AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.1.2 THE PERIODIC TABLE (PACK 1)

SCORE	PERCENTAGE
/295	%

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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_2 ☐

F^2 ☐

2F ☐

(1)

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

The table below shows the student's observations.

Potassium chloride	Potassium bromide	Potassium iodide

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	(colourless)	(colourless)	(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.

_____

_____

_____

_____

_____

_____

(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	☐

(1)

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

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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^+ ☐

Na^+ ☐

OH^- ☐

O^{2-} ☐

(1)

(f) A solution of NaOH had a concentration of 40 g/dm^3

What mass of NaOH would there be in 250 cm^3 of the solution?

_____

_____

_____

_____

Mass = _____ g

(2)

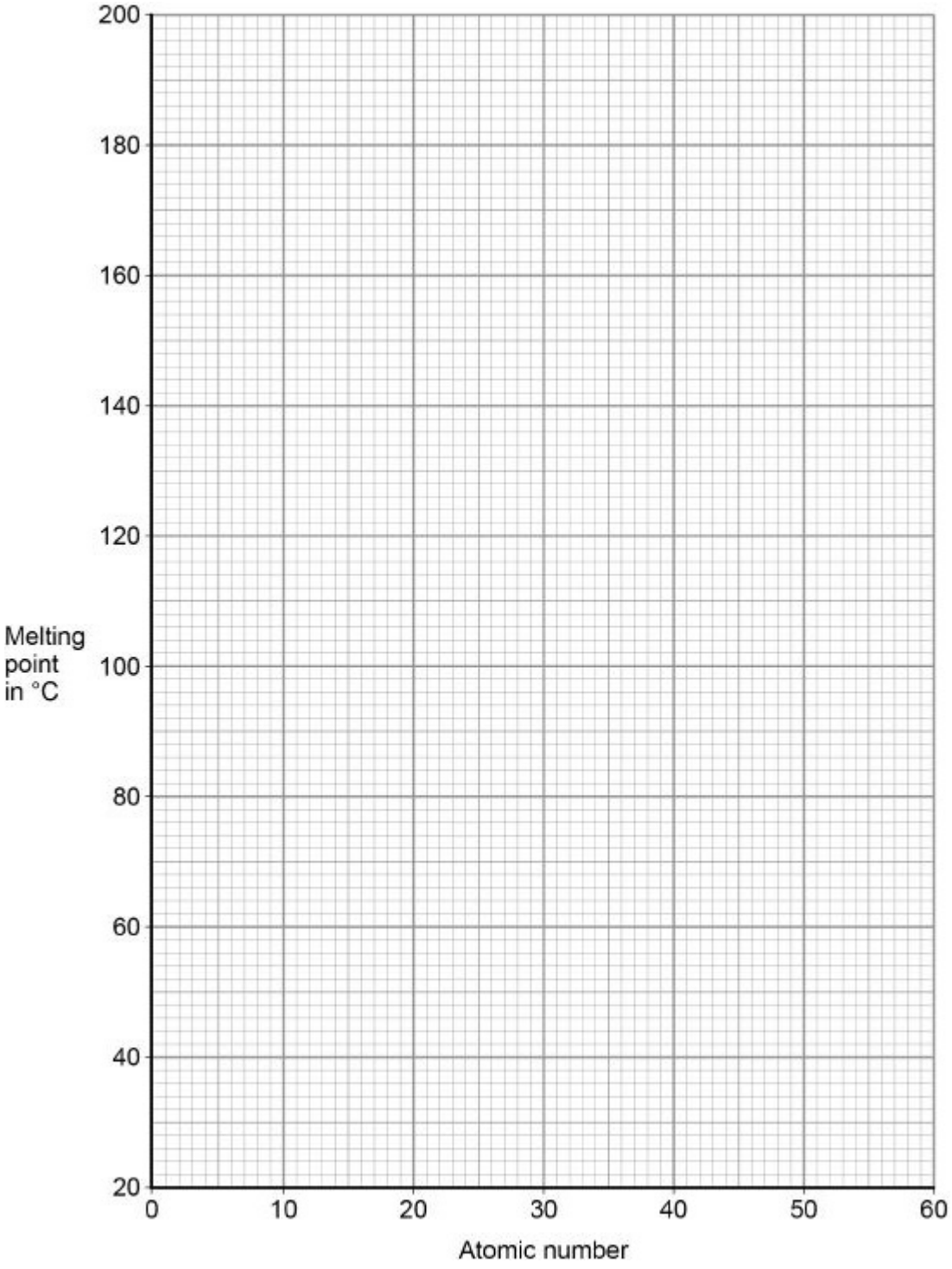
(g) The melting points of the elements in Group 1 show a trend.

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

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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)

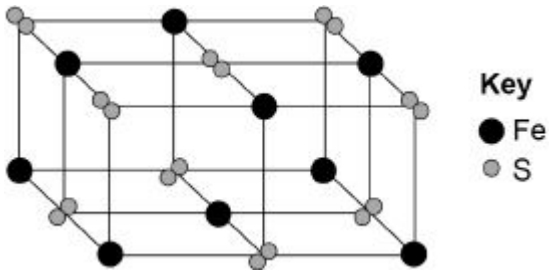
Q3.

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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 $^{56}_{26}Fe$

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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_____

(2)

(e) An equation for the reaction is:

$$NiO + C \longrightarrow Ni + CO$$

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.

_____

_____

_____

_____

_____

_____

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.

_____

_____

(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.

_____

_____

_____

_____

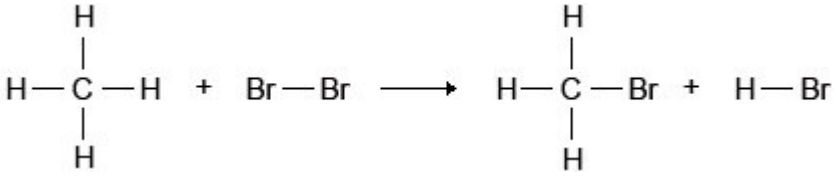
_____

_____

(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.

