Name: _____

Class: _____

Date: _____

Atomic Structure & Periodic Table part 1 AQA Triple Chemistry

Time: **81 minutes**

Marks: **77 marks**

Comments:

1. This question is about elements and compounds.

(a) What is the name of the compound with the formula $ZnBr_2$?

Use the periodic table.

Tick (✓) **one** box.

Zinc bromide ☐

Zinc chloride ☐

Zinc iodide ☐

(1)

(b) A compound has the formula C_2H_6O

The table below shows information about a molecule of C_2H_6O

Symbol of element	**Name of element**	**Number of atoms of the element in a molecule of C_2H_6O**
C		2
H	Hydrogen	
	Oxygen	1

Complete the table above.

Use the periodic table.

(3)

(c) Potassium and sulfur react to produce potassium sulfide.

Write the word equation for this reaction.

_____ + _____ → _____

(1)

(d) Aluminium reacts with fluorine to produce aluminium fluoride.

Balance the equation for this reaction.

$$\_\_\_\_\_\ Al + \_\_\_\_\_\ F_2 \rightarrow 2\ AlF_3$$

(2)

(Total 7 marks)

2. This question is about elements in the periodic table.

(a) Describe where the non-metallic elements are found in the periodic table.

_____

_____

(1)

(b) Gallium (Ga) is a metallic element in Group 3.

Which of these properties of gallium is **not** typical of most metals?

Tick (✓) **one** box.

A boiling point above 1000 °C ☐

A melting point below 100 °C ☐

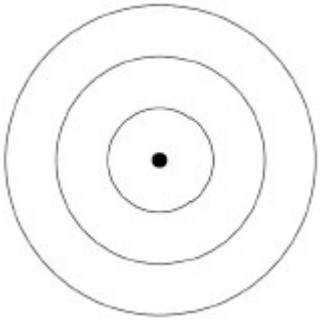
Conducts electricity when solid ☐

Forms positive ions ☐

(1)

(c) A sodium atom can be represented as $^{23}_{11}Na$

Complete the figure below to show the electronic structure of a sodium atom.



(1)

(d) Mendeleev created an early periodic table.

Mendeleev placed most of the elements in order of atomic weight.

Tellurium and iodine were not placed in order of atomic weight.

Why did Mendeleev **not** place tellurium and iodine in order of atomic weight?

_____

_____

(1)

(e) Argon is an element in Group 0 of the periodic table.

Explain why argon is unreactive.

_____

_____

_____

_____

(2)

An element **X** consists of two isotopes.

(f) What is meant by ‘isotopes’?

Answer in terms of subatomic particles.

_____

_____

_____

_____

(2)

(g) The table below shows the mass numbers and percentage abundances of the isotopes of **X**.

Mass number	Percentage abundance (%)
113	4
115	96

Which is the closest estimate to the relative atomic mass of **X**?

Tick (✓) **one** box.

