



New Document 1

Name: _____

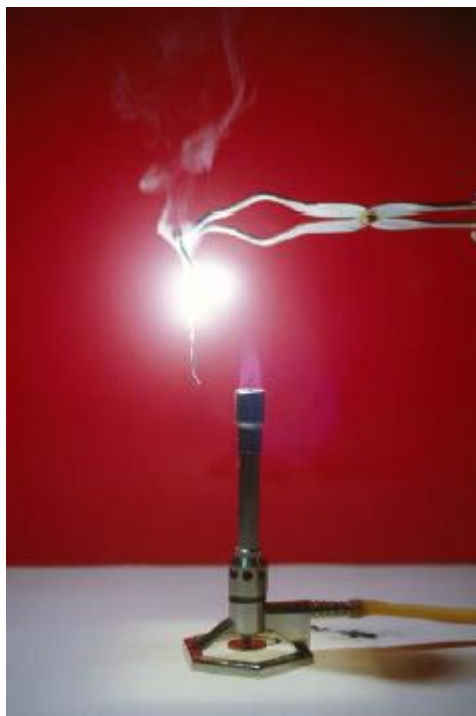
Class: _____

Date: _____

Atomic Structure

Q1.

The figure below shows magnesium burning in air.



© Charles D Winters/Science Photo Library

- (a) Look at the figure above.

How can you tell that a chemical reaction is taking place?

(1)

- (b) Name the product from the reaction of magnesium in the figure.

(1)

- (c) The magnesium needed heating before it would react.

What conclusion can you draw from this?

Tick **one** box.

The reaction is reversible

The reaction has a high activation energy

The reaction is exothermic

Magnesium has a high melting point

(1)

- (d) A sample of the product from the reaction in the figure above was added to water and shaken.

Universal indicator was added.

The universal indicator turned blue.

What is the pH value of the solution?

Tick **one** box.

1

4

7

9

(1)

- (e) Why are nanoparticles effective in very small quantities?

Tick **one** box.

They are elements

They are highly reactive

They have a low melting point

They have a high surface area to volume ratio

(1)

- (f) Give **one** advantage of using nanoparticles in sun creams.

(1)

- (g) Give **one** disadvantage of using nanoparticles in sun creams.

(1)

- (h) A coarse particle has a diameter of 1×10^{-6} m.
A nanoparticle has a diameter of 1.6×10^{-9} m.

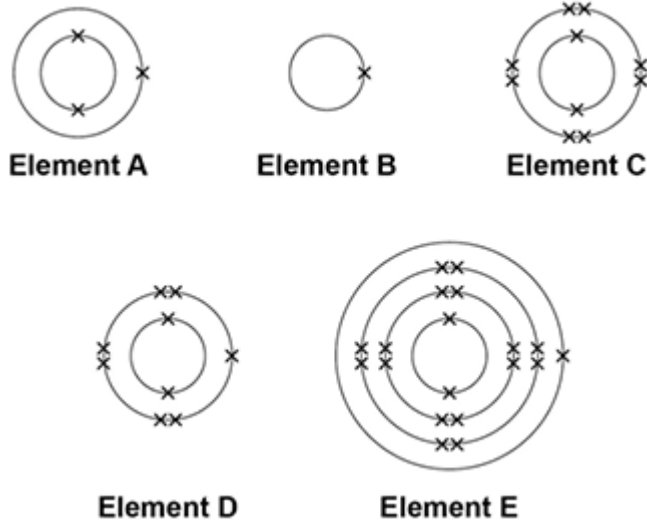
Calculate how many times bigger the diameter of the coarse particle is than the diameter of the nanoparticle.

(2)
(Total 9 marks)

Q2.

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

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



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

Use the periodic table to help you.

- (a) Which element is hydrogen?

Tick **one** box.

A B C D E

(1)

- (b) Which element is a halogen?

Tick **one** box.

A B C D E

(1)

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

Tick **one** box.

A B C D E

(1)

(d) Which element exists as single atoms?

Tick **one** box.

A B C D E

(1)

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

Mass number of the isotope	6	7
Percentage abundance	92.5	7.5

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

Give your answer to 2 decimal places.

Relative atomic mass = _____

(4)

(Total 8 marks)

Q3.

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.

(6)

(Total 10 marks)

Q4.

Rock salt is a mixture of sand and salt.

