

Questions are for both separate science and combined science students unless indicated in the question

Q1.

This question is about elements, compounds and mixtures.

- (a) Substance **A** contains only one type of atom.

Substance **A** does **not** conduct electricity.

Which type of substance is **A**?

Tick (✓) **one** box.

Compound

Metallic element

Mixture

Non-metallic element

(1)

- (b) Substance **B** contains two types of atoms.

The atoms are chemically combined together in fixed proportions.

Which type of substance is **B**?

Tick (✓) **one** box.

Compound

Metallic element

Mixture

Non-metallic element

(1)

- (c) What is the name of the elements in Group 0 of the periodic table?

Tick (✓) **one** box.

Alkali metals	<input type="checkbox"/>
Halogens	<input type="checkbox"/>
Noble gases	<input type="checkbox"/>
Transition metals	<input type="checkbox"/>

(1)

(d) Which statement about the elements in Group 0 is correct?

Tick (✓) **one** box.

All elements in the group are very reactive.	<input type="checkbox"/>
All elements in the group form negative ions.	<input type="checkbox"/>
The boiling points increase down the group.	<input type="checkbox"/>
The relative atomic masses (A_r) decrease down the group.	<input type="checkbox"/>

(1)

(e) Neon is in Group 0.

What type of particles are in a sample of neon?

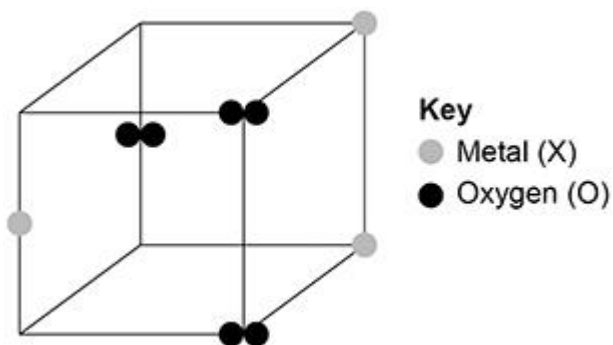
Tick (✓) **one** box.

Atoms	<input type="checkbox"/>
Ions	<input type="checkbox"/>
Molecules	<input type="checkbox"/>

(1)

(f) **Figure 1** represents part of the structure of an oxide of a metal.

Figure 1



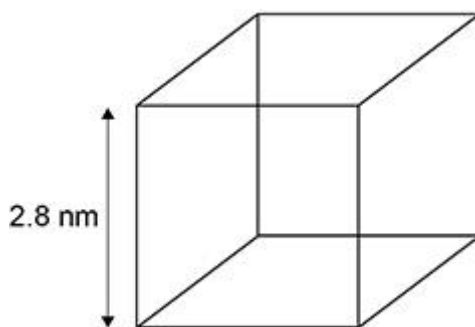
Determine the empirical formula of this oxide.

Empirical formula = XO_____ (1)

A nanoparticle of a metallic element is a cube.

Figure 2 shows a diagram of the nanoparticle.

Figure 2



(g) The surface area of a cube is given by the equation:

$$\text{surface area} = (\text{length of side})^2 \times 6$$

Calculate the surface area of the cube in **Figure 2**.

Give your answer to 2 significant figures. **(separate only)**

Surface area (2 significant figures) = _____ nm²

(3)

- (h) Fine and coarse particles of the metallic element are also cubes.

The length of a fine particle cube is 10 times smaller than the length of a coarse particle cube.

How does the surface area to volume ratio of the fine particle cube compare with that of the coarse particle cube?

Tick (✓) **one** box. **(separate only)**

Both surface area to volume ratios are the same.

The surface area to volume ratio of the fine particle is 10 times greater.

The surface area to volume ratio of the fine particle is 10 times smaller.

(1)

(Total 10 marks)

Q2.

This question is about atomic structure and the periodic table.

Gallium (Ga) is an element that has two isotopes.

- (a) Give the meaning of 'isotopes'.

You should answer in terms of subatomic particles.

(2)

- (b) The table below shows the mass numbers and percentage abundances of the isotopes of gallium.

Mass number	Percentage abundance (%)
69	60
71	40

Calculate the relative atomic mass (A_r) of gallium.

Give your answer to 1 decimal place.

Relative atomic mass (1 decimal place) = _____

(2)

Gallium (Ga) is in Group 3 of the modern periodic table.

(c) Give the numbers of electrons and neutrons in an atom of the isotope $^{69}_{31}\text{Ga}$

Number of electrons _____

Number of neutrons _____

(2)

(d) What is the most likely formula of a gallium ion?

