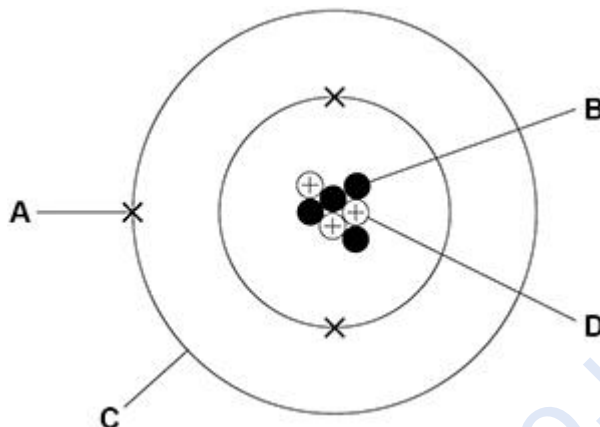


Q1.

This question is about atoms.

(a) The figure below represents an atom of an element.



Draw **one** line from each name to the correct label.

Name	Label
Neutron	A
	B
Proton	C
	D

(2)

- (b) An atom of element **Y** has:
- an atomic number of 9
 - a mass number of 19.

Give the number of electrons and the number of neutrons in this atom.

Choose answers from the box.

1	9	10	19	28
---	---	----	----	----

Number of electrons _____

Number of neutrons _____

(2)

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

	Mass number	Percentage abundance (%)
Isotope A	39	93.3
Isotope B	41	6.7

(c) Calculate the relative atomic mass (A_r) of element **Z**.

Use the table above and the equation:

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

Give your answer to 3 significant figures.

A_r (3 significant figures) = _____

(3)

(d) Suggest the identity of element **Z**.

Use the periodic table.

Element **Z** _____

(1)

(e) Complete the sentence.

Choose the answer from the box.

electrons	neutrons	protons
------------------	-----------------	----------------

Isotopes of the same element have different mass numbers because the isotopes have different numbers of _____.

(1)

(Total 9 marks)

Q2.

This question is about elements, compounds and mixtures.

(a) Which type of substance is hydrogen?

Tick (✓) **one** box.

Element

Compound

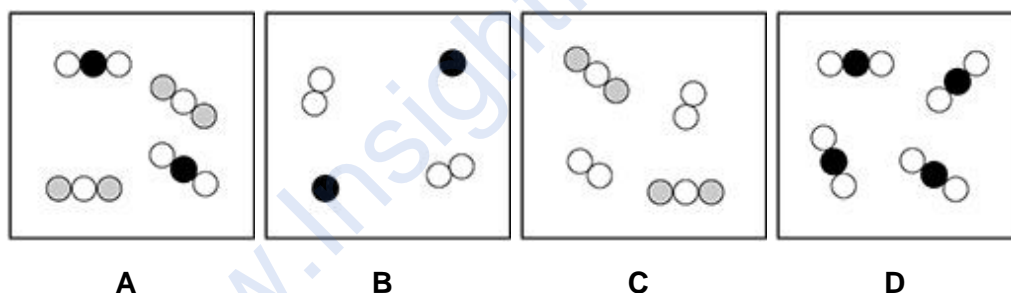
Mixture

(1)

The diagrams in **Figure 1** represent different substances.

● ● and ○ represent atoms of three different elements.

Figure 1



Use **Figure 1** to answer parts (b) and (c).

(b) Which diagram represents a mixture of compounds?

A B C D

(1)

(c) Which diagram represents a mixture of elements?

A B C D

(1)

Substances can be separated from mixtures by using different methods.

(d) Complete the sentence.