Salt dissolves in water. Sand does **not** dissolve in water.

Some students separated rock salt.

This is the method used.

1. Place the rock salt in a beaker.
2. Add 100 cm³ of cold water.
3. Allow the sand to settle to the bottom of the beaker.
4. Carefully pour the salty water into an evaporating dish.
5. Heat the contents of the evaporating dish with a Bunsen burner until salt crystals start to form.

(a) Suggest **one** improvement to step 2 to make sure all the salt is dissolved in the water.

(1)

(b) The salty water in step 4 still contained very small grains of sand.

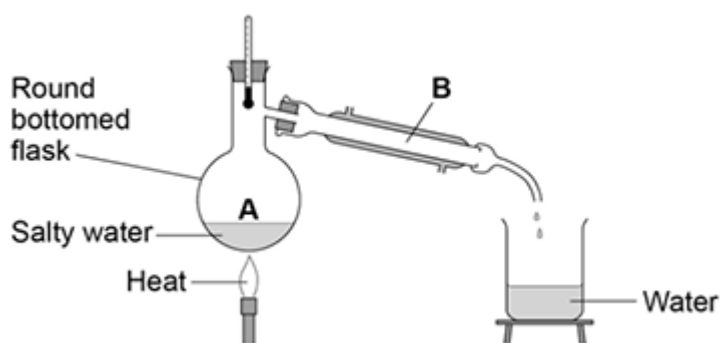
Suggest **one** improvement to step 4 to remove all the sand.

(1)

(c) Suggest **one** safety precaution the students should take in step 5.

(1)

(d) Another student removed water from salty water using the apparatus in the figure below.



Describe how this technique works by referring to the processes at **A** and **B**.

(2)

(e) What is the reading on the thermometer during this process?

_____ °C

(1)

(Total 6 marks)

Q5.

This question is about halogens and their compounds.

The table below shows the boiling points and properties of some of the elements in Group 7 of the periodic table.

Element	Boiling point in °C	Colour in aqueous solution
Fluorine	-188	colourless
Chlorine	-35	pale green
Bromine	X	orange
Iodine	184	brown

(a) Why does iodine have a higher boiling point than chlorine?

Tick **one** box.

Iodine is ionic and chlorine is covalent

Iodine is less reactive than chlorine

The covalent bonds between iodine atoms are stronger

The forces between iodine molecules are stronger

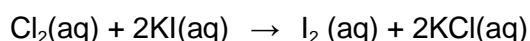
(1)

(b) Predict the boiling point of bromine.

(1)

(c) A redox reaction takes place when aqueous chlorine is added to potassium iodide solution.

The equation for this reaction is:



Look at table above.

What is the colour of the final solution in this reaction?

Tick **one** box.

Brown	<input type="checkbox"/>
Orange	<input type="checkbox"/>
Pale green	<input type="checkbox"/>
Colourless	<input type="checkbox"/>

(1)

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

Tick **one** box.

$\text{Cl}_2 + 2\text{K} \rightarrow 2\text{KCl}$	<input type="checkbox"/>
$2\text{I}^- + \text{Cl}_2 \rightarrow \text{I}_2 + 2\text{Cl}^-$	<input type="checkbox"/>
$\text{I}^- + \text{Cl} \rightarrow \text{I} + \text{Cl}^-$	<input type="checkbox"/>
$\text{I}^- + \text{K}^+ \rightarrow \text{KI}$	<input type="checkbox"/>

(1)

(e) Why does potassium iodide solution conduct electricity?

Tick **one** box.

It contains a metal	<input type="checkbox"/>
It contains electrons which can move	<input type="checkbox"/>
It contains ions which can move	<input type="checkbox"/>
It contains water	<input type="checkbox"/>

(1)

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

Tick **one** box.

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

potassium

oxygen

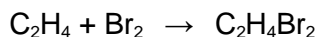


(1)
(Total 6 marks)

Q6.

This question is about the reaction of ethene and bromine.