Tick (✓) **one** box.

Ga^+	<input type="checkbox"/>
Ga^-	<input type="checkbox"/>
Ga^{3+}	<input type="checkbox"/>
Ga^{3-}	<input type="checkbox"/>

(1)

(e) Gallium was discovered six years after Mendeleev published his periodic table.

Give **two** reasons why the discovery of gallium helped Mendeleev's periodic table to become accepted.

1 _____

2 _____

(2)
(Total 9 marks)

Q3.

This question is about models of the atom.

- (a) Atoms were first thought to be tiny spheres that could not be divided.

Which particle was discovered to change this model of the atom?

Tick (✓) **one** box.

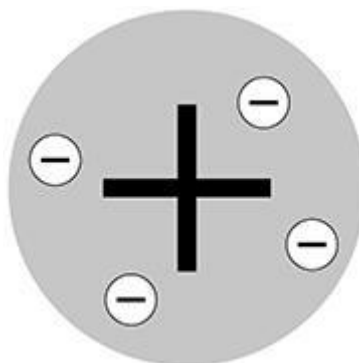
Electron

Neutron

Proton

(1)

- (b) The diagram below shows another model of the atom.



What is the name of this model of the atom?

(1)

- (c) A scientist fired particles at gold atoms.

Some of these particles were scattered.

The results led to a different model of the atom.

Which type of particle was fired at the gold atoms?

Tick (✓) **one** box.

Alpha	<input type="checkbox"/>
Electron	<input type="checkbox"/>
Neutron	<input type="checkbox"/>
Proton	<input type="checkbox"/>

(1)

- (d) Which scientist first suggested that electrons orbit the nucleus at specific distances?

Tick (✓) **one** box.

Bohr	<input type="checkbox"/>
Chadwick	<input type="checkbox"/>
Mendeleev	<input type="checkbox"/>

(1)

- (e) The model of the atom used today has three subatomic particles:

- electrons
- neutrons
- protons.

Complete the sentences.

Atoms of the same element have the same atomic number because they have the

same number of _____.

Atoms of the same element can have different mass numbers because they have

different numbers of _____.

Atoms have no overall charge because they have the same number of

_____ and _____.

(3)

- (f) The radius of a nucleus is approximately 1×10^{-14} m

The radius of an atom is approximately 1×10^{-10} m

A teacher uses a ball of radius 1 cm to represent the nucleus.

What could represent the atom on the same scale?

Tick (✓) **one** box.

A ball of radius 10 cm

A sports arena of radius 100 m

An island of radius 10 km

A planet of radius 1000 km

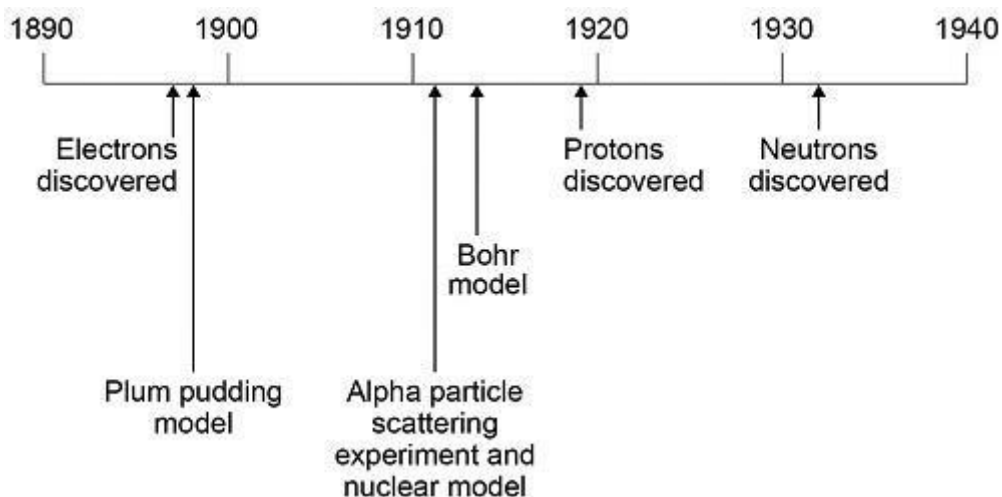
(1)

(Total 8 marks)

Q4.

This question is about the development of scientific theories.

The diagram below shows a timeline of some important steps in the development of the model of the atom.



- (a) The plum pudding model did not have a nucleus.