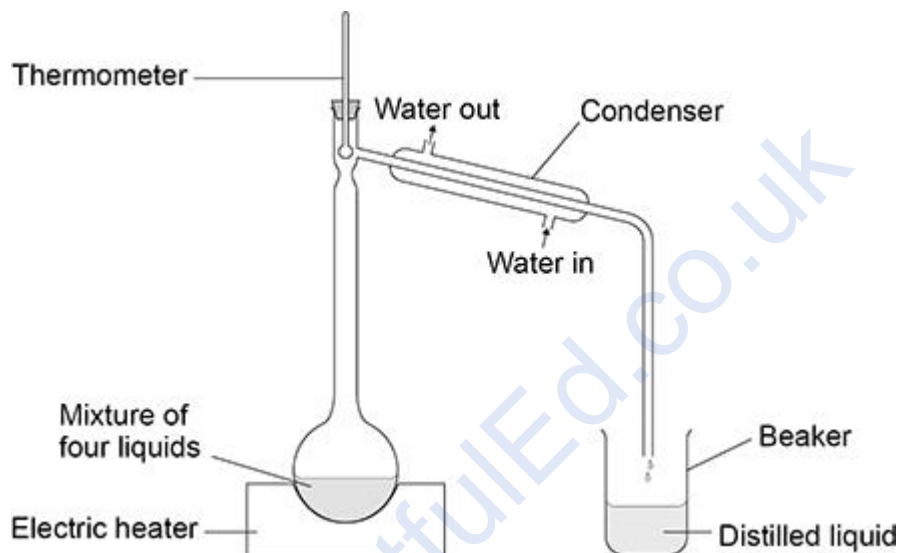
Sand can be separated from a mixture of sand and water by _____.

(1)

A mixture of four liquids was fractionally distilled.

Figure 2 shows the apparatus used.

Figure 2



The table below shows the boiling points of the four liquids in the mixture.

Liquid	Boiling point in °C
A	97
B	138
C	78
D	118

(e) Which liquid in the table would distil and be collected in the beaker first?

Liquid _____

(1)

(f) Suggest what would happen to the temperature of the water as the water flows through the condenser.

(1)

(g) Describe how to obtain sodium chloride crystals from sodium chloride solution by crystallisation.

(2)
(Total 8 marks)

Q3.

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^+

Ga^-

Ga^{3+}

Ga^{3-}

(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)

Q4.

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

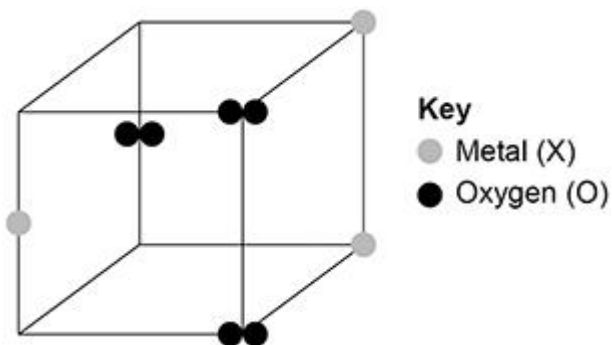
Mixture

Non-metallic element

(1)

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

Figure 1



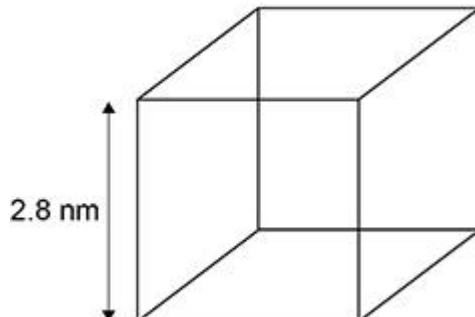
Determine the empirical formula of this oxide.

Empirical formula = XO _____

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.

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.

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)

Q5.

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)

- (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

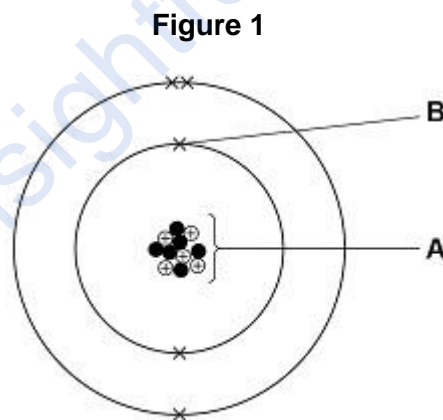
A planet of radius 1000 km

(1)
(Total 8 marks)

Q6.