The equation for the reaction is:

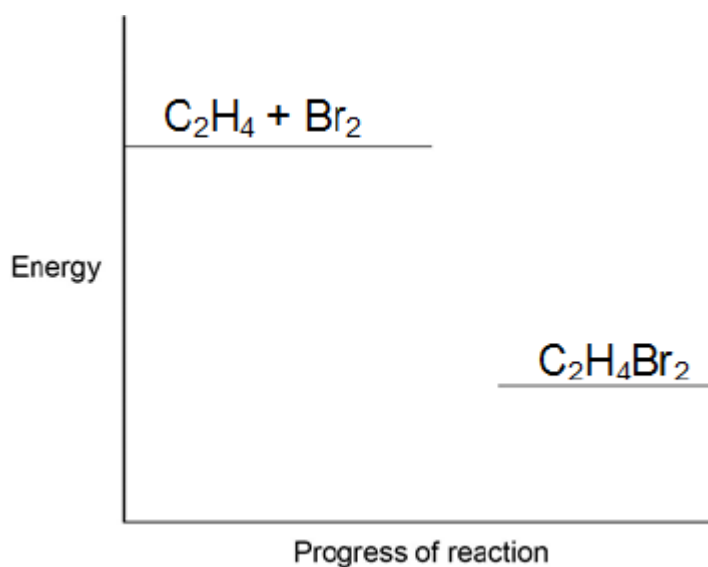


(a) Complete the reaction profile in **Figure 1**.

Draw labelled arrows to show:

- The energy given out (ΔH)
- The activation energy.

Figure 1



(3)

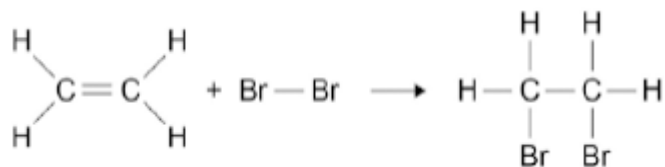
(b) When ethene reacts with bromine, energy is required to break covalent bonds in the molecules.

Explain how a covalent bond holds two atoms together.

(2)

(c) **Figure 2** shows the displayed formulae for the reaction of ethene with bromine.

Figure 2



The bond enthalpies and the overall energy change are shown in the table below.

	C=C	C-H	C-C	C-Br	Overall energy change
Energy in kJ / mole	612	412	348	276	-95

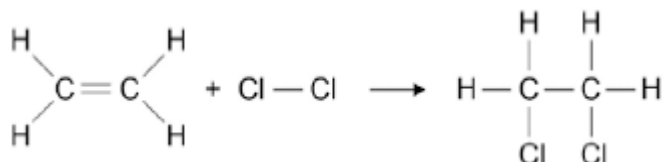
Use the information in the table above and **Figure 2** to calculate the bond energy for the Br-Br bond.

Bond energy _____ kJ / mole

(3)

- (d) **Figure 3** shows the reaction between ethene and chlorine and is similar to the reaction between ethene and bromine.

Figure 3



“The more energy levels (shells) of electrons an atom has, the weaker the covalent bonds that it forms.”

Use the above statement to predict and explain how the overall energy change for the reaction of ethene with chlorine will differ from the overall energy change for the reaction of ethene with bromine.

Q7.

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

A substance containing only atoms
which have different numbers of
protons

Pure
substance in
everyday life

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.

Calcium

Copper(II)

Iron(II)

Iron(III)

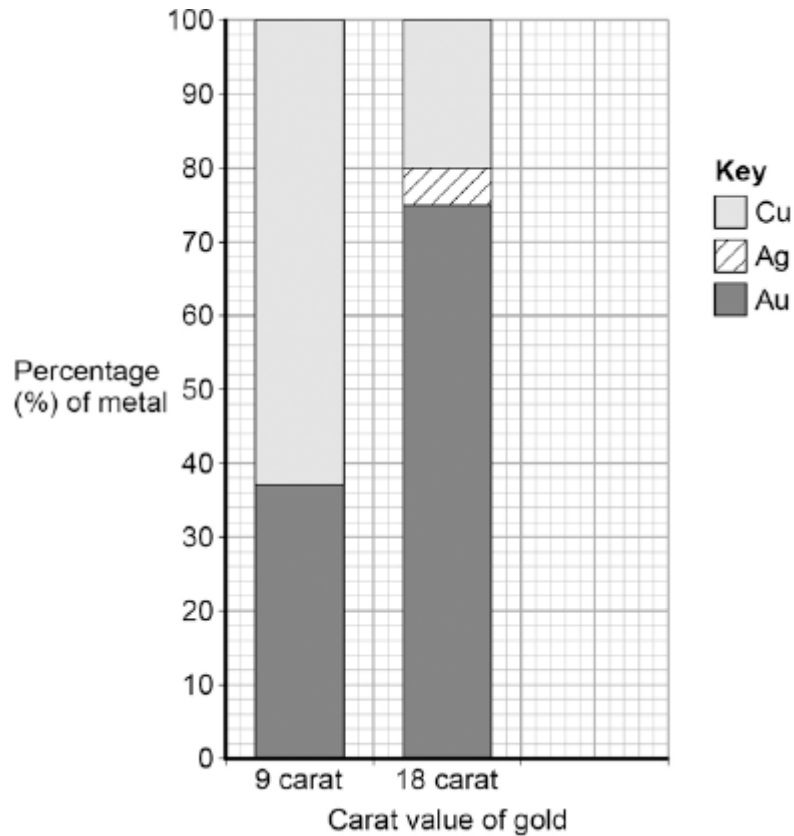
(1)