Stage 1 $TiO_2 + 2\ C + 2\ Cl_2 \longrightarrow TiCl_4 + 2\ CO$

Stage 2 $TiCl_4 + 4\ Na \longrightarrow Ti + 4\ NaCl$

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

_____

_____

(1)

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

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

_____

_____

(1)

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

_____

_____

_____

_____

(2)

(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?

_____

_____

(1)

(f) Complete the half equation for the oxidation reaction.

$$Na \longrightarrow _____ + _____$$

(1)

(g) In Stage 2, 40 kg of titanium chloride was added to 20 kg of sodium.

The equation for the reaction is:

$$TiCl_4 + 4\ Na \longrightarrow Ti + 4\ NaCl$$

Relative atomic masses (A_r): Na = 23 Cl = 35.5 Ti = 48

Explain why titanium chloride is the limiting reactant.

You **must** show your working.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(h) For a **Stage 2** reaction the percentage yield was 92.3%

The theoretical maximum mass of titanium produced in this batch was 13.5 kg.

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Calculate the actual mass of titanium produced.

_____

_____

_____

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.

_____ Na + O_2 ⟶ 2 Na_2O

(1)

(b) Why is this an oxidation reaction?

_____

_____

(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?

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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
	Silicon dioxide	Insoluble	No solution formed

The student makes two conclusions.

Conclusion 1: 'All metal oxides produce alkaline solutions.'

Conclusion 2: 'All non-metal oxides produce acidic solutions.'

(e) Explain why the student's conclusions are only partly correct.

Use information from the table above.

_____

_____

_____

_____

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_____

_____

_____

_____

(4)

(f) Give an improved conclusion for metal oxides.

Use the table above.

_____

_____

_____

_____

_____

_____

_____

_____

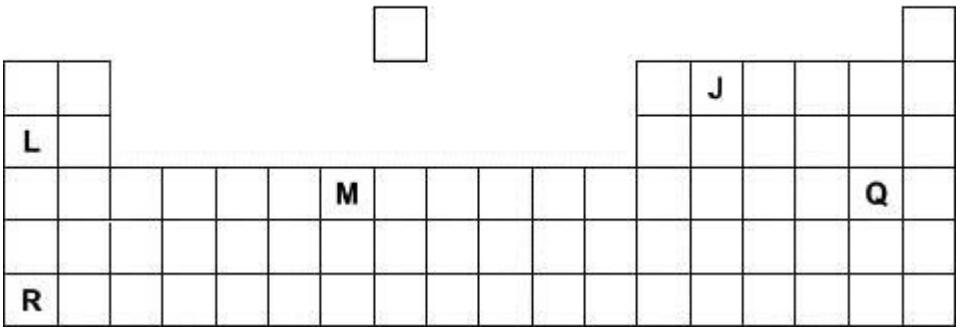
(2)

(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)

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(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

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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.

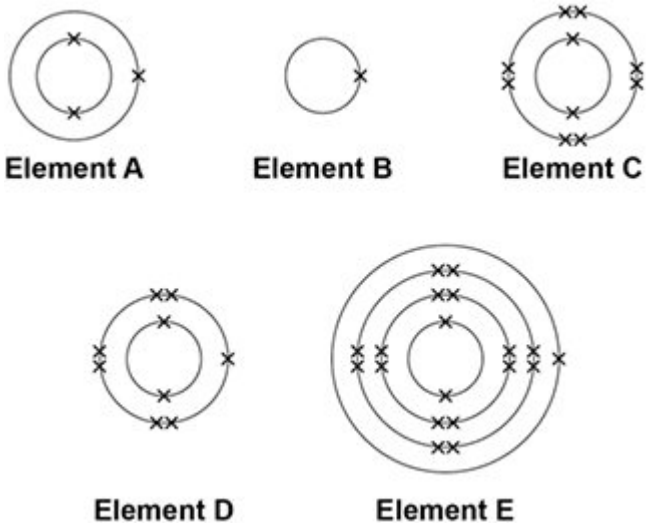
(6)

(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.

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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 above to calculate the relative atomic mass of element **A**.
Give your answer to 2 decimal places.

_____

_____

_____

_____

_____

_____

_____

Relative atomic mass = _____

(4)

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(Total 8 marks)

Q9.

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

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

Number of protons _____

Number of neutrons _____

Number of electrons _____

(3)

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

_____

_____

(1)

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

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

	Transition elements		**Group 1 elements**	
	Chromium	Iron	Sodium	Caesium
Melting point in °C	1857	1535	98	29
Formula of oxides	CrO Cr_2O_3 CrO_2 CrO_3	FeO Fe_2O_3 Fe_3O_4	Na_2O	Cs_2O

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

_____

_____

_____

_____

_____

_____

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_____

_____

_____

_____

(6)

(Total 10 marks)

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:

$$Cl_2(aq) + 2KI(aq) \rightarrow I_2(aq) + 2KCl(aq)$$

Look at table above.

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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.

$Cl_2 + 2K \rightarrow 2KCl$ ☐

$2I^- + Cl_2 \rightarrow I_2 + 2Cl^-$ ☐

$I^- + Cl \rightarrow I + Cl^-$ ☐

$I^- + K^+ \rightarrow KI$ ☐

(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 electrolysing potassium iodide solution?

Tick **one** box.