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

Ion

Isotope

Molecule

(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)

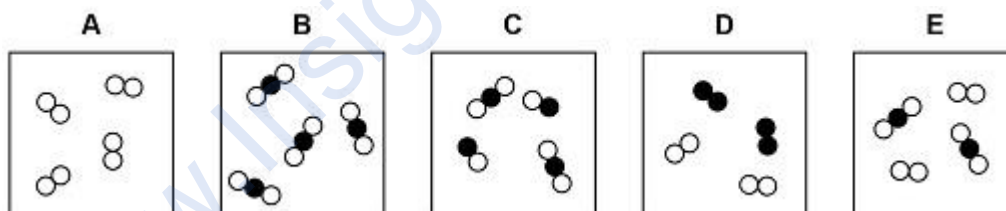
Q7.

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
<input type="checkbox"/> chromatography	<input type="checkbox"/> blue food colour from a mixture of food colours
<input type="checkbox"/> crystallisation	<input type="checkbox"/> copper from an alloy of copper and zinc
	<input type="checkbox"/> copper sulfate from copper sulfate solution
	<input type="checkbox"/> ethanol from a mixture of ethanol and water

(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:

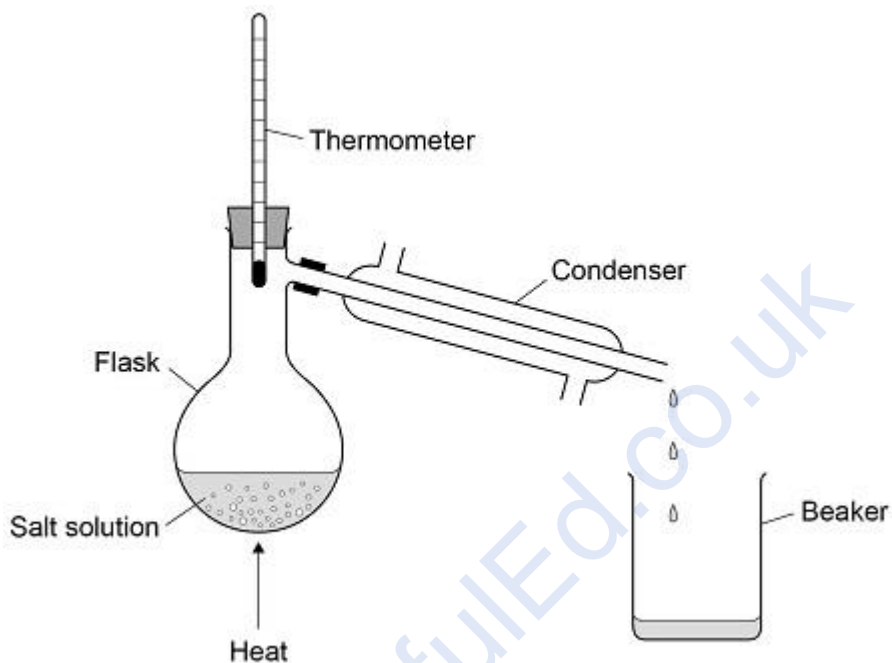
- where the sand is collected
- where the water is collected.

Diagram

- (f) A student distills 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

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

(4)

(Total 13 marks)

Q8.

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)

Q9.

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.