Describe **three** other differences between the nuclear model of the atom and the plum pudding model.

1 _____

2

3

(3)

- (b) Niels Bohr adapted the nuclear model.

Describe the change that Bohr made to the nuclear model.

(2)

- (c) Mendeleev published his periodic table in 1869.

Mendeleev arranged the elements in order of atomic weight.

Mendeleev then reversed the order of some pairs of elements.

A student suggested Mendeleev's reason for reversing the order was to arrange the elements in order of atomic number.

Explain why the student's suggestion **cannot** be correct.

Use the diagram above.

(2)

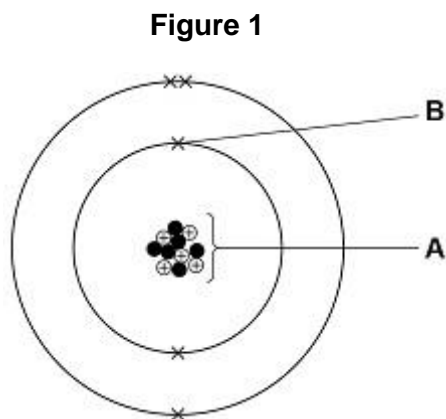
- (d) Give the correct reason why Mendeleev reversed the order of some pairs of elements.

(1)
(Total 8 marks)

Q5.

This question is about atomic structure.

Figure 1 represents an atom of element **Z**.



- (a) Name the parts of the atom labelled **A** and **B**.

Choose answers from the box.

electron	neutron	nucleus	proton
----------	---------	---------	--------

A

B

(2)

- (b) Which particle has the lowest mass?

Choose the answer from the box.

electron	neutron	nucleus	proton
----------	---------	---------	--------

(1)

- (c) Which group of the periodic table contains element **Z**?

Use **Figure 1**.

Group _____

(1)

- (d) Give the atomic number and the mass number of element **Z**.

Use **Figure 1**.

Choose answers from the box.

1	5	6	11	16
---	---	---	----	----

Atomic number _____

Mass number _____

(2)

Bromine has two different types of atom.

The atoms have a different number of neutrons but the same number of protons.

- (e) What is the name for this type of atom?

Tick (✓) **one** box.

Compound	<input type="checkbox"/>
Ion	<input type="checkbox"/>
Isotope	<input type="checkbox"/>
Molecule	<input type="checkbox"/>

(1)

- (f) The different types of bromine atom can be represented as ${}^{79}_{35}\text{Br}$ and ${}^{81}_{35}\text{Br}$

The relative atomic mass (A_r) of bromine is 80

Which statement is true about the number of each type of atom in bromine?

Tick (✓) **one** box.

There are fewer ${}^{79}_{35}\text{Br}$ atoms than ${}^{81}_{35}\text{Br}$ atoms.

There are more ${}^{79}_{35}\text{Br}$ atoms than ${}^{81}_{35}\text{Br}$ atoms.

There are the same number of ${}^{79}_{35}\text{Br}$ atoms and ${}^{81}_{35}\text{Br}$ atoms.

(1)

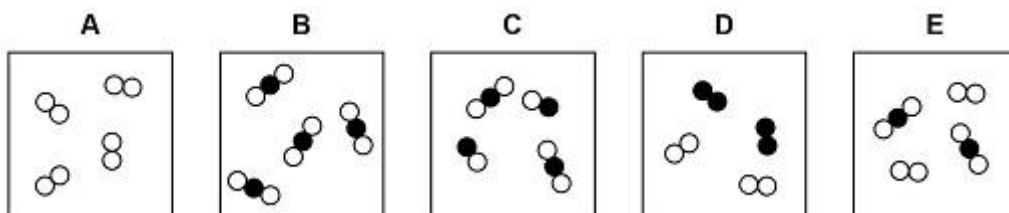
(Total 8 marks)

Q6.

This question is about elements, compounds and mixtures.

Figure 1 shows five different substances, **A**, **B**, **C**, **D** and **E**.

○ and ● represent atoms of different elements.

Figure 1

Use **Figure 1** to answer parts (a) to (c)

(a) Which substance is only one compound?

Tick (✓) **one** box.

A B C D E

(1)

(b) Which substance is a mixture of elements?

Tick (✓) **one** box.

A B C D E

(1)

(c) Which substance is a mixture of an element and a compound?

Tick (✓) **one** box.

A B C D E

(1)

Substances are separated from a mixture using different methods.

- (d) Draw **one** line from each method of separation to the substance and mixture it would separate.