Product at cathode	**Product at anode**	
hydrogen	iodine	☐
hydrogen	oxygen	☐

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potassium	iodine	☐
potassium	oxygen	☐

(1)

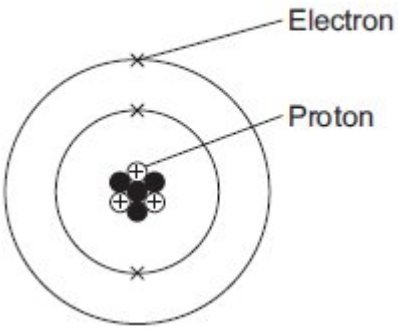
(Total 6 marks)

Q11.

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

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

Figure 1



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

Tick (✔) **one** box.

3	☐
4	☐
7	☐

(1)

(ii) What is the charge of an electron?

Tick (✔) **one** box.

–1	☐
0	☐
+1	☐

(1)

(iii) Protons are in the nucleus.

Which other sub-atomic particles are in the nucleus?

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Tick (✔) **one** box.

ions ☐

molecules ☐

neutrons ☐

(1)

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

Tick (✔) **one** box.

number of neutrons ☐

number of protons ☐

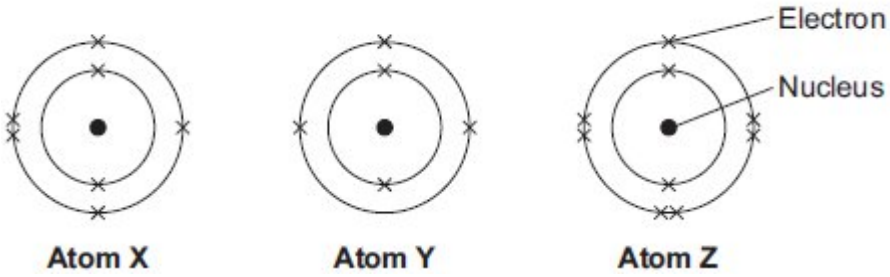
number of shells ☐

(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 ☐

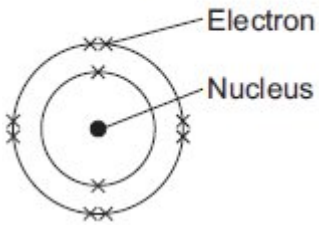
Atom Z ☐

(1)

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

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Figure 3



(i) Give the chemical symbol of this element.

_____

(1)

(ii) Why is this element unreactive?

_____

_____

(1)

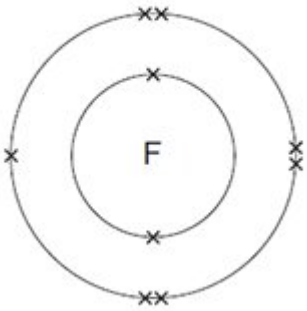
(Total 7 marks)

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

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(2)

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

alkalis	alloys	isotopes

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

The relative formula mass (M_r), in grams, of sodium fluoride is one

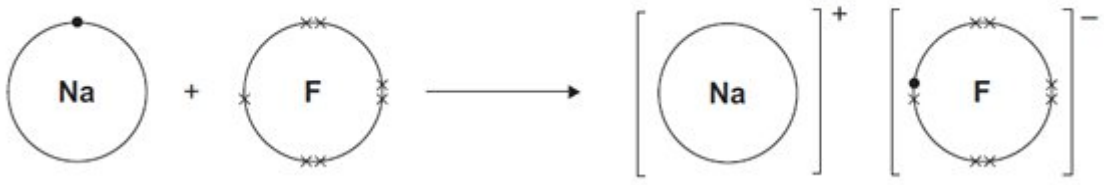
_____ of the substance.

(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 (×) 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.

atoms	**atomic weights**	**electrons**	**proton numbers**

Newlands' and Mendeleev's periodic tables show the elements in order of their _____ .

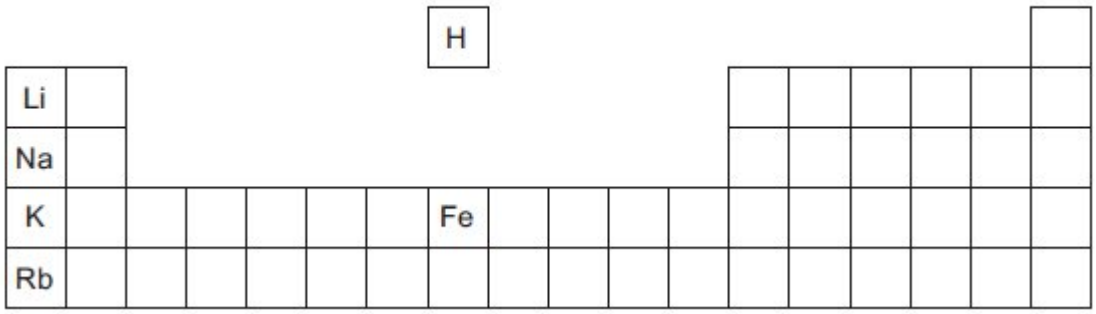
Following the discovery of protons and _____, the modern periodic table shows the elements in order of their _____ .

(3)

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

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Figure 1



(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. ☐

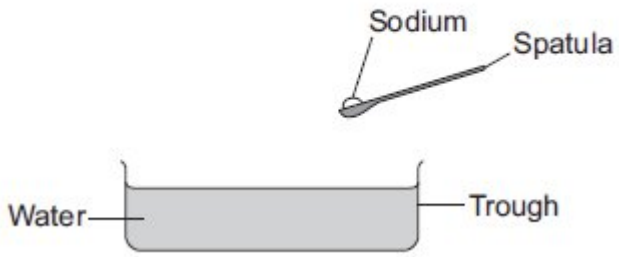
Iron forms ions that have different charges. ☐

(2)

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

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Figure 2



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

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(Total 11 marks)

Q14.

This question is about elements and the periodic table.

(a) Newlands and Mendeleev both produced early versions of the periodic table.

(i) Complete the sentence.

In their periodic tables, Newlands and Mendeleev arranged the elements in order of _____ .