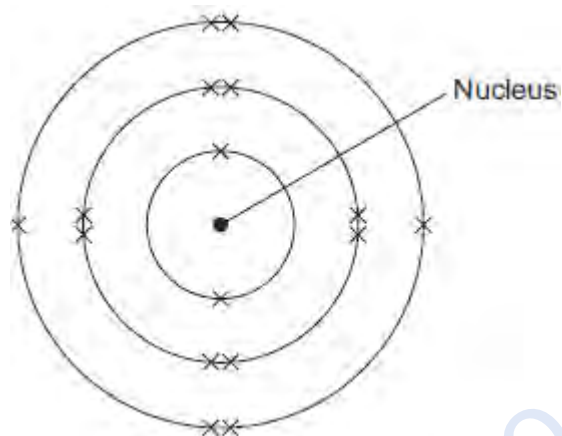
Use the relative electrical charges of sub-atomic particles in your explanation.

(2)

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

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

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



What is the chemical symbol of this non-metal?

Tick (✓) **one** box.

Ar

O

S

Si

(1)

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

Complete the sentences.

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

(1)

- (ii) Compounds formed from only non-metals consist of particles called _____.

(1)

Q10.

This question is about mixtures.

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

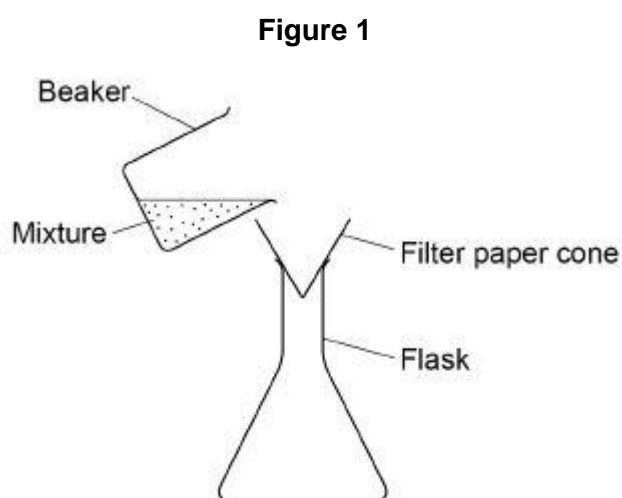
Draw **one** line from each substance and mixture to the best method of separation.

Substance and mixture	Method of separation
Ethanol from ethanol and water	Chromatography
Salt from sea water	Crystallisation
The different colours in black ink	Electrolysis
	Filtration
	Fractional distillation

(3)

- (b) A student filters a mixture.

Figure 1 shows the apparatus.



Suggest **one** improvement to the apparatus.

(1)

(c) Complete the sentences.

Choose answers from the box.

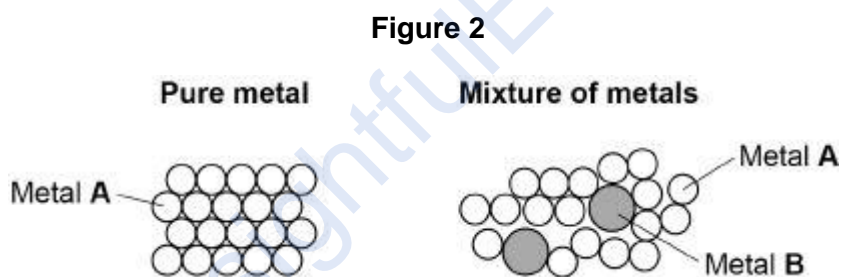
condense	evaporate	freeze	melt	solidify
-----------------	------------------	---------------	-------------	-----------------

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.



(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.

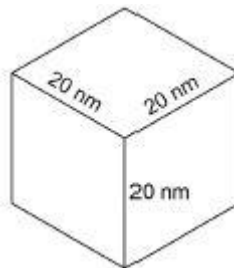
(1)

(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.

20 nm³

60 nm³

400 nm³

8000 nm³

(1)
(Total 11 marks)

Q11.

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)

(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?

_____ (1)

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

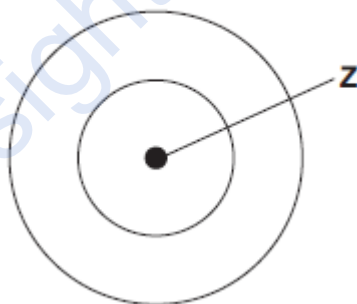
_____ (1)

Q12.

