very little of it

*allow it has a short half-life*

1

(c) (i) (much) more violent

*accept more reactive*

1

(ii) since outer electron / or shell further from nucleus

*do not credit lower down group larger / more shells neutral*

1

therefore more easily lost

*accept screening by inner electrons*

1

[6]

**Q32.**

- (a) He 1
- (b) carbon / silicon / germanium / tin / lead  
*accept correctly written symbols C / Si / Ge / Sn / Pb* 1
- (c) copper  
*accept Cu* 1
- (d) iodine  
*accept I or I<sub>2</sub>* 1

[4]

**Q33.**

- (a) **A** – electron 1
- B** – nucleus 1
- C** – proton 1
- D** – neutron 1
- (b) Group 1 / alkali metals 1
- has one electron in outer shell  
*accept 3 protons / 3 electrons / atomic number 3  
therefore lithium (so Group 1 / alkali metals)* 1
- (c) lithium  
*accept Li* 1

[7]

**Q34.**

- (a) (i) liquid  
*allow l* 1
- (ii) solid  
*allow s  
allow responses written in table*

- 1
- (b) fluorine  
*accept F, reject fluoride*
- 1
- (c) hydrogen bromide  
*reject hydrogen bromine*  
*accept HBr/BrH*  
*allow responses written in table*
- 1

[4]

**Q35.**

fluorine has fewer shells / less shielding than iodine

1

gains electrons more easily / more pull

1

[2]

**Q1.**

John Newland produced a periodic table in 1866. The first 21 elements in his table are shown in the diagram.

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

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

- (a) In which **two** columns of Newland's periodic table do all the elements have similar properties?

\_\_\_\_\_ (1)

- (b) The modern periodic table is arranged in a different order to Newland's table.

- (i) What order is used in the modern periodic table?

\_\_\_\_\_ (1)

- (ii) Argon has a higher relative atomic mass than potassium. Explain why.

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(1)

- (iii) Describe the changes in the number of electrons in the atoms of elements in the period which begins with potassium and ends with krypton.

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(2)

(Total 5 marks)

**Q2.**

The table gives some properties of the element silicon.

Melting point	1410 °C
Relative atomic mass	28
Conductivity	Conducts electricity
Compounds	Forms compounds with covalent bonds
Position in periodic table	Group 4
Reaction with water	Unreactive
Density	Relatively low

- (a) Give **two** ways in which silicon is similar to the alkali metals.

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

\_\_\_\_\_

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

\_\_\_\_\_

(2)

- (b) Give **two** ways in which the properties of silicon are different from those of the alkali metals.

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

\_\_\_\_\_

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

\_\_\_\_\_

---

(2)  
(Total 4 marks)

**Q3.**

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

- (a) Write the symbol for helium.

---

(1)

- (b) Write the name of an element in Group 4.

---

(1)

- (c) Write the name of the element which has a relative atomic **mass** of 64.

---

(1)

- (d) Write the name of the element with the next highest atomic number after Te (tellurium) in the periodic table.

---

(1)  
(Total 4 marks)

**Q4.**

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

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

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

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(2)

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

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(2)

- (b) Explain why Group 0 elements are monatomic.

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(2)

(Total 6 marks)

**Q5.**

Part of the Periodic Table is shown. It includes the symbols for six elements.

Li			C			F	
Na							
K	Ca						

Alkali metals

Halogens

- (a) Write the symbol for carbon. \_\_\_\_\_

(1)

- (b) (i) Put the symbol Cl, for chlorine, into its correct position in the Table.

(1)

- (ii) Bromine, chlorine, fluorine and iodine are halogens. Which one of these halogens is least reactive?

\_\_\_\_\_ (1)

(c) The alkali metals form Group 1 in the Periodic Table. Write the symbol of the most reactive alkali metal shown in the Table above.

\_\_\_\_\_ (1)

(d) Write the symbol for an element which is in the same Group as sodium.