(1)

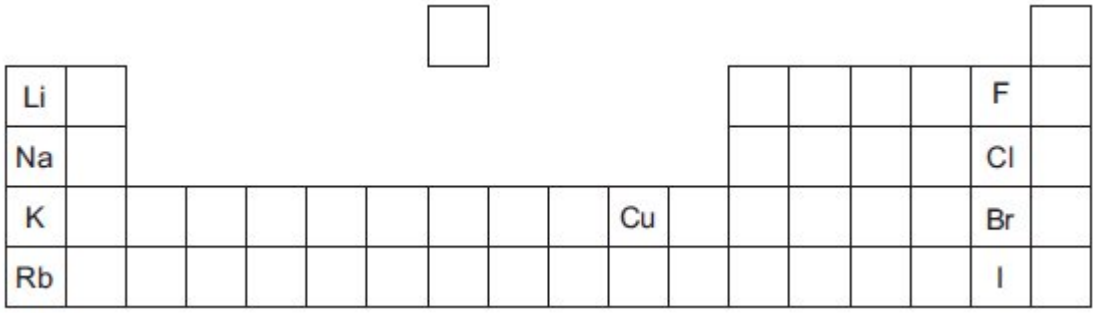
(ii) Name the particle that allowed the elements to be arranged in order of their atomic number in the modern periodic table.

_____

(1)

(b) The diagram below shows the position of nine elements in the modern periodic table.

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(i) Which **one** of the nine elements shown in the diagram above has the lowest boiling point?

_____

(1)

(ii) Copper and potassium have different melting points and boiling points.
Give **one other** difference between the properties of copper and potassium.

_____

_____

(1)

(iii) Explain why the reactivity of the elements increases going down Group 1 from lithium to rubidium but decreases going down Group 7 from fluorine to iodine.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

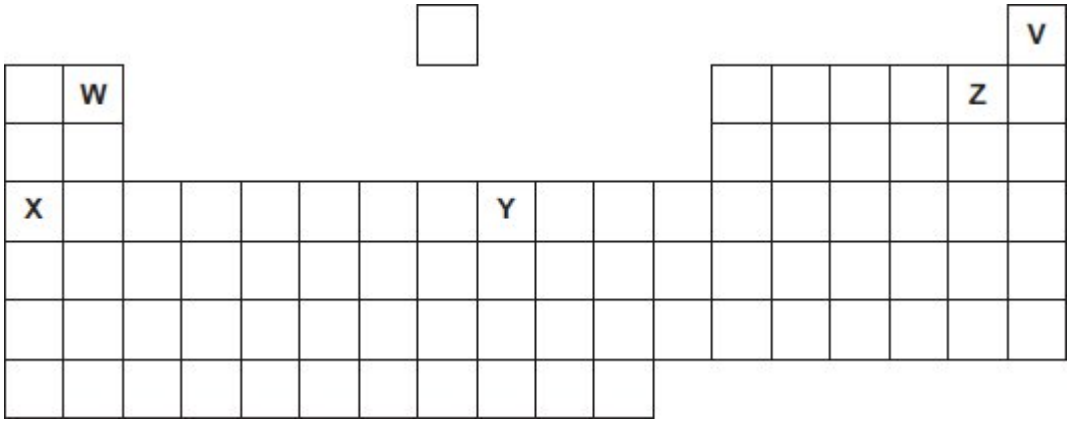
(Total 8 marks)

Q15.

Five elements, **V**, **W**, **X**, **Y** and **Z**, are shown in the periodic table.

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



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

(a) Which element is a transition metal?

(1)

(b) Which element is in Group 2?

(1)

(c) Which element is a noble gas?

(1)

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

(1)

(e) Which element forms only 1+ ions?

(1)

(Total 5 marks)

Q16.

This question is about atoms.

Atoms contain electrons, neutrons and protons.

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

Tick (✓) **one** box.

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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 ☐

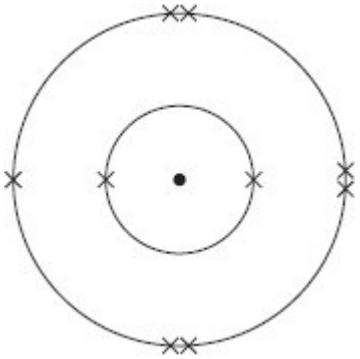
In order of increasing mass number ☐

In order of increasing reactivity ☐

(1)

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

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(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 °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.

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Use the figure above to help you to answer this question.

_____

_____

_____

_____

_____

(2)

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

_____

_____

_____

_____

_____

(2)

(Total 9 marks)

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

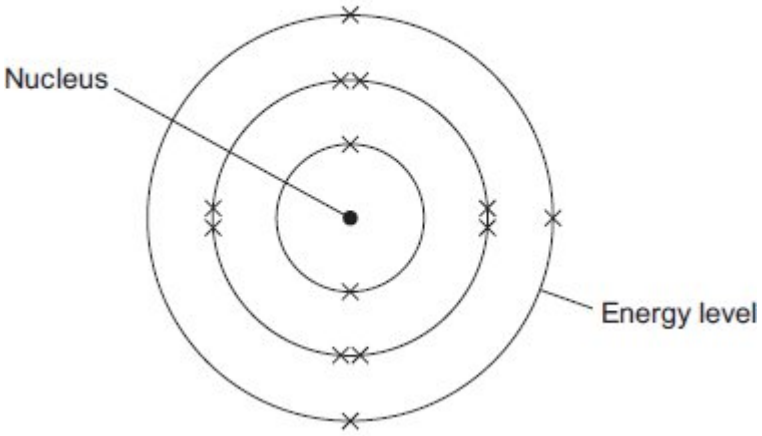
only one type of _____ .