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

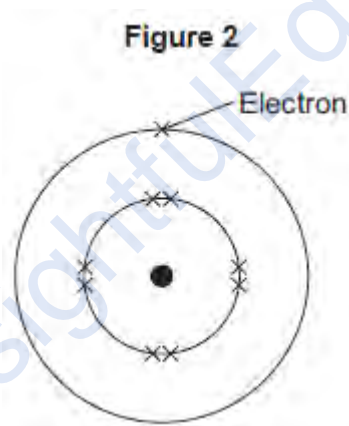


(i) Complete **Figure 1** to show the electronic structure of a boron atom. (1)

(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.

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



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

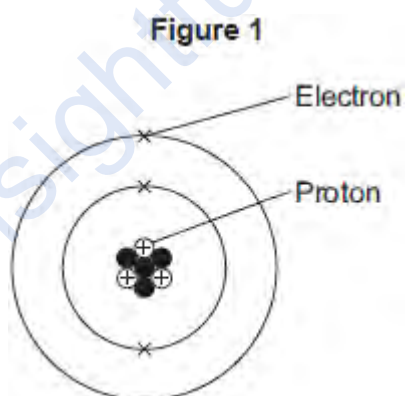
(3)

(Total 8 marks)

Q13.

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? (1)

Tick (✓) **one** box.

ions

molecules

neutrons

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

Tick (✓) **one** box.

number of neutrons

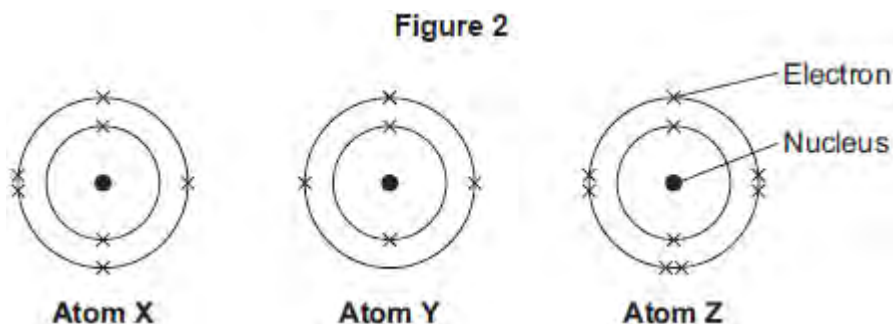
number of protons

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.



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

Tick (✓) **one** box.

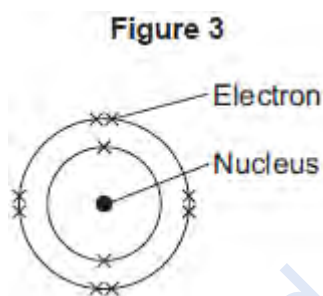
Atom X

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.



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

(1)

- (ii) Why is this element unreactive?

(1)

(Total 7 marks)

Q14.

This question is about metals.

- (a) Which unreactive metal is found in the Earth as the metal itself?

Tick (✓) **one** box.

aluminium

gold

magnesium



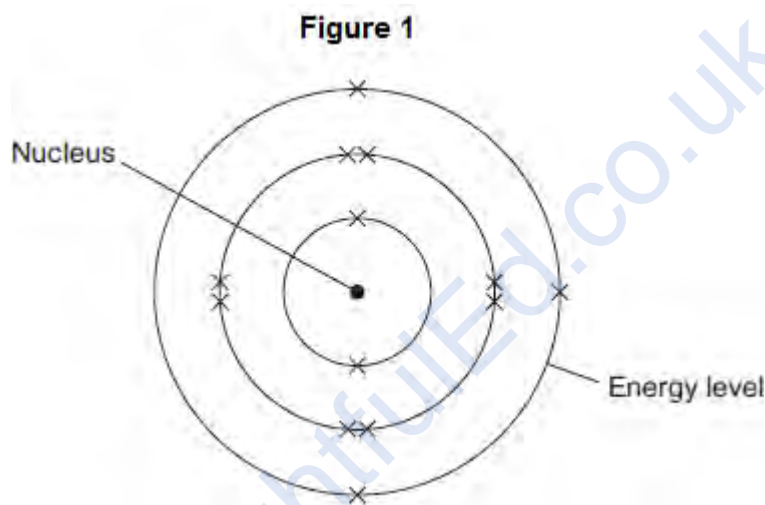
(1)

(b) Complete the sentence.