Method of separation	Substance and mixture
<div style="border: 1px solid black; padding: 5px; width: fit-content;">chromatography</div>	<div style="border: 1px solid black; padding: 5px; width: fit-content;">blue food colour from a mixture of food colours</div>
	<div style="border: 1px solid black; padding: 5px; width: fit-content;">copper from an alloy of copper and zinc</div>
<div style="border: 1px solid black; padding: 5px; width: fit-content;">crystallisation</div>	<div style="border: 1px solid black; padding: 5px; width: fit-content;">copper sulfate from copper sulfate solution</div>
	<div style="border: 1px solid black; padding: 5px; width: fit-content;">ethanol from a mixture of ethanol and water</div>

(2)

- (e) Sand does not dissolve in water. A student separates a mixture of sand and water by filtration.

Draw a diagram of the apparatus the student could use.

You should label:

- where the sand is collected
- where the water is collected.

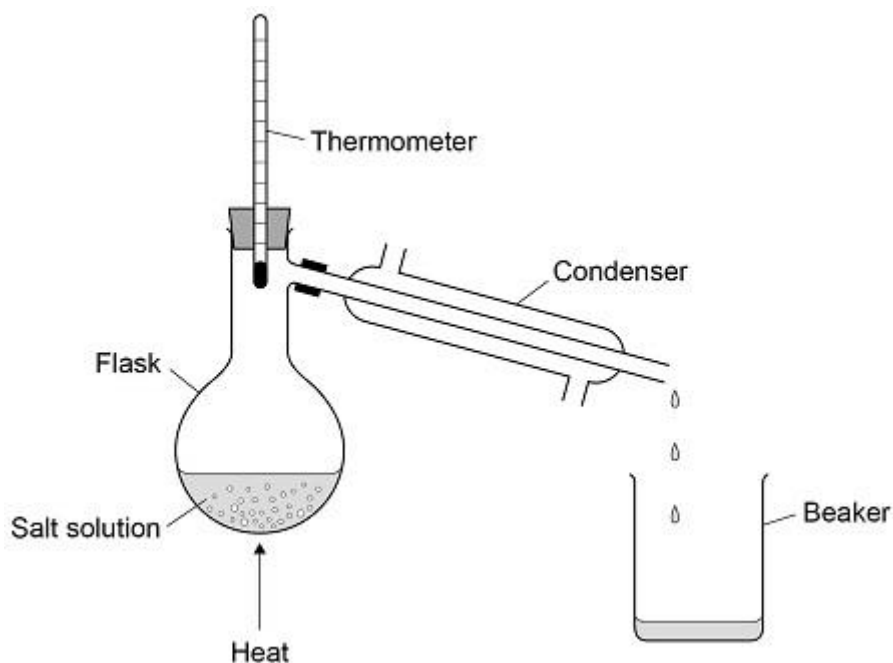
Diagram

(3)

- (f) A student distils a sample of salt solution to produce pure water.

Figure 2 shows the apparatus.

Figure 2



What temperature would you expect the thermometer to show?

Tick (✓) **one** box.

0 °C

10 °C

50 °C

100 °C

(1)

- (g) Describe how the process of distillation shown in **Figure 2** produces pure water from salt solution.

(4)

(Total 13 marks)

Q7.

This question is about atomic structure.

- (a) Atoms contain subatomic particles.

The table below shows properties of two subatomic particles.

Complete the table.

Name of particle	Relative mass	Relative charge
neutron		
		+1

(2)

An element **X** has two isotopes.

The isotopes have different mass numbers.

- (b) Define mass number.

(1)

- (c) Why is the mass number different in the two isotopes?

(1)

- (d) The model of the atom changed as new evidence was discovered.

The plum pudding model suggested that the atom was a ball of positive charge with electrons embedded in it.

Evidence from the alpha particle scattering experiment led to a change in the model of the atom from the plum pudding model.

Explain how.

(4)

(Total 8 marks)

Q8.

This question is about mixtures.

- (a) Substances are separated from a mixture using different methods.

Draw **one** line from each substance and mixture to the best method of separation.