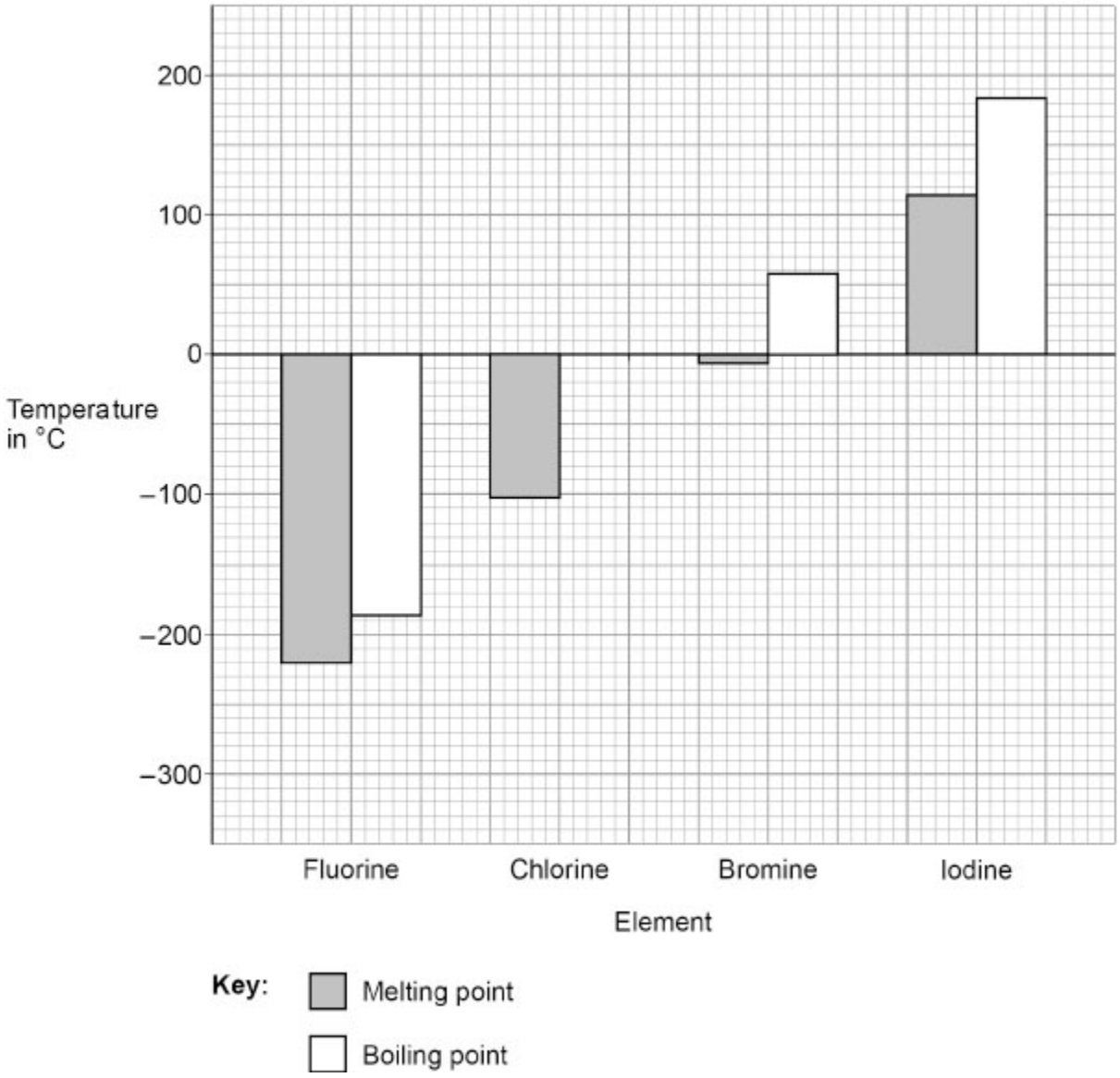
~113 ☐ ~114 ☐ ~115 ☐

(1)

(Total 9 marks)

3. The elements in Group 7 of the periodic table are known as the halogens.

The figure below shows information about some of the elements in Group 7.



(a) Predict the boiling point of chlorine.

Use the figure above.

_____ °C

(1)

(b) What is the state of fluorine at –250 °C?

Use the figure above.

_____

(1)

Astatine (At) is an element in Group 7.

(c) What is the number of electrons in the outer shell of an astatine atom?

_____

(1)

(d) Hydrogen reacts with astatine to produce hydrogen astatide.

Predict the formula of hydrogen astatide.

_____

(1)

(e) Explain the trend in reactivity of the elements going down Group 7.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(f) A more reactive halogen can displace a less reactive halogen from a solution of its salt.

Write a balanced equation for the reaction between bromine and potassium iodide.

_____ + _____ → _____ + _____

(3)

(Total 11 marks)

4. This question is about small particles.

Before the discovery of the electron, atoms were thought to be tiny spheres that could not be divided.

(a) The discovery of the electron led to the plum pudding model of the atom.

Describe the plum pudding model of the atom.

_____

_____

_____

_____

(2)

(b) The model of the atom changed again after the alpha particle scattering experiment.

Give **two** conclusions that were made from the alpha particle scattering experiment.

1 _____

_____

2 _____

_____

(2)

(c) Niels Bohr made another change to the model of the atom.

What was this change?

_____

_____

(1)

(d) A helium atom has a radius of 1.4×10^{-10} m.

The nucleus of this atom has a radius of 1.7×10^{-15} m.

How many times larger is the radius of the atom than the radius of the nucleus?

Tick (✓) **one** box.

~ 1000 times larger ☐

~ 10 000 times larger ☐

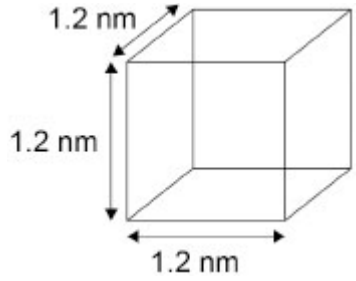
~ 100 000 times larger ☐

~ 1 000 000 times larger ☐

(1)

Nanoparticles contain a few hundred atoms.