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

(1)

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



(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.

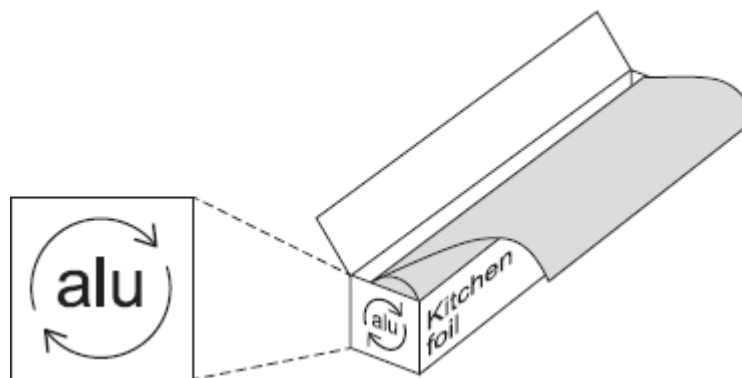
In the periodic table, aluminium is in Group _____ .

(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?

(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.

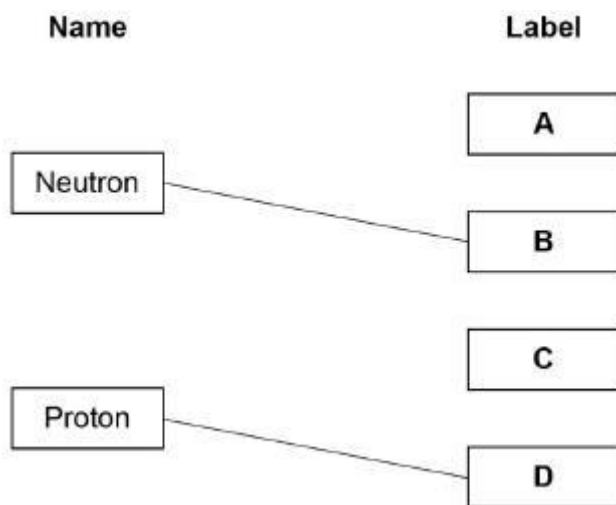
(2)

(Total 10 marks)

Mark schemes

Q1.

(a)



do **not** accept more than one line from a box on the left

2

(b) (number of electrons) 9

1

(number of neutrons) 10

1

(c) **Mark with part (d)**

$$\text{(relative atomic mass =)} \frac{(39 \times 93.3) + (41 \times 6.7)}{100}$$

allow (relative atomic mass =) $\frac{(3638.7) + (274.7)}{100}$

allow (relative atomic mass =) 36.387 + 2.747

1

= 39.134

1

= 39.1

allow an answer correctly calculated to 3 significant figures from an incorrect calculation which uses the values in the table

1

(d) **Mark with part (c)**

potassium / K

allow ecf from part (c)

1

(e) neutrons

1

Q2.

- (a) element 1
- (b) A 1
- (c) B 1
- (d) filtration
allow filtering
allow a description of filtration 1
- (e) C
allow 78 (°C) 1
- (f) increases
allow becomes warmer / hotter 1
- (g) heat (the solution) until crystallisation point is reached
allow heat (the solution) until crystals start to form
allow heat (the solution) to reduce the volume
allow heat (the solution) to evaporate (some of the water) 1
- leave the solution (to cool / crystallise) 1
- if no other mark is awarded allow 1 mark for heat the solution to dryness*

[8]

Q3.