(1)

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(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.

electrons	**ions**	**protons**	**neutrons**	**shells**

The nucleus of an aluminium atom contains _____ and

_____ .

(2)

(ii) Complete the sentence.

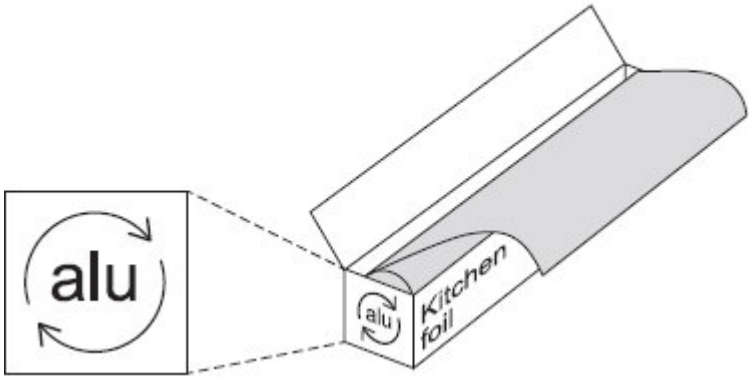
In the periodic table, aluminium is in Group _____ .

(1)

(d) Aluminium is used for kitchen foil.

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

Figure 2



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

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

_____ .

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(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 _____

_____

(1)

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

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

_____

_____

_____

_____

(2)

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

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

_____

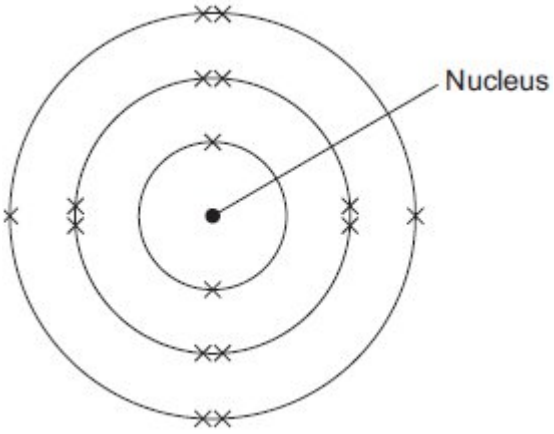
_____

_____

_____

(2)

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



What is the chemical symbol of this non-metal?

Tick (✓) **one** box.

Ar ☐

O ☐

S ☐

Si ☐

(1)

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

Complete the sentences.

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

(1)

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

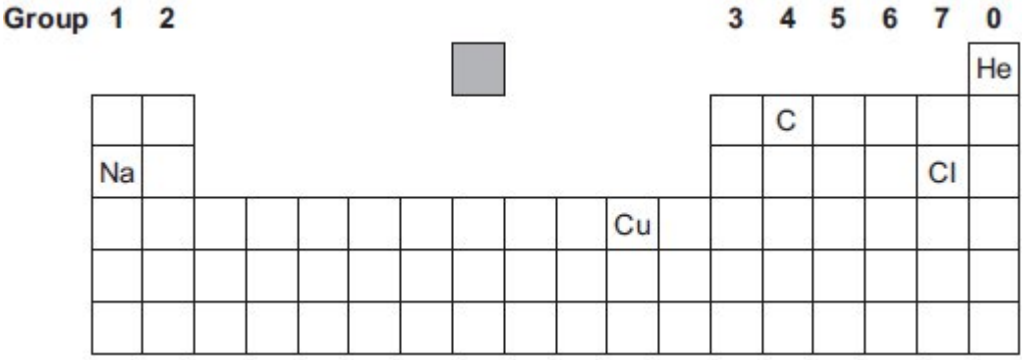
particles called _____ .

(1)

(Total 9 marks)

Q19.

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



(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

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Cl	K	Ca	Cr	Ti	Mn	Fe

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

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

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

Give a reason why.

_____

_____

(1)

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

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

_____

_____

(1)

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

Complete the sentence.

The modern periodic table places the elements in order of

_____ .

(1)

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

Explain why.

_____

_____

_____

_____

(2)

(Total 5 marks)

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.

_____

(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 ⟶ bromine + _____

(1)

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

_____

_____

(1)

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

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

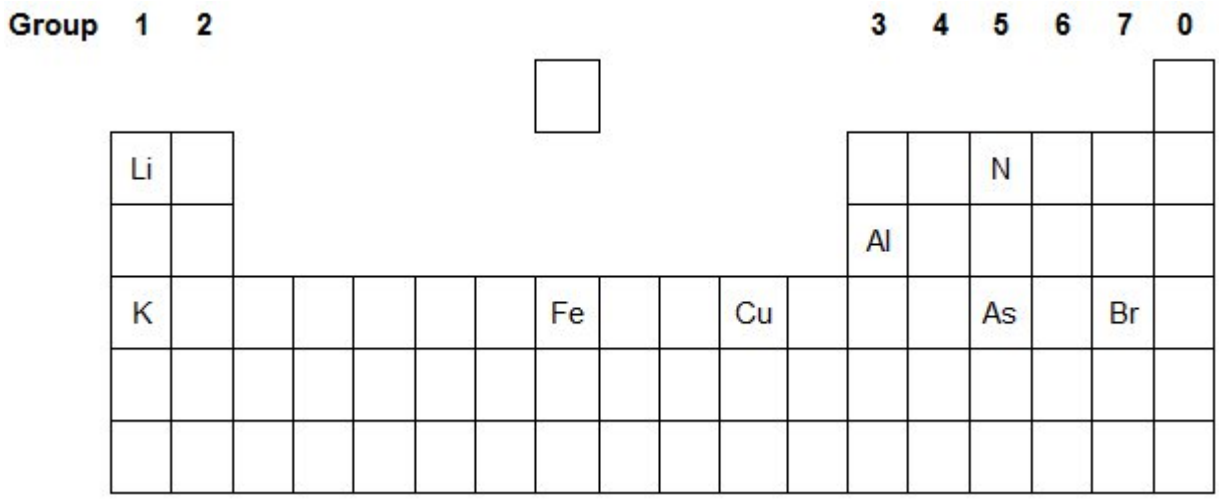
_____

(1)

(Total 5 marks)

Q22.