(Total 6 marks)

Q8.

Gold is mixed with other metals to make jewellery.

The figure below shows the composition of different carat values of gold.



(a) What is the percentage of gold in 12 carat gold?

Tick **one** box.

12 % 30 % 50 % 80 %

(1)

(b) Give the percentage of silver in 18 carat gold.

Use the figure above to answer this question.

Percentage = _____ %

(1)

(c) Suggest **two** reasons why 9 carat gold is often used instead of pure gold to make jewellery.

1. _____

2. _____

(2)

(Total 4 marks)

Q9.

The table below gives information about four alcohols.

Alcohol	Formula	Melting point in °C	Boiling point in °C
Methanol	CH ₃ OH	-94	65
Ethanol	CH ₃ CH ₂ OH	-118	78
Propanol	CH ₃ CH ₂ CH ₂ OH	-129	97
Butanol	CH ₃ CH ₂ CH ₂ CH ₂ OH	-89	118

(a) Which alcohol in the table is liquid over the greatest temperature range?

(1)

(b) Which statement is correct?

Tick **one** box.

A molecule of ethanol has 5 hydrogen atoms

Butanol has the highest boiling point

Methanol has the largest molecules

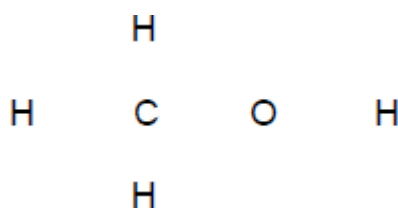
Propanol has the highest melting point

(1)

(c) A molecule of methanol has five single covalent bonds.

Draw the missing bonds in **Figure 1** to complete the displayed formula for methanol.

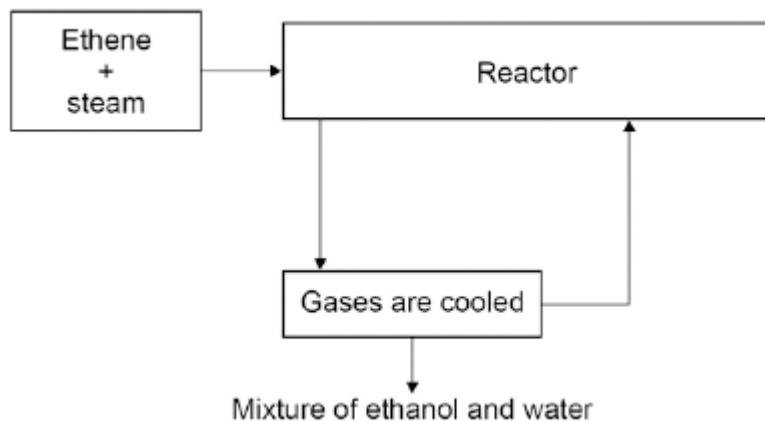
Figure 1



(1)

(d) **Figure 2** shows a flow diagram of the process to produce ethanol.

Figure 2



Complete the word equation for the reaction to produce ethanol.

_____ + _____ → ethanol

(1)

(e) What happens to the unreacted ethene?

(1)

(f) Wine contains ethanol.
A bottle of wine was left open in air.
After a few days, the wine tasted of vinegar.
Vinegar is a solution of ethanoic acid in water.

Explain how oxidation causes the wine to taste of vinegar after a few days.

(3)

(Total 8 marks)

Q10.

This question is about hydrocarbons.

(a) The names and formulae of three hydrocarbons in the same homologous series are:

Ethane	C_2H_6
Propane	C_3H_8
Butane	C_4H_{10}

The next member in the series is pentane.