Substance and mixture

Ethanol from ethanol and water

Salt from sea water

The different colours in black ink

Method of separation

Chromatography

Crystallisation

Electrolysis

Filtration

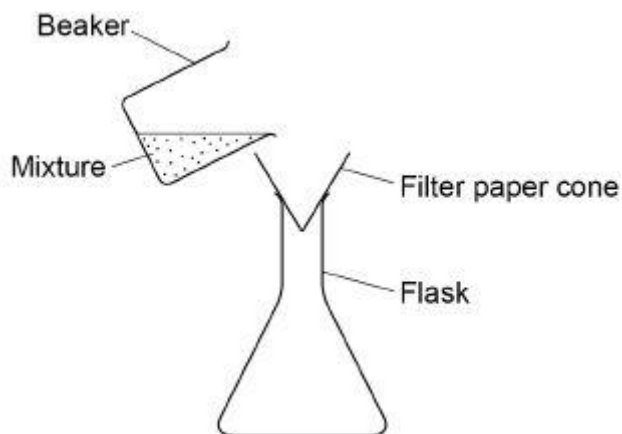
Fractional distillation

(3)

- (b) A student filters a mixture.

Figure 1 shows the apparatus.

Figure 1



Suggest **one** improvement to the apparatus.

(1)

(c) Complete the sentences.

Choose answers from the box.

condense	evaporate	freeze	melt	solidify
-----------------	------------------	---------------	-------------	-----------------

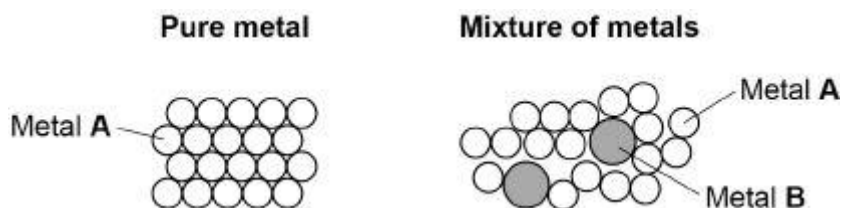
In simple distillation, the mixture is heated to make the liquid _____ .

The vapour is then cooled to make it _____ .

(2)

Figure 2 shows the arrangement of atoms in a pure metal and in a mixture of metals.

Figure 2



(d) Calculate the percentage of metal B atoms in the mixture of metals shown in **Figure 2**.

Percentage of metal **B** atoms = _____ %

(2)

(e) What is a mixture of metals called?

Tick **one** box.

An alloy

A compound

A molecule

A polymer

(1)

(f) Why is the mixture of metals in **Figure 2** harder than the pure metal?Tick **one** box.

The atoms in the mixture are different shapes.

The layers in the mixture are distorted.

The layers in the mixture slide more easily.

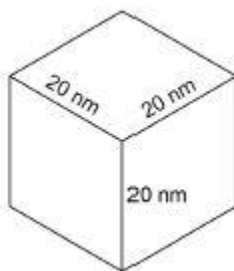
The mixture has a giant structure.

(1)

(g) A nanoparticle of pure metal **A** is a cube.

Each side of the cube has a length of 20 nm.

Figure 3 shows the cube.**Figure 3**



What is the volume of the nanoparticle?

Tick **one** box. **(separate only)**

20 nm³

60 nm³

400 nm³

8000 nm³

(1)

(Total 11 marks)

Q9.

This question is about the structure of the atom.

(a) Complete the sentences.

Choose answers from the box.

Each word may be used once, more than once, or not at all.

electron	ion	neutron
	nucleus	proton

The centre of the atom is the _____ .

The two types of particle in the centre of the atom are the proton
and the _____ .

James Chadwick proved the existence of the _____ .

Niels Bohr suggested particles orbit the centre of the atom. This type of
particle

is the _____ .

The two types of particle with the same mass are the neutron
and the _____ .

(5)

The table below shows information about two isotopes of element **X**.

	Mass number	Percentage (%) abundance
Isotope 1	63	70
Isotope 2	65	30

(b) Calculate the relative atomic mass (A_r) of element **X** using the equation:

$$A_r = \frac{(\text{mass number} \times \text{percentage}) \text{ of isotope 1} + (\text{mass number} \times \text{percentage}) \text{ of isotope 2}}{100}$$

Use the table above.

Give your answer to 1 decimal place.

$$A_r = \underline{\hspace{2cm}}$$

(2)

(c) Suggest the identity of element **X**.

Use the periodic table.

Element **X** is

(1)

(d) The radius of an atom of element **X** is 1.2×10^{-10} m

The radius of the centre of the atom is $\frac{1}{10000}$ the radius of the atom.

Calculate the radius of the centre of an atom of element **X**.

Give your answer in standard form.