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



Choose the correct chemical symbols to complete each sentence.

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(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 _____ .

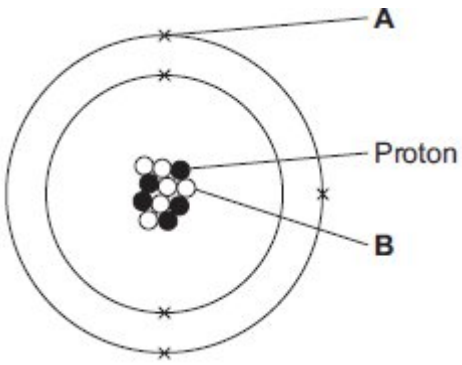
(1)

(Total 4 marks)

Q23.

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

Figure 1



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

(i) Label **A** shows

an electron **an ion** **a nucleus**

(1)

(ii) The particle labelled **B** is

an isotope **a molecule** **a neutron**

(1)

(iii) The mass number of element **G** is

5 **6** **11**

(1)

(iv) Use the periodic table to identify element **G**.

Element **G** is

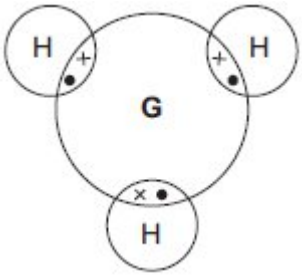
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boron **carbon** **sodium**

(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_3 **G_3H** **3HG**

(1)

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

covalent **ionic** **metallic**

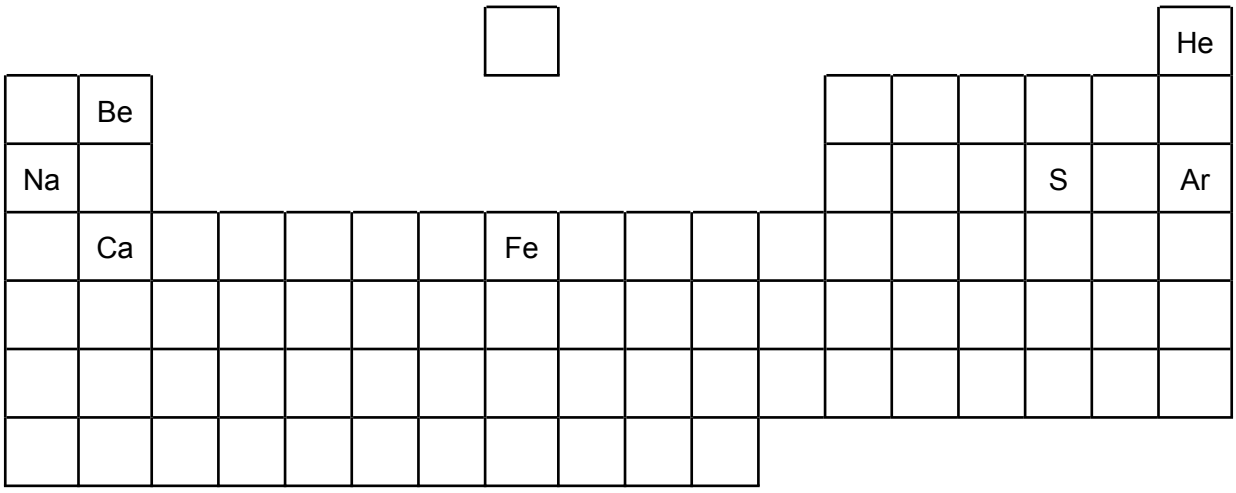
(1)

(Total 6 marks)

Q24.

(a) The symbols for seven different elements are shown in **Figure 1**.

Figure 1



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

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_____

(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)

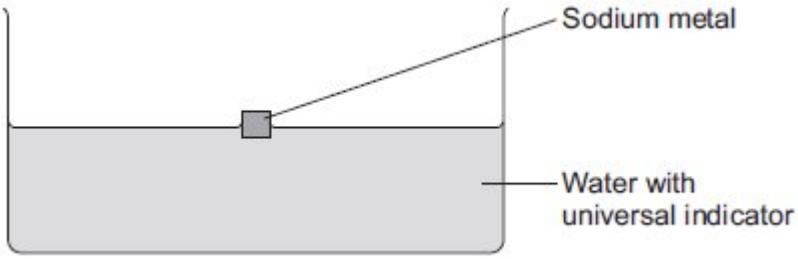
(v) an element that forms a chloride with the formula XCl

_____

(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:

$$2Na(s) + 2H_2O(l) \longrightarrow 2NaOH\ (aq) + H_2(g)$$

sodium + water ⟶ sodium hydroxide + hydrogen

(i) The sodium floated on the surface of the water. The universal indicator turned purple.

Give **three other** observations that would be seen during the reaction.

1. _____

_____

2. _____

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_____

3. _____

_____

(3)

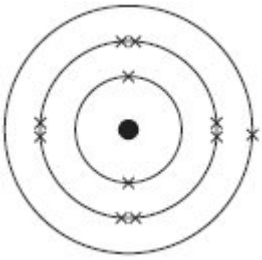
(ii) Name the ion that made the universal indicator turn purple.

_____

(1)

(c) **Figure 3** represents the electronic structure of a sodium atom.

Figure 3



In the space below, draw the electronic structure of a sodium ion. Include the charge on the ion.

(2)
(Total 11 marks)

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.

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(i) State one **similarity** between hydrogen and the elements in Group 1.

_____

_____

(1)

(ii) State one **difference** between hydrogen and the elements in Group 1.