(e) The figure below represents a cubic nanoparticle.



Calculate the simplest surface area : volume ratio of the cubic nanoparticle.

_____

_____

_____

_____

_____

Simplest surface area to volume ratio = _____ : _____

(4)

(f) Lenses in reading glasses often have a scratch-resistant coating that contains a hard substance.

Nanoparticles of the hard substance are used instead of fine particles of the hard substance.

Explain why nanoparticles are used instead of fine particles.

_____

_____

_____

_____

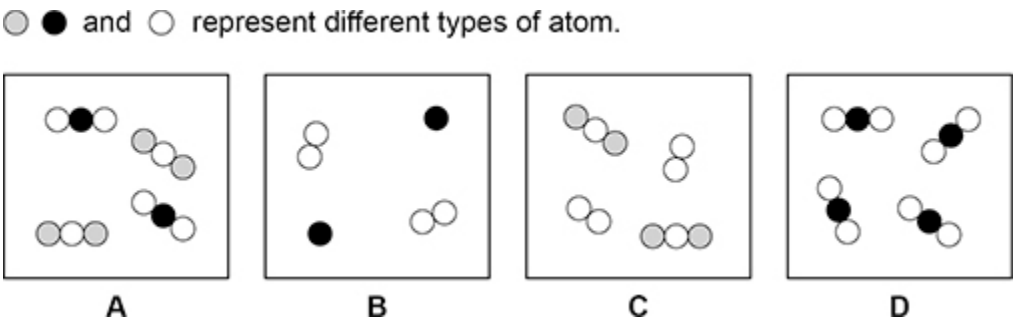
(2)

(Total 12 marks)

5. This question is about elements, compounds and mixtures.

Figure 1 shows diagrams which represent the atoms and molecules in different substances.

Figure 1



(a) Which diagram in **Figure 1** represents a pure compound?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(b) Which diagram in **Figure 1** represents a mixture of an element and a compound?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

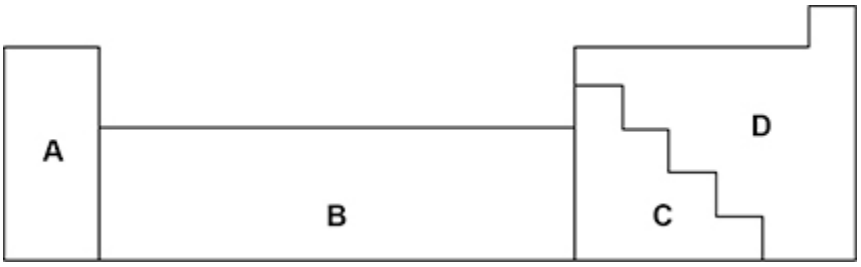
(1)

(c) Elements are metals or non-metals.

Figure 2 shows an outline of the periodic table.

The periodic table is divided into sections.

Figure 2



Where are metals found in the periodic table?

Tick (✓) **one** box.

Section **A** only ☐

Sections **A**, **B** and **C** ☐

Sections **B**, **C** and **D** ☐

Section **D** only ☐

(1)

(d) Which **two** of the following are typical properties of a transition metal?

Tick (✓) **two** boxes.

Can be bent and shaped	☐
Good conductor of electricity	☐
Low density	☐
Low melting point	☐
Poor conductor of heat	☐

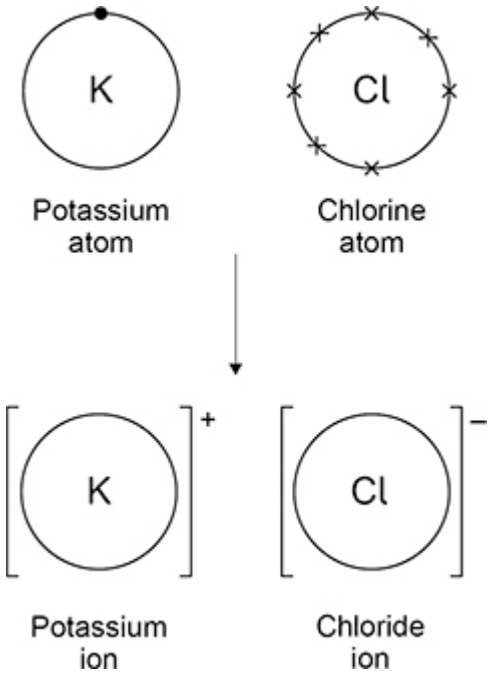
(2)

(e) Potassium and chlorine react to produce potassium chloride.