\_\_\_\_\_ (1)

**(Total 5 marks)**

**Q6.**

(a) Choose from the names of elements in the box the answers to the questions which follow.

aluminium	carbon	chlorine	copper
helium	iron	magnesium	sodium

Give the name of:

(i) an alkali metal

\_\_\_\_\_ (1)

(ii) a halogen

\_\_\_\_\_ (1)

(iii) a noble gas

\_\_\_\_\_ (1)

(b) The alkali metals are in Group 1 of the Periodic Table. The elements in Group 1 have a number of similar properties.

(i) Describe **one chemical** property which they have in common.

\_\_\_\_\_ (1)

(ii) Describe **one physical** property which they have in common.

\_\_\_\_\_ (1)

(Total 5 marks)

**Q7.**

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)



**Q8.**

Potassium reacts violently with cold water.

It forms an alkaline solution of potassium hydroxide and hydrogen.



- (a) In what physical state is hydrogen given off?

Choose your answer from the words in the box.

gas	liquid	solid	solution
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\_\_\_\_\_ (1)

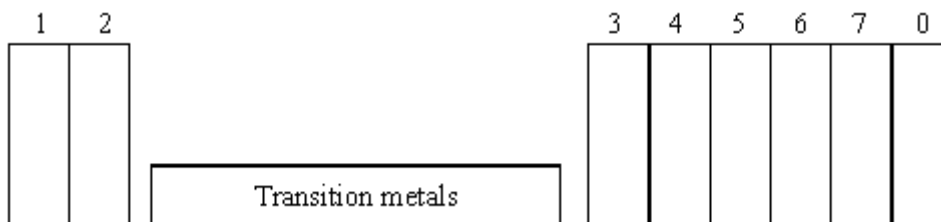
- (b) (i) What type of substance will neutralise potassium hydroxide solution?

\_\_\_\_\_ (1)

- (ii) What is the pH of the neutral solution?

\_\_\_\_\_ (1)

- (c) In the Periodic Table there are eight main groups.



What is the number of the group that has potassium in it?

\_\_\_\_\_ (1)

- (d) Sodium is in the same group as potassium.

- (i) How does sodium react with cold water and what is formed?

\_\_\_\_\_  
 \_\_\_\_\_ (2)

- (ii) How can you prove that an alkaline solution is formed when sodium reacts with water?

\_\_\_\_\_

\_\_\_\_\_ (2)

(e) Lithium reacts more slowly with cold water than sodium.

State **two** ways the reaction can be made to go faster.

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

(2)  
(Total 10 marks)

**Q9.**

Part of the Periodic Table is shown below. The symbol for helium is given.

		transition metals											He

(a) (i) What name is given to the group that contains helium?

\_\_\_\_\_ (1)

(ii) Give **one** use for helium and explain why it is used.

\_\_\_\_\_  
\_\_\_\_\_ (2)

(iii) What is the name of another element in the same group as helium?

\_\_\_\_\_ (1)

(iv) Write the symbol for this element.

\_\_\_\_\_ (1)

(b) Give the names of **two** other elements not in Group 0 that are gases at room temperature.

\_\_\_\_\_ and \_\_\_\_\_ (2)

- (c) The alkali metals are in Group I of the Periodic Table.

Give the name and the symbol of **one** alkali metal.

Name \_\_\_\_\_ Symbol \_\_\_\_\_

(2)

- (d) Alkali metals have low melting points.

Give another physical property of the alkali metals.

\_\_\_\_\_

(1)

(Total 10 marks)

### Q10.

- (a) The diagram shows the electronic structure of a particular element.



In a similar way, show the electronic structure of another element from the same group in the periodic table and name the element you select.

Name of element selected \_\_\_\_\_

(4)

- (b) The element lithium gives a moderate reaction with cold water, releasing hydrogen and forming a solution of lithium hydroxide.

Describe how sodium is similar to and how it is different from lithium in its chemical reaction with cold water.

Explain any similarity or difference in terms of their atomic structure.