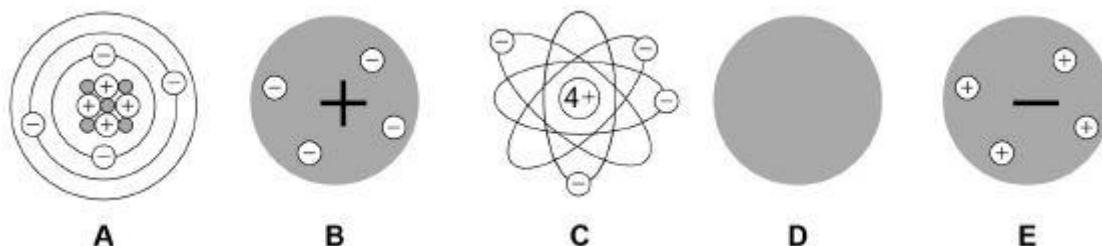
Radius = _____ m

(2)

(Total 10 marks)

Q10.

The diagram below represents different models of the atom.



(a) Which diagram shows the plum pudding model of the atom?

Tick **one** box.

A		B		C		D		E	
---	--	---	--	---	--	---	--	---	--

(1)

(b) Which diagram shows the model of the atom developed from the alpha particle scattering experiment?

Tick **one** box.

A		B		C		D		E	
---	--	---	--	---	--	---	--	---	--

(1)

(c) Which diagram shows the model of the atom resulting from Bohr's work?

Tick **one** box.

A		B		C		D		E	
---	--	---	--	---	--	---	--	---	--

(1)

(d) Define the mass number of an atom.

(1)

- (e) Element **X** has two isotopes. Their mass numbers are 69 and 71

The percentage abundance of each isotope is:

- 60% of ^{69}X
- 40% of ^{71}X

Estimate the relative atomic mass of element **X**.

Tick **one** box.

< 69.5

Between 69.5 and 70.0

Between 70.0 and 70.5

> 70.5

(1)

- (f) Chadwick's experimental work on the atom led to a better understanding of isotopes.

Explain how his work led to this understanding.

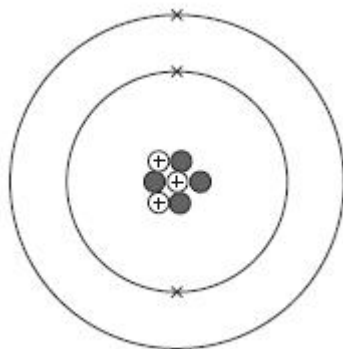
(3)

(Total 8 marks)

Q11.

This question is about atomic structure.

The figure below represents the structure of a lithium atom.



- (a) Name the particle in the atom that has a positive charge.

(1)

- (b) Name the particle in the atom that has the smallest mass.

(1)

- (c) Complete the sentences.

Choose the answers from the box.

3	4	7	10
---	---	---	----

The mass number of the lithium atom is _____.

The number of neutrons in the lithium atom is _____.

(2)

- (d) What are lithium atoms with different numbers of neutrons called?

Tick (✓) **one** box.

Compounds

Ions

Isotopes

Molecules

(1)

- (e) Name the particle in the atom discovered by James Chadwick.

_____ .

(1)

- (f) An element has two isotopes.

The table shows information about the isotopes.

	Mass number	Percentage (%) abundance
Isotope 1	10	20
Isotope 2	11	80

Calculate the relative atomic mass (A_r) of the element.

Use the equation:

$$A_r = \frac{(\text{mass number} \times \text{percentage}) \text{ of isotope 1} + (\text{mass number} \times \text{percentage}) \text{ of isotope 2}}{100}$$

Give your answer to 1 decimal place.

Relative atomic mass (A_r) = _____

(2)

- (g) The radius of an atom is 0.2 nm

The radius of the nucleus is $\frac{1}{10000}$ the radius of the atom.

Calculate the radius of the nucleus.

Give your answer in standard form.

Radius = _____ nm

(2)

(Total 10 marks)

Q12.

This question is about atoms.

- (a) What does the number 19 represent in ${}_{9}^{19}\text{F}$?

(1)

- (b) How many atoms are present in one mole of fluorine atoms?

Tick (✓) **one** box.

2.03×10^{26}

2.06×10^{23}

6.02×10^{23}

6.02×10^{26}

(1)

- (c) The plum pudding model of the atom was replaced by the nuclear model.

The nuclear model was developed after the alpha particle scattering experiment.

Compare the plum pudding model with the nuclear model of the atom.

(4)

- (d) An element has three isotopes.

The table shows the mass numbers and percentage of each isotope.

	Isotope 1	Isotope 2	Isotope 3
Mass number	24	25	26
Percentage (%)	78.6	10.1	11.3

Calculate the relative atomic mass (A_r) of the element.