An atom of potassium loses an electron to form a potassium ion.

An atom of chlorine gains an electron to form a chloride ion.

Complete the dot and cross diagram.

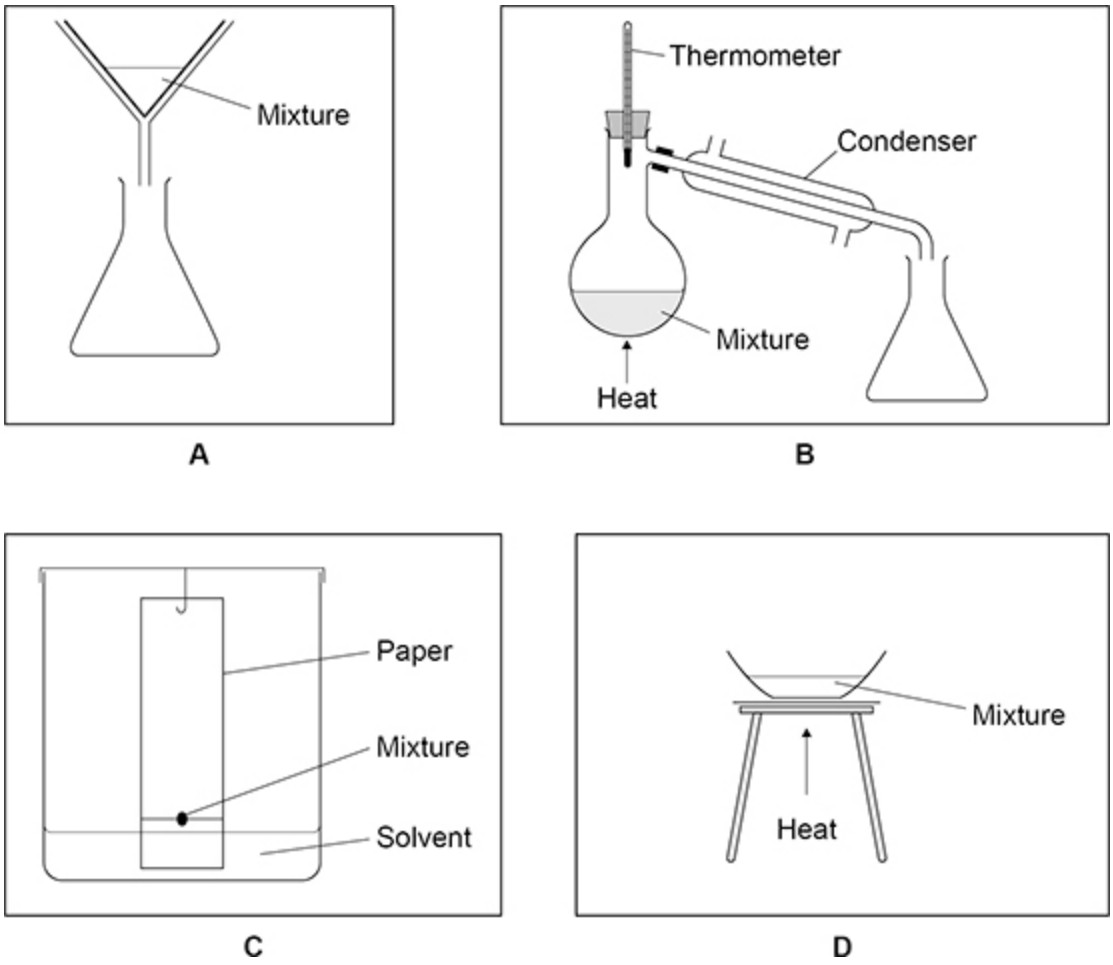


(2)

Mixtures are separated by different methods.

Figure 3 shows the apparatus for separating four different types of mixture.

Figure 3



(f) Which apparatus could be used to collect water from sodium chloride solution?

Use **Figure 3**.

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(g) Which apparatus shows filtration?

Use **Figure 3**.