Similarity. \_\_\_\_\_

Reason. \_\_\_\_\_

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Difference. \_\_\_\_\_

Reason. \_\_\_\_\_

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(5)  
(Total 9 marks)

**Q11.**

The table shows the properties of four elements from Group VII of the Periodic Table.

Element	Proton Number	Electronic structure	Boiling point (°C)	Melting point (°C)	State at 20°C	Reaction with hydrogen	
						Ease	Product
Fluorine		2.7	-188	-218	gas	Explosive reaction in dull light	hydrogen fluoride
Chlorine	17		-34	-101		Explosive reaction in sunlight	hydrogen chloride
Bromine	35	2.8.18.7	+59	-7		React if heated	hydrogen bromide
Iodine	53	2.8.18.18.7	+185	+114	solid	React if heated strongly	hydrogen iodide

(a) Complete the spaces in the table.

(4)

(b) Comment briefly on the trend in melting points for these four elements.

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(1)

(c) Explain, in as much detail as you can:

(i) why the reactions of these elements with hydrogen are similar.

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(ii) why their reactivity with hydrogen decreases from fluorine to iodine.

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(4)  
(Total 9 marks)

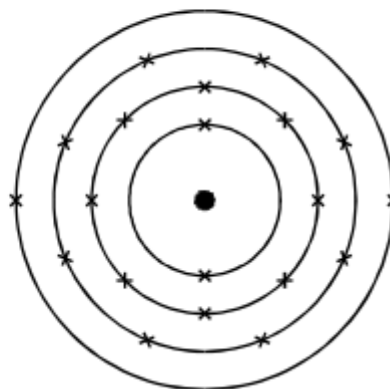
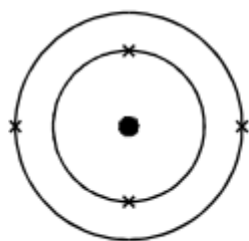
**Q12.**

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.

$\begin{matrix} 9 \\ \text{Be} \\ 4 \end{matrix}$

$\begin{matrix} 24 \\ \text{Mg} \\ 12 \end{matrix}$

$\begin{matrix} 40 \\ \text{Ca} \\ 20 \end{matrix}$



(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.

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(6)  
(Total 9 marks)

**Q13.**

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

$\frac{V}{2.1}$	$\frac{W}{2.6}$	$\frac{X}{2.8.4}$	$\frac{Y}{2.5}$	$\frac{Z}{2.8.6}$
-----------------	-----------------	-------------------	-----------------	-------------------

- (a) (i) Write the letters of the **two** elements which belong to the same group in the Periodic Table \_\_\_\_\_
- (ii) To which group do they belong? \_\_\_\_\_ (2)

- (b) Write the letters of **two** elements that are gases \_\_\_\_\_ (1)

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

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

Describe how the reaction between sodium and water is

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

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

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

- (ii) Potassium is much more reactive than lithium.

Explain this in terms of their electronic structures.

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

(3)  
**(Total 9 marks)**

**Q14.**

The diagram shows part of the periodic table.

Group 1		Group 2					Group 3		Group 4	Group 5	Group 6	Group 7	Group 0
23 sodium 11	24 magnesium 12			27 aluminium 13	28 silicon 14	31 phosphorous 15	32 sulphur 16	35 chlorine 17	40 argon 18				

Choose from the elements shown in the table:

- (a) one metal \_\_\_\_\_ (1)
  - (b) a noble gas \_\_\_\_\_ (1)
  - (c) a coloured gas \_\_\_\_\_ (1)
- (Total 3 marks)**

**Q15.**

Sodium reacts with water to produce hydrogen gas and a solution of sodium hydroxide.

Complete the **word** equation for this reaction (do **not** use symbols or formulae).

\_\_\_\_\_ + \_\_\_\_\_      \_\_\_\_\_ + \_\_\_\_\_  
**(Total 3 marks)**

**Q16.**

The idea of a periodic table of the elements was started by John Newlands about 140 years ago.