_____

_____

(1)

(b) Fluorine, chlorine, bromine and iodine are in Group 7, the halogens.

The reactivity of the halogens decreases down the group.

Bromine reacts with a solution of potassium iodide to produce iodine.

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

(i) In the reaction between bromine and potassium iodide, there is a reduction of bromine to bromide ions.

In terms of electrons, what is meant by reduction?

_____

_____

(1)

(ii) Complete the half equation for the oxidation of iodide ions to iodine molecules.

$$2I^- \longrightarrow$$

(2)

(iii) Explain, in terms of electronic structure, why fluorine is the most reactive element in Group 7.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

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Q26.

This question is about the periodic table of elements.

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

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

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

(i) Mendeleev first arranged the elements in order of

their

atomic weight.
date of discovery.
electron number.

(1)

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

called

groups.
periods.
shells.

(1)

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

Mendeleev

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

(1)

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

table because the noble gases

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

(1)

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

electrons	**molecules**	**neutrons**	**protons**

In the modern periodic table elements are arranged in order of the number of

_____ in their nucleus. Elements in the same group have the

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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 ⟶ _____ + sodium chloride

(1)

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

_____

_____

(1)

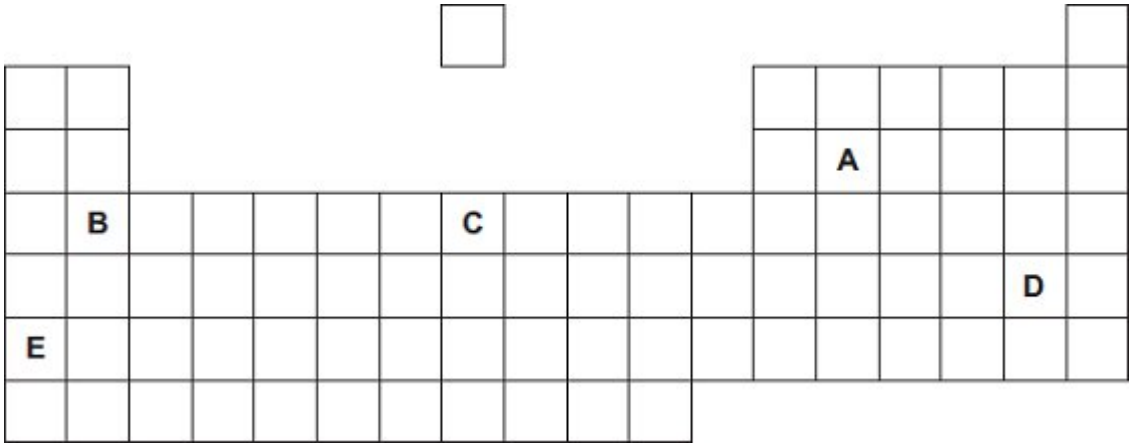
(Total 10 marks)

Q27.

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

Part of the periodic table is shown below.

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

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

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

(a) (i) an alkali metal Letter ☐

(1)

(ii) a transition element Letter ☐

(1)

(iii) a Group 4 element Letter ☐

(1)

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

The reaction between sodium and water

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

The sodium was added to some water in a trough.

The sodium:

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

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

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What evidence is there that:

(i) sodium has a low melting point

_____

_____

(1)

(ii) sodium is soft

_____

_____

(1)

(iii) a gas was produced?

_____

_____

(1)

(Total 6 marks)

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.

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_____

_____

_____

_____

_____

(2)

(d) Describe and explain the trend in reactivity of the alkali metals (Group 1).

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 9 marks)

Q29.

(a) Dmitri Mendeleev was one of the first chemists to classify the elements by arranging them in order of their atomic weights. His periodic table was published in 1869.

How did Mendeleev know that there must be undiscovered elements **and** how did he take this into account when he designed his periodic table?

_____

_____

_____

_____

_____

(2)

(b) By the early 20th century protons and electrons had been discovered.

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Describe how knowledge of the numbers of protons and electrons in atoms allow chemists to place elements in their correct order and correct group.

_____

_____

_____

_____

_____

_____

(3)

(c) The transition elements are a block of elements between Groups 2 and 3 of the periodic table.

(i) Transition elements have similar properties.

Explain why, in terms of electronic structure.

_____

_____

_____

_____

(2)

(ii) There are **no** transition elements between the Group 2 element magnesium and the Group 3 element aluminium.

Give a reason why, in terms of electronic structure.

_____

_____

_____

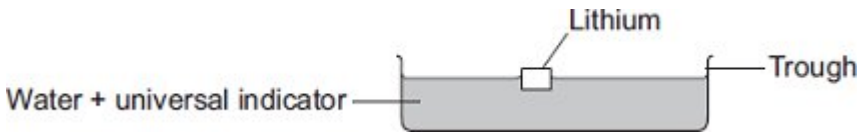
(1)

(Total 8 marks)

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:

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lithium + water ⟶ lithium hydroxide + hydrogen

(a) (i) The lithium floated on the water.

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

1. _____

2. _____

(2)

(ii) Balance the symbol equation for the reaction of lithium and water.

2 Li(s) + _____ $H_2O(l)$ ⟶ _____ LiOH(aq) + $H_2(g)$

(2)

(iii) Describe a simple test and the result that would show the gas was hydrogen.

_____

_____

(1)

(iv) All Group 1 metals have similar reactions with water.

State why, in terms of electronic structure.

_____

_____

(1)

(b) Lithium and other Group 1 metals have different properties from the transition metals.

Tick (✔) **two** properties that are properties of Group 1 metals.

They react with oxygen. ☐

They form coloured compounds. ☐

They are strong and hard. ☐

They have low melting points. ☐

(2)

(c) The electronic structure of a potassium atom is 2, 8, 8, 1

(i) Draw a diagram to show the electronic structure of a potassium ion.