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(Total 9 marks)

6. This question is about carbon and carbon compounds.

An atom of carbon is represented as:

$$\begin{matrix}\text{(Mass number)} & 13 \\ \text{(Atomic number)} & 6\end{matrix}\ \mathrm{C}$$

(a) What is the number of protons in this atom of carbon?

Tick (✓) **one** box.

1 ☐ 6 ☐ 7 ☐ 13 ☐

(1)

(b) What is the number of neutrons in this atom of carbon?

Tick (✓) **one** box.

1 ☐ 6 ☐ 7 ☐ 13 ☐

(1)

(c) What is the number of electrons in this atom of carbon?

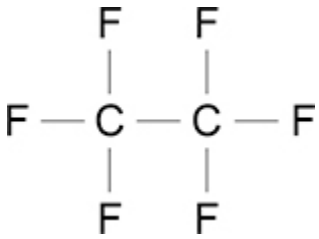
Tick (✓) **one** box.

1 ☐ 6 ☐ 7 ☐ 13 ☐

(1)

(d) **Figure 1** shows the structure of a carbon compound.

Figure 1



Complete the formula of the carbon compound.

C__ F__

(1)

(e) Methane:

- is a carbon compound
- exists as small molecules
- has a low boiling point.

What is the reason for the low boiling point of methane?

Tick (✓) **one** box.

Covalent bonds **and** intermolecular forces are weak. ☐

Only covalent bonds are weak. ☐

Only intermolecular forces are weak. ☐

(1)

(f) Buckminsterfullerene (C_{60}) is a form of carbon.

Buckminsterfullerene was the first fullerene to be discovered.

What is the shape of a buckminsterfullerene molecule?

Tick (✓) **one** box.

Cubic ☐

Cylindrical ☐

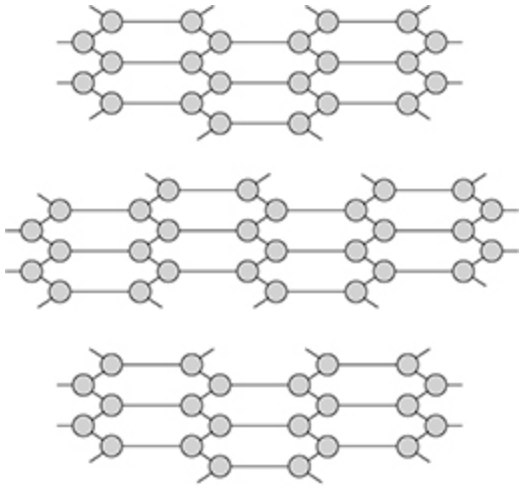
Spherical ☐

(1)

(g) Graphite is a form of carbon.

Figure 2 represents the structure of graphite.

Figure 2



How many covalent bonds does each carbon atom form in graphite?

Tick (✓) **one** box.

1 ☐

2 ☐

3 ☐

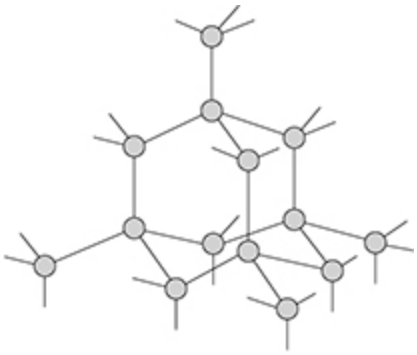
4 ☐

(1)

(h) Diamond is another form of carbon.

Figure 3 represents the structure of diamond.

Figure 3



Key

○ = carbon atom

Describe the structure and bonding in diamond.

_____

_____

_____

_____

_____

_____

(3)

(Total 10 marks)

7. This question is about the periodic table.

Sodium and potassium are in Group 1 of the periodic table.

(a) Give **one** similarity and **one** difference between the electronic structures of sodium and potassium.

Similarity _____

_____

Difference _____

_____

(2)

Group 1 elements react with water.

(b) Give **two** observations made when potassium reacts with water.

1 _____

_____

2 _____

_____

(2)

(c) Potassium hydroxide solution is produced when potassium reacts with water.

What is the colour of universal indicator when added to potassium hydroxide solution?

Give **one** reason for your answer.