He wrote down the elements he knew about in order, starting with the lightest atoms.

Then he arranged them into seven groups, like this:

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

- (a) Write down **three** differences between the groups in Newlands' periodic table and the groups in the modern periodic table (up to the element Ca, which is calcium).

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(3)

- (b) Suggest one reason why this part of Newlands' table was different from the modern one.

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(1)

(Total 4 marks)

### Q17.

The idea of a periodic table of the elements was started by John Newlands about 140 years ago.

He wrote down the elements he knew about in order, starting with the lightest atoms.

Then he arranged them into seven groups, like this:

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



- (a) Write down **three** differences between the groups in Newlands' periodic table and the groups in the modern periodic table (up to the element Ca, which is calcium).

---



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(3)

- (b) Suggest **one** reason why this part of Newlands' table was different from the modern one.

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(1)

- (c) Dimitri Mendeleev later developed the periodic table of the elements. He arranged the elements according to their properties and their relative atomic masses.

The diagram shows where Mendeleev put tellurium (Te) and iodine (I) in his table because of their properties.

(The diagram uses present day symbols and the atomic numbers of the elements have been added to Mendeléev's table.)

	GROUP 6	GROUP 7	
	$^{16}_8\text{O}$	$^{19}_9\text{F}$	
	$^{32}_{16}\text{S}$	$^{35.5}_{17}\text{Cl}$	
		$^{80}_{35}\text{Br}$	
	$^{128}_{52}\text{Te}$	$^{127}_{53}\text{I}$	

- (i) What is wrong with this arrangement of tellurium and iodine in terms of their relative atomic masses?

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(1)

(ii) Explain why this is not a problem in the modern periodic table.

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(2)  
(Total 7 marks)

**Q18.**

These are the electronic structures of the atoms of three different elements.

2.8.1  
element A

2.8.8  
element B

2.8.8.1  
element C

(a) Identify elements A and B.

Element A is \_\_\_\_\_

Element B is \_\_\_\_\_

(2)

(b) (i) Why is element C more reactive than element A?

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(2)

(ii) Why is element B unreactive?

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(2)  
(Total 6 marks)

**Q19.**

The diagram shows some of the elements in Groups I and 7 of the Periodic Table.

Group	1	2	3	4	5	6	7	0
Li							F	
Na							Cl	
K							Br	
							I	

- (a) The elements in Group 1 have similar chemical properties.

Describe **one** chemical reaction which shows that lithium, sodium and potassium react in the same sort of way.  
 You should say what you would react them with and what substances would be produced.

- What you would react them with

---

- Substances produced

---



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(3)

- (b) All the elements in Group 7 react with hydrogen.

Fluorine reacts in the dark, explosively, at very low temperatures.  
 Chlorine reacts explosively in sunlight, at room temperature.  
 Bromine, in light, only reacts if heated to about 200°C.

Suggest the conditions needed for hydrogen and iodine to react.  
 Give reasons for your answer.

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(2)

- (c) Hydrogen and chlorine react to produce hydrogen chloride.  
 Balance the symbol equation for the reaction.



(1)

- (d) Use your understanding of atomic structure to explain the trend in reactivity in the Group 7 elements.

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(2)  
(Total 8 marks)

## Mark schemes

### Q1.

- (a) 2 and 3  
*both needed* 1
- (b) (i) atomic number / proton number  
*electrons neutral* 1
- (ii) argon has more neutrons  
*accept more particles in nucleus* 1
- (iii) increases 1
- by one with each element 1
- [5]

### Q2.

- (a) conducts electricity 1
- density low 1
- (b) any **two** from:  
unreactive (with water)  
forms compounds with  
covalent bonds  
high melting point 2
- [4]

### Q3.

- (a) He 1
- (b) carbon / silicon / germanium / tin / lead  
*accept correctly written symbols  
C / Si / Ge / Sn / Pb* 1
- (c) copper  
*accept Cu* 1