What is the formula of pentane?

(1)

(b) Which homologous series contains ethane, propane and butane?

Tick **one** box.

Alcohols

Alkanes

Alkenes

Carboxylic acids

(1)

(c) Propane (C_3H_8) is used as a fuel.

Complete the equation for the complete combustion of propane.



(2)

(d) Octane (C_8H_{18}) is a hydrocarbon found in petrol.

Explain why octane is a hydrocarbon.

(2)

(e) The table below gives information about the pollutants produced by cars using diesel or petrol as a fuel.

Fuel	Relative amounts of pollutants		
	Oxides of Nitrogen	Particulate matter	Carbon dioxide
Diesel	31	100	85
Petrol	23	0	100

Compare the pollutants from cars using diesel with those from cars using petrol.

(3)

(f) Pollutants cause environmental impacts.

Draw **one** line from each pollutant to the environmental impact caused by the pollutant.

Pollutant	Environmental impact caused by the pollutant
	Acid rain
Oxides of nitrogen	Flooding
	Global dimming
Particulate matter	Global warming
	Photosynthesis

(2)

(Total 11 marks)

Q11.

Water from a lake in the UK is used to produce drinking water.

(a) What are the two main steps used to treat water from lakes?

Give a reason for each step.

Step 1 _____

Reason _____

Step 2 _____

Reason _____

(2)

(b) Explain why it is more difficult to produce drinking water from waste water than from water in lakes.

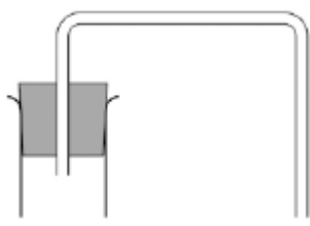
(3)

(c) Some countries make drinking water from sea water.

Complete the figure below to show how you can distil salt solution to produce and collect pure water.

Label the following:

- pure water
- salt solution



(3)

(d) How could the water be tested to show it is pure?

Give the expected result of the test for pure water.

(2)

(e) Why is producing drinking water from sea water expensive?

(1)

(Total 11 marks)

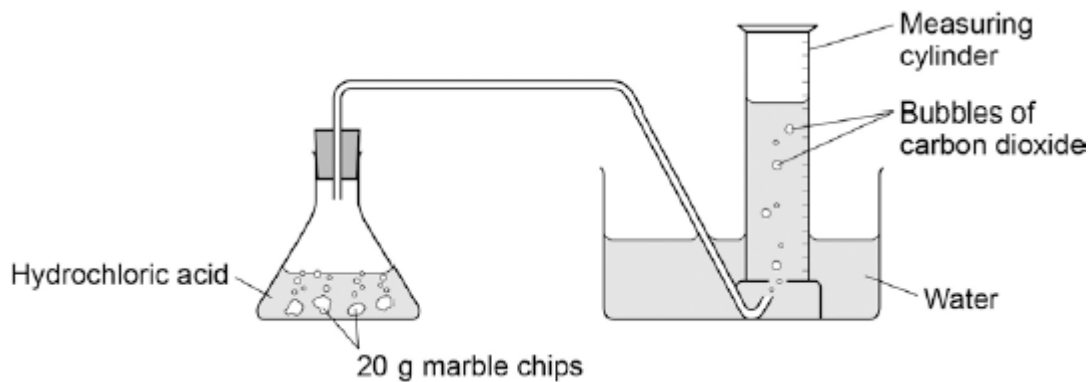
Q12.

Marble chips are mainly calcium carbonate (CaCO_3).

A student investigated the rate of reaction between marble chips and hydrochloric acid (HCl).

Figure 1 shows the apparatus the student used.

Figure 1



- (a) Complete and balance the equation for the reaction between marble chips and hydrochloric acid.