Colour of universal indicator _____

Reason _____

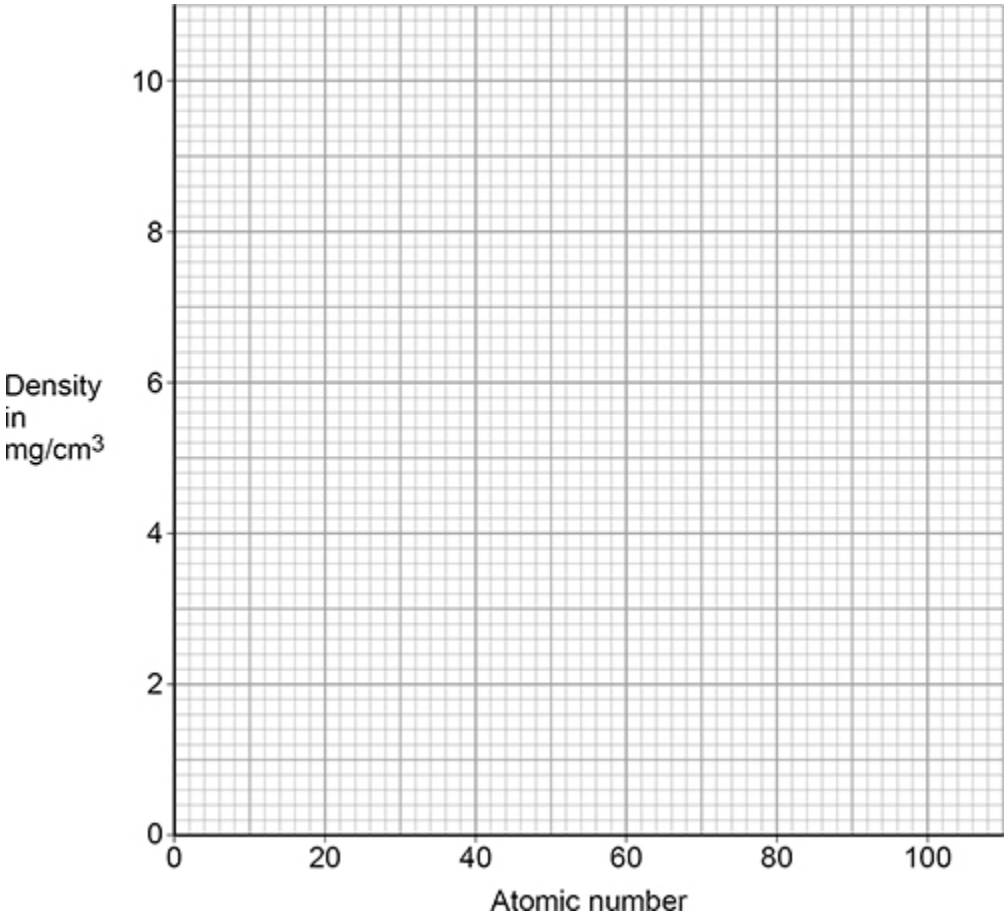
_____

(2)

The table below shows the densities of some of the elements in Group 0 of the periodic table.

Element	**Atomic number**	**Density in mg/cm^3**
Helium	2	0.2
Neon	10	0.8
Argon	18	1.6
Krypton	36	**X**
Xenon	54	5.4
Radon	86	9.1

(d) Plot the data from the table above on the figure below.



(2)

(e) Estimate the density (**X**) of krypton.

Use the figure and table above.

_____

_____

Density = _____ mg/cm^3

(1)

(f) The elements in Group 7 are called the halogens.

A more reactive halogen can displace a less reactive halogen from a solution of its salt.

Which combination of solutions will produce a reaction when mixed?

Tick (✓) **one** box.

Chlorine and potassium fluoride ☐

Chlorine and potassium bromide ☐

Bromine and potassium fluoride ☐

Bromine and potassium chloride ☐

(1)

(g) Which of the following describes the trends going down Group 7?

Tick (✓) **one** box.

Relative molecular mass decreases and boiling point decreases. ☐

Relative molecular mass decreases and boiling point increases. ☐

Relative molecular mass increases and boiling point decreases. ☐

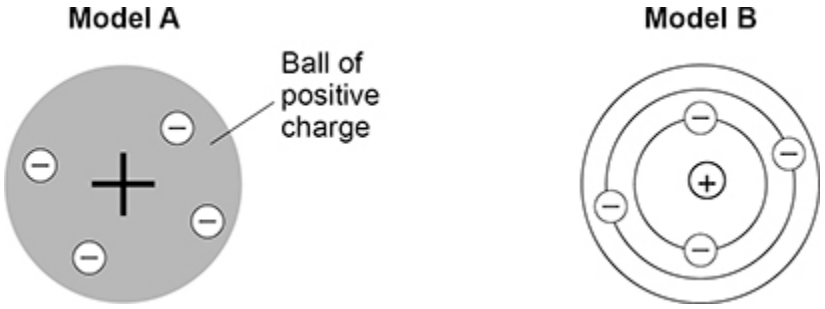
Relative molecular mass increases and boiling point increases. ☐

(1)

(Total 11 marks)

8. This question is about models of the atom.

The figure below shows two early models of the atom.