Give your answer to 3 significant figures.

Relative atomic mass = _____

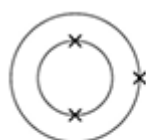
(2)

(Total 8 marks)

Q13.

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

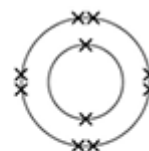
The letters are **not** the symbols of the elements.



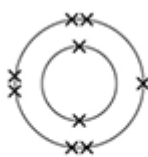
Element A



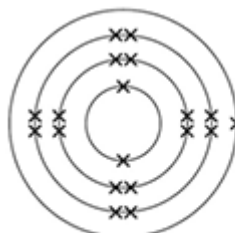
Element B



Element C



Element D



Element E

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

Use the periodic table to help you.

(a) Which element is hydrogen?

Tick **one** box.

A B C D E

(1)

(b) Which element is a halogen?

Tick **one** box.

A B C D E

(1)

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

Tick **one** box.

A B C D E

(1)

(d) Which element exists as single atoms?

Tick **one** box.

A B C D E

(1)

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

Mass number of the isotope	6	7
Percentage abundance	92.5	7.5

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

Give your answer to 2 decimal places.

Relative atomic mass = _____

(4)

(Total 8 marks)

Q14.An atom of aluminium has the symbol ${}_{13}^{27}\text{Al}$

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

Number of protons _____

Number of neutrons _____

Number of electrons _____

(3)

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

(1)

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

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

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

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

(6)
(Total 10 marks)

Q15.

This question is about mixtures and analysis.

(a) Which **two** substances are mixtures?

Tick **two** boxes.

Air

Carbon dioxide

Graphite

Sodium Chloride

Steel

(2)

(b) Draw **one** line from each context to the correct meaning.

Context

Meaning

Pure
substance in
chemistry

A substance that has had nothing
added to it

A single element or a single
compound

Pure
substance in
everyday life

A substance containing only atoms
which have different numbers of
protons

A substance that can be separated
by filtration

A useful product made by mixing
substances

(2)

(c) What is the test for chlorine gas?

Tick **one** box.

A glowing splint relights

A lighted splint gives a pop

Damp litmus paper turns white

Limewater turns milky

(1)

(d) A student tested a metal chloride solution with sodium hydroxide solution.

A brown precipitate formed.

What was the metal ion in the metal chloride solution?

Tick **one** box. **(separate only)**

Calcium

Copper(II)

Iron(II)

Iron(III)

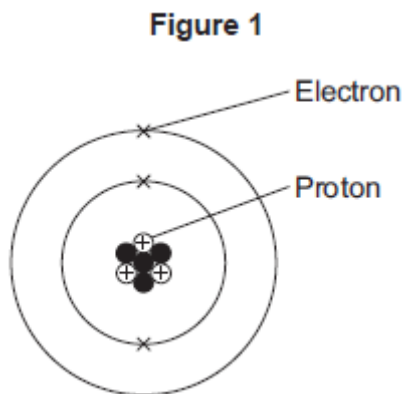
(1)

(Total 6 marks)

Q16.

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

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?

Tick (✓) **one** box.

ions

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

(1)

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

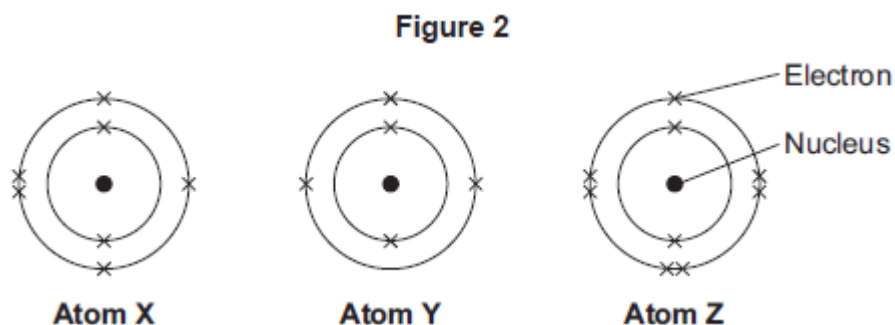
Tick (✓) **one** box.

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.



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

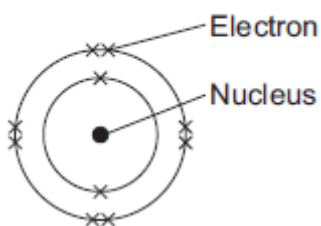
Tick (✓) **one** box.