- (a) (atoms with the) same number of protons
allow atoms with the same atomic number
allow atoms of the same element
ignore the same number of electrons 1
- (but with) different numbers of neutrons
ignore (but with) different mass numbers
*do **not** accept (but with) different relative atomic mass* 1
- (b) $(A_r =) \frac{(69 \times 60) + (71 \times 40)}{100}$

- = 69.8 1
- (c) (number of electrons) = 31 1
- (number of neutrons) = 38 1
- (d) Ga^{3+} 1
- (e) (gallium) fitted in a gap (Mendeleev had left) 1
- (gallium's) properties were predicted correctly (by Mendeleev)
allow (gallium's) properties matched the rest of the group 1

[9]

Q4.

- (a) non-metallic element 1
- (b) compound 1
- (f) XO_2 1
- (g) $(2.8)^2 \times 6$ 1
- = 47.04 1
- = 47 (nm^2)
allow an answer correct to 2 significant figures resulting from an incorrect attempt at the calculation 1

- (h) the surface area to volume ratio of the fine particle is 10 times greater 1

[10]

Q5.

- (a) electron 1
- (e) protons 1

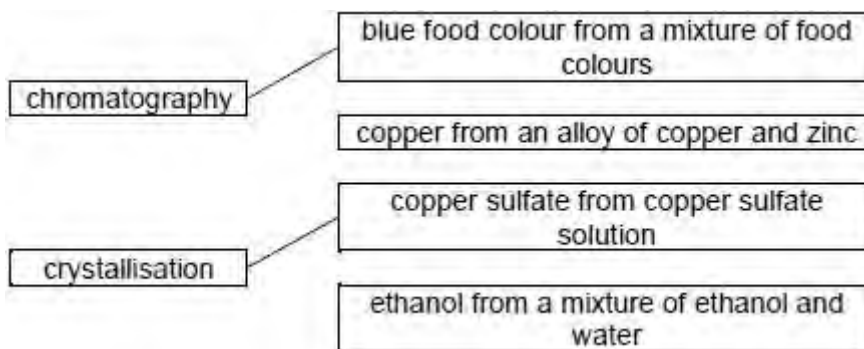
- neutrons 1
- protons (and) electrons
either order 1
- (f) a sports arena of radius 100 m 1
- [8]

Q6.

- (a) **A** nucleus 1
- B** electron 1
- (b) electron 1
- (c) 3 / three 1
- (d) (atomic number) 5 1
- (mass number) 11 1
- (e) isotope 1
- (f) there are the same number of ${}^{79}_{35}\text{Br}$ atoms and ${}^{81}_{35}\text{Br}$ atoms 1
- [8]

Q7.

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



additional line from a box negates the mark for that box

2

(e) (filter) funnel containing filter paper

1

suitable vessel for collecting filtrate

1

sand **and** water labelled in correct place

1

(f) 100 °C

1

(g) any **four** from:

- solution is heated
- water evaporates
allow water boils / vaporises
- the vapour cools in the condenser
- the vapour condenses
or
the vapour turns to a liquid
- (pure) water collects in the beaker

4

[13]

Q8.

(a) (neutron)

1

0

both needed

allow (neutron)

1

neutral

1

proton

1

(+1)

both needed

1

(b) number of protons plus neutrons

allow number of protons and neutrons

*ignore protons and neutrons unqualified
do **not** accept references to mass or relative
mass of protons and / or neutrons*

- (c) (the isotopes contain) different numbers of neutrons 1
- (d) most (alpha) particles passed (straight) through (the gold foil) 1
- (so) the mass of the atom is concentrated in the nucleus / centre
or
(so) most of the atom is empty space 1
- some (alpha) particles were deflected / reflected 1
- (so) the atom has a (positively) charged nucleus / centre
*if not awarded for MP2 allow (so) the mass of the
atom is concentrated in the nucleus / centre.* 1

[8]

Q9.