(a) Name the models of the atom shown in above figure.

Model **A** _____

Model **B** _____

(2)

(b) Compare model **A** with the model of the atom used today.

Use the figure above.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(c) Chadwick's experiments showed the existence of neutrons in an atom.

This led to an understanding of isotopes.

Define the term 'isotopes'.

Refer to subatomic particles in your answer.

_____

_____

_____

_____

(2)

(Total 8 marks)

1. (a) zinc bromide

1

(b)

Symbol of element	Name of element	Number of atoms of the element in a molecule of C_2H_6O
C	**Carbon**	2
H	Hydrogen	**6**
O	Oxygen	1

3

(c) potassium + sulfur → potassium sulfide

allow $2\ K + S \rightarrow K_2S$

1

(d) **2** Al + **3** F_2 → 2 AlF_3

allow multiples

*allow **1** mark for 2 Al*

or

*allow **1** mark for 3 F_2*

2

[7]

2. (a) towards the right **and** the top

allow a description of the position in the periodic table

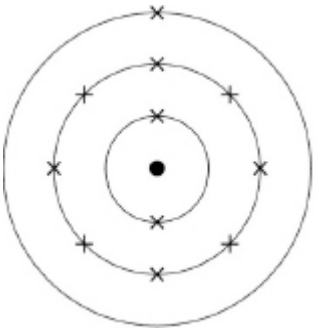
allow in Groups (3) 4 to 0

1

(b) a melting point below 100 °C

1

(c)



*allow any combination of ×, *l*, o, $e^{(-)}$ for electrons*

1

(d) any **one** from:

- so elements / tellurium / iodine were in groups with similar properties
- iodine has similar properties to Group 7 elements
- iodine has different properties to Group 6 elements

ignore reference to atomic structure
allow named elements for Group 6 / 7 elements
allow converse arguments in terms of tellurium

1

(e) argon has a full outer shell (of electrons)

allow energy level for shell
allow argon has eight outer shell electrons
ignore argon has no outer shell electrons

1

(so argon) has a stable arrangement of electrons
or
(so argon) has a stable electronic structure

allow (so argon) does not gain / lose / share electrons

1

(f) atoms with the same number of protons

allow atoms of the same element
allow atoms with the same atomic number
ignore atoms with the same number of electrons

1

(but with) different numbers of neutrons

1

(g) ~115

1

[9]

3. (a) –34 °C

allow a value in the range –70 to –20 °C

1

(b) solid

allow (s)

1

(c) 7

1

(d) HAt

1

(e) reactivity decreases (going down the group)

1

(because) the outer shell / electrons become further from the nucleus

allow energy level for shell

allow (because) the atoms become larger

allow (because) the atoms have more shells

1

(so) there is less (electrostatic) attraction between the nucleus and the outer electron(s)

allow (so) there is more shielding between the outer electron(s) and the nucleus

1

(so) gaining an electron is more difficult

1

(f) $Br_2 + 2\ KI \rightarrow I_2 + 2\ KBr$

allow multiples

*allow **1** mark for Br_2 **and** I_2*

*allow **1** mark for KI **and** KBr*

ignore state symbols

3

[11]

4. (a) a ball of positive charge

allow a positive(ly charged) ball

*do **not** accept references to protons, nuclei, neutrons*

1

with (negative) electrons embedded

1

(b) any **two** from:

- the mass of the atom is concentrated at the centre / nucleus
- the nucleus is positive / charged
- most of the atom is empty space
- electrons orbit the nucleus

*do **not** accept references to shells*

2

(c) electrons orbit the nucleus at specific distances

allow electrons orbit the nucleus in energy levels

allow electrons orbit the nucleus in shells

1

(d) ~100 000 times larger

1

(e) (surface area = 6×1.2^2 =)
$8.64\ (nm^2)$

1

(volume = 1.2^3 =) $1.728\ (nm^3)$

1

(ratio = 8.64 : 1.728 =)
$\frac{8.64}{1.728}$ (: 1)

allow (ratio = 1.728 : 8.64 =)
(1 :) $\frac{1.728}{8.64}$

allow correct use of incorrectly determined values of surface area and / or volume