(2)

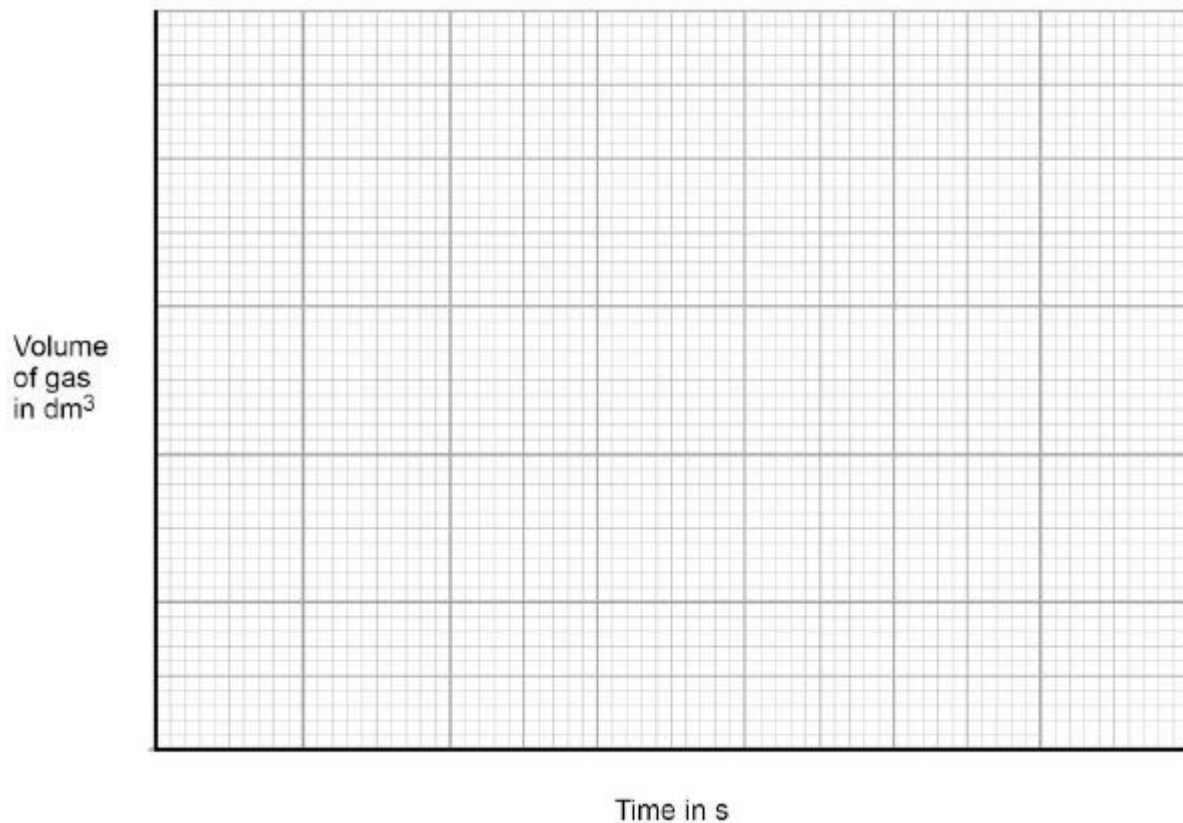
- (b) The table below shows the student's results.

Time in s	Volume of gas in dm ³
0	0.000
30	0.030
60	0.046
90	0.052
120	0.065
150	0.070
180	0.076
210	0.079
240	0.080
270	0.080

On **Figure 2**:

- Plot these results on the grid.
- Draw a line of best fit.

Figure 2



(4)

- (c) Sketch a line on the grid in **Figure 2** to show the results you would expect if the experiment was repeated using 20 g of smaller marble chips.

Label this line **A**.

(2)