- (d) iodine  
*accept I or I<sub>2</sub>* 1
- [4]**

**Q4.**

- (a) (i) same number of electrons  
*allow all have 7 electrons* 1
- in outermost shell 1
- (ii) fluorine has fewer shells than iodine / less shielding 1
- gains electrons more easily / more pull 1
- (b) outermost shell full 1
- no tendency to lose / gain electrons 1
- [6]**

**Q5.**

- (a) C 1
- (b) (i) C1 immediately below F  
*do not credit C below F* 1
- (ii) iodine or I **or** I<sub>2</sub>  
*do not credit iodide* 1
- (c) K **or** accept word potassium  
*do not credit word potassium* 1
- (d) Li **or** K **or** Rb **or** Cs **or** Fr  
*do not credit lithium **or** potassium  
**or** rubidium **or** caesium **or**  
 francium* 1
- [5]**

**Q6.**

- (a) (i) sodium  
*do not credit Na* 1

- (ii) chlorine  
*do not credit Cl* 1
- (iii) helium  
*do not credit He* 1
- (b) (i) any **one** from  
react with water  
*do not credit just 'very reactive'*  
*accept a recognised general reaction for a Group I metal*  
*such as reacts with oxygen **or** chlorine **or** acids*  
  
form alkalis with water  
  
give off hydrogen with water  
*It must specify a named chemical reaction* 1
- (ii) any **one** from  
low melting  
*accept solid*  
  
low density  
*accept float on water*  
  
malleable  
  
soft  
*accept easily cut with a knife*  
  
ductile  
  
shiny  
  
(good) conductors 1
- Q7.**
- (a) (i) Cl  
*only* 1
- (ii) Na  
*only* 1
- (b) (i) Mg  
*only* 1

[5]

- (ii) halogens  
*do not credit halide* 1
- (c) (i) 2.8  
*ignore commas or fullstops* 1
- (ii) 2.8.3 1
- (d) the number of protons  
*accept the number of electrons in an atom or 'number of protons or electrons'*  
*do not credit just the number of electrons* 1
- (e) neutron 1

[8]

**Q8.**

- (a) gas 1
- (b) (i) acid  
*ignore any reference to a particular kind of acid* 1
- (ii) 7 1
- (c) 1  
*credit potassium or K written into Group 1* 1
- (d) (i) reacts rapidly or quickly or fast  
*credit melts or fizzes or dissolves or violently or less violently (than K)* 1
- sodium hydroxide or hydrogen  
*credit NaOH or H<sub>2</sub>* 1
- (ii) add universal indicator  
*credit add indicator or litmus or use pH paper* 1
- turns blue or purple  
*credit 'it goes purple' providing something has been added to the water* 1
- (e) any two from



heat **or** warm

cut it up **or** have smaller pieces or larger surface area  
*do not accept more lithium **or** less water*

stir

2

[10]

**Q9.**

(a) (i) any **one** from

noble gases inert gases

*accept group 0 **or** group 8 do not accept rare gases*

1

(ii) any **pair** from

*an appropriate reason gains the second mark*

balloons lighter than air

airships lighter than air **or** non-flammable

*do not accept light*

*do not accept they go up **or***

*rise in the air **or** unreactive*

for divers insoluble in blood **or**  
 (air supply) to stop the bends

2

(iii) neon **or** argon

*accept krypton, xenon, radon*

1

(iv) Ne **or** Ar

*accept Kr, Xe, Rn*

*do not accept NE **or** AR **or** ne*

***or** ar etc*

1

(b) any **two** from

oxygen

nitrogen

hydrogen

chlorine

fluorine

2

(c) any **pair** from

*the first mark for the name and the  
 second mark for the correct symbol*

sodium Na

potassium K

lithium                      Li  
                                       *accept rubidium, caesium, francium Rb,  
                                       Cs, Fr  
                                       do not accept NA or na etc*

2

(d) any **one** from

low density  
                                       *accept floats on water*

soft  
                                       *accept malleable **or** ductile*

grey

shiny when cut

conducts electricity **or** heat

1

[10]