1

= 5 : 1

allow = 1 : 0.2

1

(f) (nanoparticles)
have a higher surface area to volume ratio

allow converse arguments in terms of fine particles

1

(so) less coating is used

OR

(with nanoparticles)
a thinner layer can be used (1)

(so) a thinner layer can be used

allow less coating is used

(so) more light gets through the lenses (1)

allow (so) visibility is not reduced (as much)

1

[12]

5. (a) D

1

(b) C

1

(c) sections **A**, **B** and **C**

1

(d) can be bent and shaped

1

good conductor of electricity

1

(e) evidence of the outer electron on the potassium atom moving to leave a potassium ion with no outer electrons

allow any combination of ×, •, ○, $e^{(-)}$ for electrons

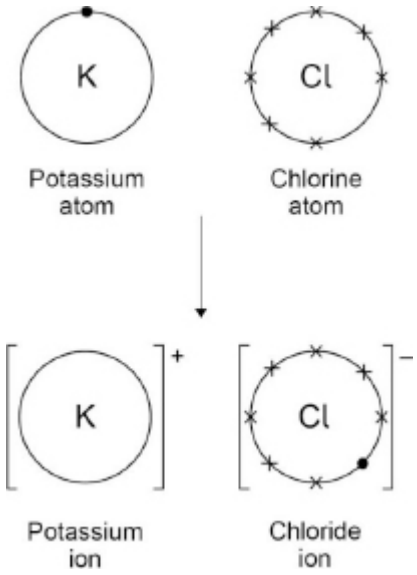
ignore any inner shells

allow potassium ion with eight outer electrons

1

chloride ion with eight outer electrons

an answer of



*scores **2** marks*

1

(f) B

1

(g) A

1

[9]

6. (a) 6

1

(b) 7

1

(c) 6

1

(d) C_2F_6

1

(e) only intermolecular forces are weak

1

(f) spherical

1

(g) 3

1

(h) giant structure

allow lattice

1

(of atoms joined by) covalent bonds

1

each carbon / atom forms four bonds

1

[10]

7. (a) (similarity)
both have one outer (shell)
electron

allow energy level for shell

allow same number of outer (shell) electrons

1

(difference)
sodium has 3 shells but
potassium has 4 shells

allow potassium has more shells

allow (different) number of shells

1

(b) any **two** from:

- effervescence / bubbles / fizzing

  ignore gas produced
- (potassium) floats
- (potassium) moves around
- (potassium) becomes smaller
- (potassium) melts

  allow (potassium) forms a ball

  ignore colour of flame
- flame
- explosion

2

(c) blue / violet / purple

1

(the solution is) alkaline

allow (the solution) contains

OH^- (ions)

allow (the solution) contains hydroxide ions

allow the solution is basic

1

(d) all five points correctly plotted

allow a tolerance of ± ½ a small square

*allow **1** mark for three or four points correctly plotted*

2

(e) 3.4 (mg/cm^3)

allow a value in the range 3.0 to 3.8 (mg/cm^3)

1

(f) chlorine and potassium bromide

1

(g) relative molecular mass increases and boiling point increases

1

[11]

8. (a) (model **A**) plum pudding

allow Thomson (model)

1

(model **B**) Bohr

allow nuclear (model)

allow planetary (model)

allow Rutherford-Bohr (model)

1

(b) **Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.

3–4

Level 1: Relevant features are identified and differences noted.

1–2

No relevant content

0

Indicative content

Similarities

- both contain electrons
- both are neutral overall

Differences

- model **A** has no nucleus
  or
  the model used today has a nucleus

- model **A** has no protons
  or
  the model used today has protons

- model **A** has no neutrons
  or
  the model used today has neutrons

- model **A** has positive charge spread throughout the atom
  or
  model **A** is a ball of positive charge
- the model used today has the positive charge in the centre

- model **A** the electrons are distributed randomly
- the model used today has electrons in shells / energy levels

- the mass was spread throughout model **A**
- the mass is concentrated at the centre of the model used today

- model **A** does not have empty space
- model used today is mostly empty space

(c) atoms with the same number of protons

allow atoms of the same element

allow atoms with the same atomic number

1

with different numbers of neutrons

ignore references to electrons

1

[8]