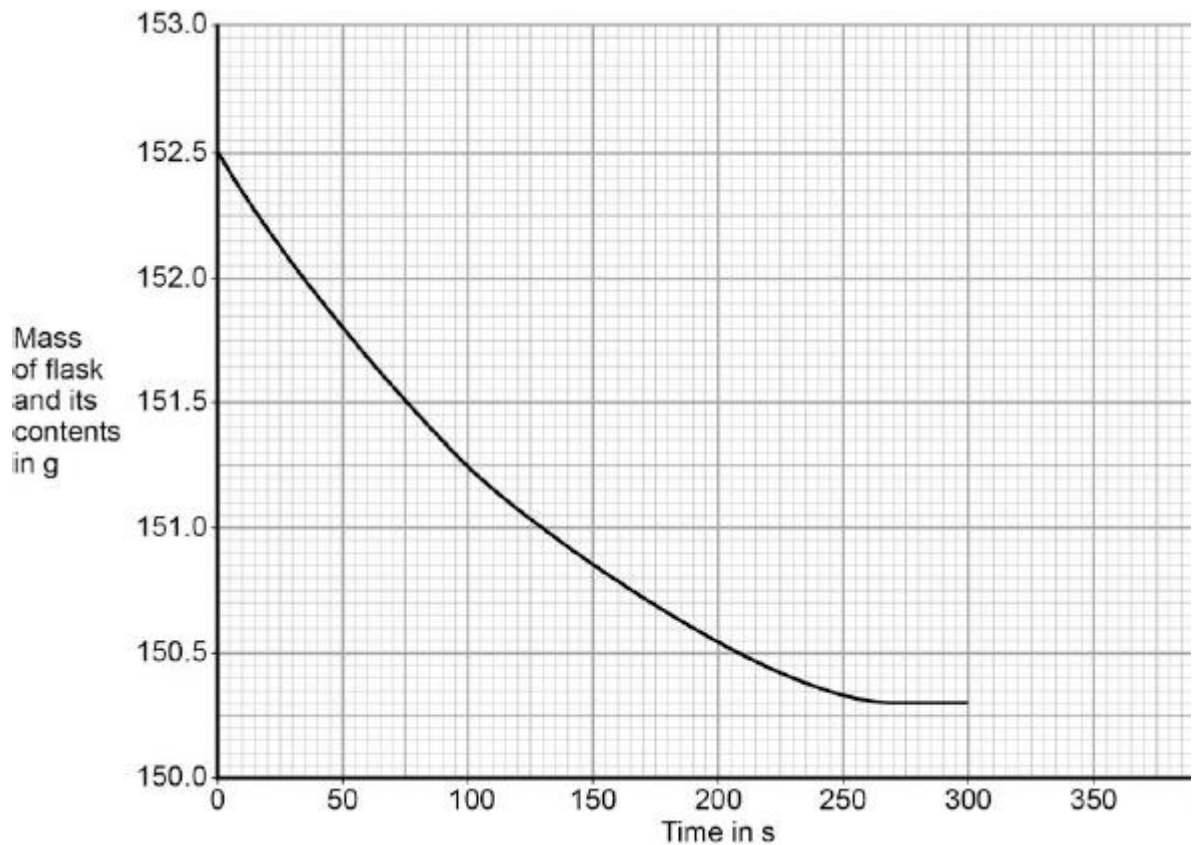
- (d) Explain, in terms of particles, how and why the rate of reaction changes during the reaction of calcium carbonate with hydrochloric acid.

(4)

- (e) Another student investigated the rate of reaction by measuring the change in mass.

Figure 3 shows the graph plotted from this student's results.

Figure 3



Use **Figure 3** to calculate the mean rate of the reaction up to the time the reaction is complete.

Give your answer to three significant figures.

Mean rate of reaction = _____ g / s

(4)

(f) Use **Figure 3** to determine the rate of reaction at 150 seconds.

Show your working on **Figure 3**.

Give your answer in standard form.

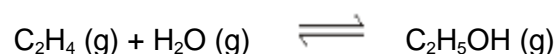
Rate of reaction at 150 s = _____ g / s

(4)
(Total 20 marks)

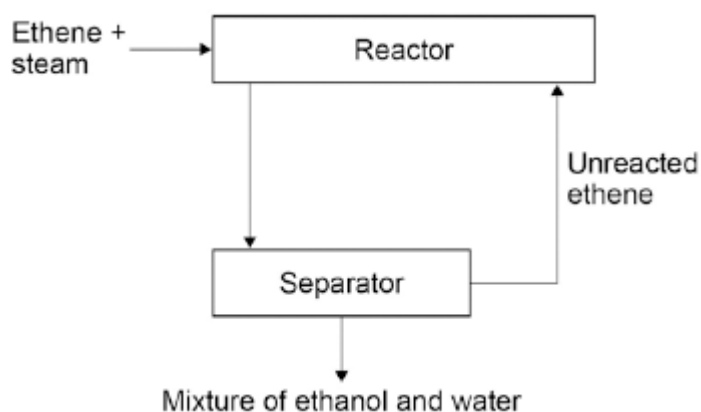
Q13.

In industry ethanol is produced by the reaction of ethene and steam at 300°C and 60 atmospheres pressure using a catalyst.

The equation for the reaction is:



The figure below shows a flow diagram of the process.



(a) Why does the mixture from the separator contain ethanol and water?

(1)

(b) The forward reaction is exothermic.