Show the charge on the potassium ion.

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(2)

(ii) Potassium is more reactive than sodium.

Explain why, in terms of electronic structure.

_____

_____

_____

_____

_____

_____

_____

_____

(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.

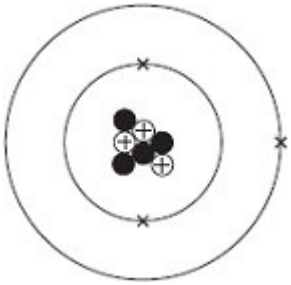
In which group of the periodic table are lithium and sodium? Group ☐

(1)

(b) A lithium atom can be represented as $^{7}_{3}Li$

The diagram represents the lithium atom.

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

What is the name of these particles?

_____

(1)

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

What is the name of these particles?

_____

(1)

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

3	**4**	**7**

The mass number of this atom of lithium is ☐

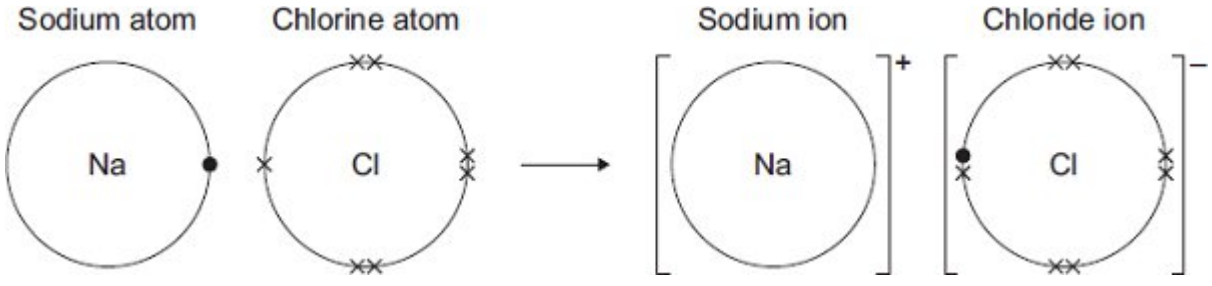
(1)

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

sodium + chlorine ⟶ 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

an electron.

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sharing

(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 **not** dissolve in water	
High melting points	
Low boiling points	
Strong bonds	

(2)

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

Calculate the relative formula mass of sodium chloride.

Relative atomic masses: Na = 23; Cl = 35.5

_____

_____

Relative formula mass = _____

(1)

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

The relative formula mass of a substance, in grams,

ion

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is one | isotope / mole | of the substance.

(1)

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

What are nanoparticles?

_____

_____

(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.

_____

(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.

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Why did Mendeleev leave gaps in his periodic table?

_____

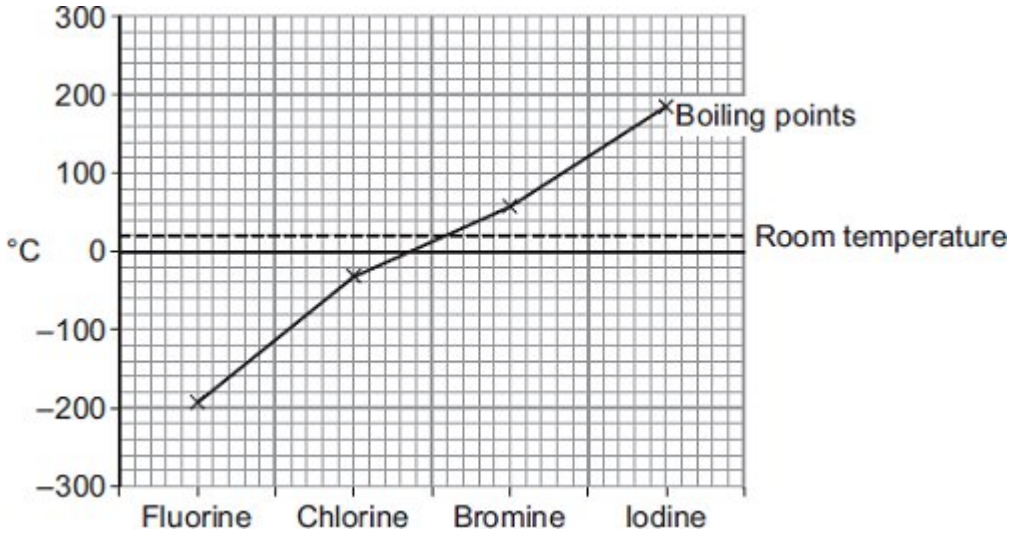
_____

(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.

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_____

(1)

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

Why is chlorine added to tap water?

_____

(1)

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

Fluoride is added to improve dental health.

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

_____

_____

_____

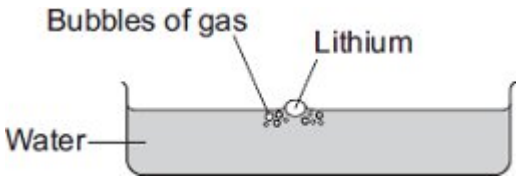
(1)

(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.

_____

(1)

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

_____

(1)

(b) Potassium is also in Group 1 of the periodic table.
Potassium reacts with water in a similar way to lithium.

Write down **two** differences you would see between the reactions of potassium and lithium with water.

1. _____

_____

2. _____

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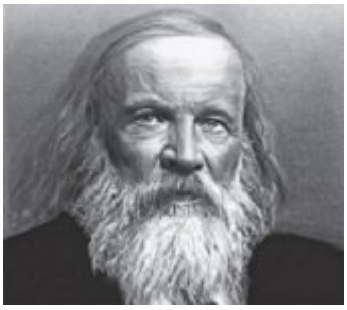
_____

(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.

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

(1)

(Total 4 marks)

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