Atom X	<input type="checkbox"/>
Atom Y	<input type="checkbox"/>
Atom Z	<input type="checkbox"/>

(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)

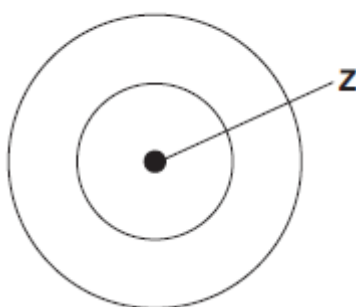
(Total 7 marks)

Q17.

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

- (a) **Figure 1** shows an atom with two energy levels (shells).

Figure 1



- (i) Complete **Figure 1** to show the electronic structure of a boron atom. (1)

- (ii) What does the central part labelled **Z** represent in **Figure 1**?

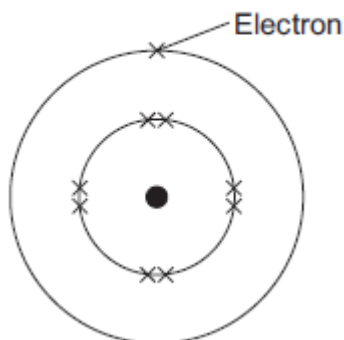
_____ (1)

- (iii) Name the sub-atomic particles in part **Z** of a boron atom.
 Give the relative charges of these sub-atomic particles.

(3)

(b) The electronic structure of a neon atom shown in **Figure 2** is **not** correct.

Figure 2



Explain what is wrong with the electronic structure shown in **Figure 2**.

(3)

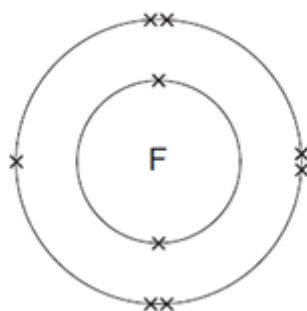
(Total 8 marks)

Q18.

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.

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.

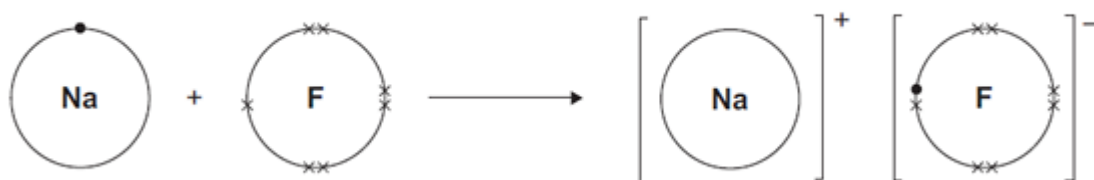
ion	mole	molecule
-----	------	----------

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 2Use **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.

(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)

Q19.

This question is about atoms, molecules and nanoparticles.

(a) Different atoms have different numbers of sub-atomic particles.

(i) An oxygen atom can be represented as $^{16}_{8}\text{O}$

Explain why the mass number of this atom is 16.

You should refer to the numbers of sub-atomic particles in the nucleus of the atom.

(2)

(ii) Explain why $^{12}_{6}\text{C}$ and $^{14}_{6}\text{C}$ are isotopes of carbon.

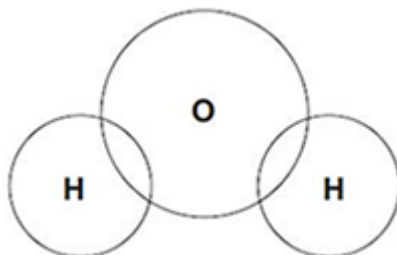
You should refer to the numbers of sub-atomic particles in the nucleus of each isotope.

(3)

(b) Hydrogen atoms and oxygen atoms chemically combine to produce water molecules.

(i) Complete the figure below to show the arrangement of the outer shell electrons of the hydrogen and oxygen atoms in a molecule of water.

Use dots (•) or crosses (x) to represent the electrons.



(2)

(ii) Name the type of bonding in a molecule of water.

(1)

(iii) Why does pure water **not** conduct electricity?

(1)

(c) Nanoparticles of cobalt oxide can be used as catalysts in the production of hydrogen from water.

(i) How does the size of a nanoparticle compare with the size of an atom? **(separate only)**

(1)

(ii) Suggest **one** reason why 1 g of cobalt oxide nanoparticles is a better catalyst than 1g of cobalt oxide powder. **(separate only)**

(1)

(Total 11 marks)