**Q10.**

(a) 2.8.2. magnesium or 2.8.8.2. calcium  
 inner shell (2)  
 outer shell (2)  
 intermediate shell/s correct  
 element named to match structure

*each for 1 mark  
 (Structure correct for element name but not in group  
 2, award 2 marks)*

4

(b) Similar    hydrogen and/or an alkali/hydroxide produced  
   *for 1 mark*

Reasons:    chemical reaction involves loss of an electron  
   Na + Li have the same number of electrons in the  
 outer shell    (do not allow same group of p.table)

*each for 1 mark*

Different    rate of reaction faster for sodium\*  
   *for 1 mark*

Reason:    outer electron more easily lost from the sodium  
 atom  
 [\* allow sodium hydroxide produced]

*for 1 mark*

5

[9]

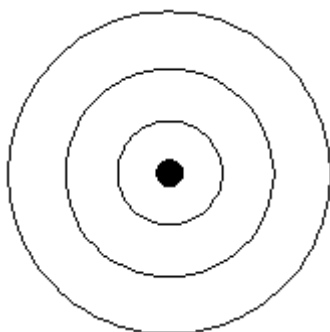
**Q11.**

- (a) (i) 9  
 (ii) 2.8.7 gas  
 (iii) liquid  
*each for 1 mark* 4
- (b) increase as go down the table/F → I/down group/  
 as more protons/as atoms get bigger  
*for 1 mark* 1
- (c) (i) reactions depend on taking/sharing electrons  
 same number of electrons in outer shell/highest energy level  
 (ii) F → I electrons in a higher energy level/further from nucleus  
 so less easy to gain/hold electrons  
*each for 1 mark* 4

[9]

**Q12.**

(a)



each shell completed correctly  
 [for written 2.8.2 award 1 mark]  
*for 1 mark each*

3

- (b) idea that
- chemical reactions of metals, involves losing electrons  
*for 1 mark*
  - these three elements have the same number of electrons in the outer shell/highest energy level  
*gains 1 mark*
- but**
- these three elements all have two electrons in

the outer shell/highest energy level

*gains 2 marks*

All form ions with a 2+ charge gains all 3 of these marks

- reactivity depends on how easily the electrons are lost  
*for 1 mark*
- the further the electrons are from the nucleus/the higher the energy level they are in, the more shells the atom has\* then the more easily they are lost  
*for 1 mark*
- in calcium the electrons are further from the nucleus than in magnesium than in beryllium  
*for 1 mark*

**or** as you go down the group .....  
(\*not just “the more electrons”....)

6

[9]

**Q13.**

- (a) (i) W and Z (allow oxygen and sulphur)  
*for 1 mark*

- (ii) Group 6  
*for 1 mark*

2

- (b) W and Y (allow oxygen and nitrogen or correct symbol for any 2 gaseous elements)  
*for 1 mark*

1

- (c) (i) (S) • produce an alkali/hydroxide *each*  
• produce hydrogen or idea of effervescence

- (D) • (alkali is) sodium hydroxide  
• the reaction is faster/more vigorous  
*any 3 • for 1 mark*

3

- (ii) *ideas that*

potassium is further down the group or more electron shells  
*gains 1 mark*

**but** because the electrons in potassium are further from the nucleus/in a more outer shell / in a higher energy level  
*gains 2 marks*

so they are most easily lost **or** less strongly pulled/held by nucleus  
for 1 mark

3

[9]

**Q14.**

(a) sodium / magnesium / aluminium (*Allow correct symbols*)  
for 1 mark

1

(b) argon (*Allow correct symbols*)  
for 1 mark

1

(c) chlorine (*Allow correct symbols*)  
for 1 mark

1

[3]

**Q15.**

- correct reactants (i.e. sodium + water either way round)
- correct products (i.e. sodium hydroxide + hydrogen, either way round)
- arrow  $\rightarrow$  / = [do not allow produce/makes or similar]