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

(e) (i) ions

1

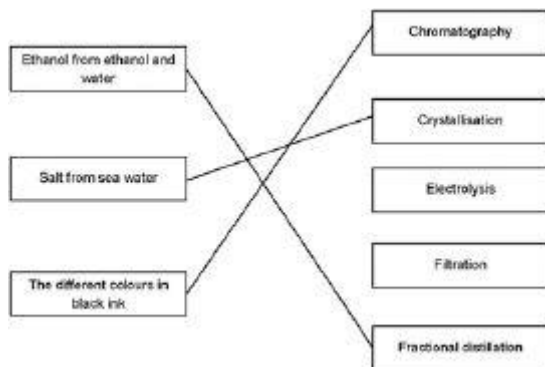
(ii) molecules

1

[9]

Q10.

(a)



1
1
1

(b) include a (filter) funnel

*allow funnel drawn on the diagram
ignore clamp stand*

1

(c) evaporate

1

condense

1

must be this order

(d) $\frac{2}{20} \times 100$

1

= 10 (%)

1

*an answer of 10 (%) scores 2 marks
an answer of 11.1(%) or 90 (%) scores 1 mark*

(e) an alloy

1

(f) the layers in the mixture are distorted

1

(g) 8000 nm³

1

[11]

Q11.

- (a) (i) (mass number = 16) because there are 8 protons and 8 neutrons (in the nucleus)
accept mass number is total number of protons and neutrons for 1 mark 2
- (ii) same number of protons **or** both have 6 protons
accept same atomic number 1
- ^{12}C has 6 neutrons 1
- ^{14}C has 8 neutrons 1
- accept different number of neutrons for 1 mark numbers, if given, must be correct incorrect reference to electrons = max 2 marks*
- (c) (i) larger
accept the size of a few hundred atoms accept atoms are smaller (than nanoparticles) allow up to 1000 atoms) 1
- (ii) (nanoparticles have) large(r) surface area 1

[11]

Q12.

- (a) (i) electronic structure 2,3 drawn
allow any representation of electrons, such as, dots, crosses, or numbers (2,3) 1
- (ii) nucleus 1
- (iii) protons and neutrons
do not allow electrons in nucleus 1
- (relative charge of proton) +1
allow positive 1
- (relative charge of neutron) 0
allow no charge/neutral 1
- ignore number of particles*
- (b) too many electrons in the first energy level or inner shell
allow inner shell can only have a maximum of 2 electrons 1

too few electrons in the second energy level or outer shell

allow neon has 8 electrons in its outer shell or neon does not have 1 electron in its outer shell

allow neon has a stable arrangement of electrons or a full outer shell

1

neon does not have 9 electrons or neon has 10 electrons

allow one electron missing

allow fluorine has 9 electrons

1

ignore second shell can hold (maximum) 8 electrons or 2,8,8 rule or is a noble gas or in Group 0

max 2 marks if the wrong particle, such as atoms instead of electrons

if no other mark awarded allow 1 mark for the electronic structure of neon is 2,8

[8]

Q13.

(a) (i) 7

1

(ii) -1

1

(iii) neutrons

1

(b) number of protons

1

(c) atom Y

1

(d) (i) Ne

allow neon

1

(ii) has a full outer shell

allow in Group 0

allow a noble gas

or

full outer energy level

allow the shells are full

or

has 8 electrons in its outer shell

ignore in Group 8

1

Q14.

- (a) gold 1
- (b) atom (s) 1
- (c) (i) protons
any order
allow proton 1
- neutrons
allow neutron 1
- (ii) 3 / three 1
- (d) (i) Al
ignore any numbers / charges 1
- (ii) any **two** from:
 • limited resource
 • expensive in terms of energy / mining
 • effects on the environment, such as, landfill, atmospheric pollution, quarrying
allow uses a lot of energy to extract. 2
- (e) resistant to corrosion 1
- does not react (with water or food)
*allow **one** mark for low density with a suitable reason given* 1