[do not allow symbols or formulae]  
each for 1 mark

[3]

**Q16.**

(a) *ideas that*

- hydrogen is in a group / is with the halogens
- only seven groups / no group O / no noble gases / fewer elements
- halogens are in the first group / Group 1
- other elements are in one group higher / **one** example
- modern table only has two elements in the top row/period
- metals and non-metals are not separated
- arranged in increasing mass number [*Credit converse answers*]  
any three for 1 mark each

3

(b) *ideas that*

- all rows / periods are the same length / have seven elements

- all elements had to be in one of the groups
- **he didn't know** about the noble gases / not all the elements **had been discovered**
- he didn't know about atomic number / proton number / atomic structure / electron structure  
*any one for 1 mark*

1

[4]

### Q17.

(a) ideas that

- hydrogen is in a group / is with the halogens
- only seven groups / no group O / no noble gases / fewer elements
- halogens are in the first group / Group 1
- other elements are in one group higher (*or example*)
- modern table only has two elements in the top row / period
- modern table not in order of atomic weight/mass
- metals and non-metals not at opposite ends  
*(NB allow converse answers throughout)*  
*any three for 1 mark each*

3

(b) ideas that

- all rows / periods are the same length / have seven elements
- all elements had to be in one of the groups
- he didn't know about the noble gases / not all the elements had been discovered
- he didn't know about atomic/proton number/electron structure
- he arranged elements in order of atomic weight/mass  
*any one for 1 mark*

1

(c) (i) *ideas that*  
tellurium and iodine are in reverse order  
*for 1 mark*

1

- (ii) elements are arranged in order of proton (atomic) number or based on electron structure/outer shell electrons (so tellurium is correctly placed before iodine)

[tellurium = 'dead mark']  
each for 1 mark

2

[7]

**Q18.**

- (a) A is sodium/Na\*  
B is argon/Ar\*

each for 1 mark  
(\*case of letters must be correct)

2

- (b) (i) *ideas that*

- outer electron (in element C / 2.8.8.1 / potassium) is at a higher energy level / in a more outer shell/further away from nucleus / shielded by more full electron shells
- electron is more easily lost/less strongly held / attracted  
each for 1 mark

2

- (ii) *ideas that*

- (element B / 2.8.8 / argon) has an outer shell that is complete/has 8 electrons
- no tendency to gain or lose electrons / has a stable configuration
- (not 'is stable' / 'in group O' / 'a noble gas')  
each for 1 mark

2

[6]

**Q19.**

- (a) • water  
(allow acid\*)
- (metal) hydroxide (solution)/alkali  
(allow metal salt / compound)
- hydrogen  
(allow hydrogen)  
for 1 mark each

(\*if named acid then matching salt)

or

- oxygen / chlorine / halogen
- for 1 mark

- oxide / chloride / halide  
*gains 1 mark*

**but**

- named oxide(s) *gains 2 marks*  
(accept fully correct formulae throughout)

3

(b) *idea that*

- hydrogen and iodine would only react if heated to  $> 200^{\circ}\text{C}$  / a high temperature (*ignore* reference to light / dark)
- reactivity decreases down the Group / iodine is lower in the Group than bromine / iodine is the lowest in the Group

(**or** converse N.B. credit this idea here even if given in (d))  
*for 1 mark each*

2

(c)  $\text{H}_2 + \text{Cl}_2 \rightleftharpoons 2\text{HCl}$  or  $\frac{1}{2}\text{H}_2 + \frac{1}{2}\text{Cl}_2 \rightarrow \text{HCl}$   
*for 1 mark*

1

(d) *idea that (or converse)*

- in atoms lower down the Group the electrons in the outer shell / highest energy level (of electrons) are further from the nucleus  
**or shielded by** more (inner) shells / electrons

[but not simply “more electrons”]

**or** are less strongly attracted to the nucleus

- so an electron is less easily gained  
*for 1 mark each*

2

**[8]**