Use Le Chatelier's Principle to predict the effect of increasing temperature on the amount of ethanol produced at equilibrium.

Give a reason for your prediction.

(2)

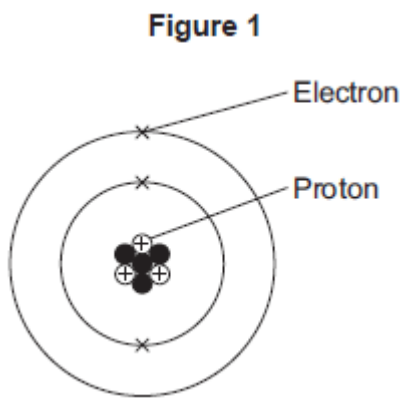
(c) Explain how increasing the pressure of the reactants will affect the amount of ethanol produced at equilibrium.

(2)
(Total 5 marks)

Q14.

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

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



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

Tick (✓) **one** box.

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

(1)

(ii) What is the charge of an electron?

Tick (✓) **one** box.

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

(1)

(iii) Protons are in the nucleus.

Which other sub-atomic particles are in the nucleus?

Tick (✓) **one** box.

ions

molecules

neutrons

(1)

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

Tick (✓) **one** box.

number of neutrons

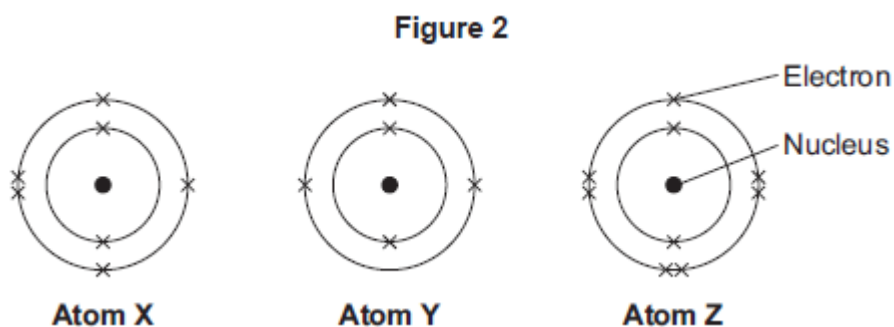
number of protons

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.



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

Tick (✓) **one** box.

Atom X

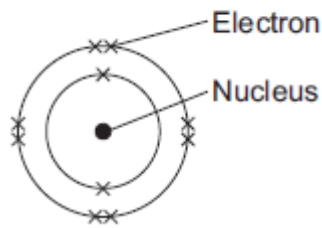
Atom Y

Atom Z

(1)

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

Figure 3



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

(1)

- (ii) Why is this element unreactive?

(1)

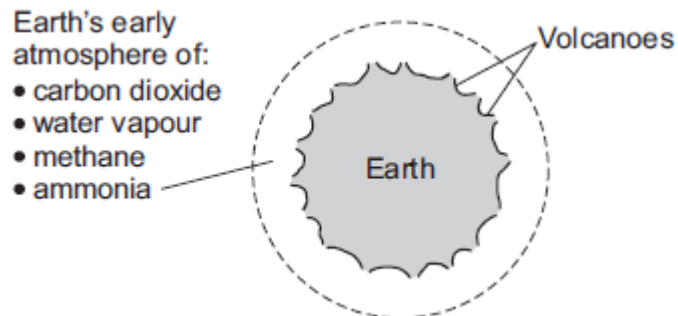
(Total 7 marks)

Q15.

This question is about the Earth and its atmosphere.

- (a) **Figure 1** shows the Earth and its atmosphere billions of years ago.

Figure 1



The boiling point of water is 100 °C.

Suggest **one** reason why there was no liquid water on the Earth's surface billions of years ago.

(1)

- (b) The Earth's atmosphere today contains nitrogen, oxygen, argon, carbon dioxide and other gases.

- (i) Draw **one** line from each substance to a description of the substance.

Substance	Description of the substance
air	compound
carbon dioxide	element
argon	hydrocarbon
	metal
	mixture

(3)

(ii) Which gas in the Earth's atmosphere is used when hydrocarbons burn?

Tick (✓) **one** box.

carbon dioxide

nitrogen

oxygen

(1)

(iii) What percentage of the Earth's atmosphere is nitrogen?

Tick (✓) **one** box.

about 40%

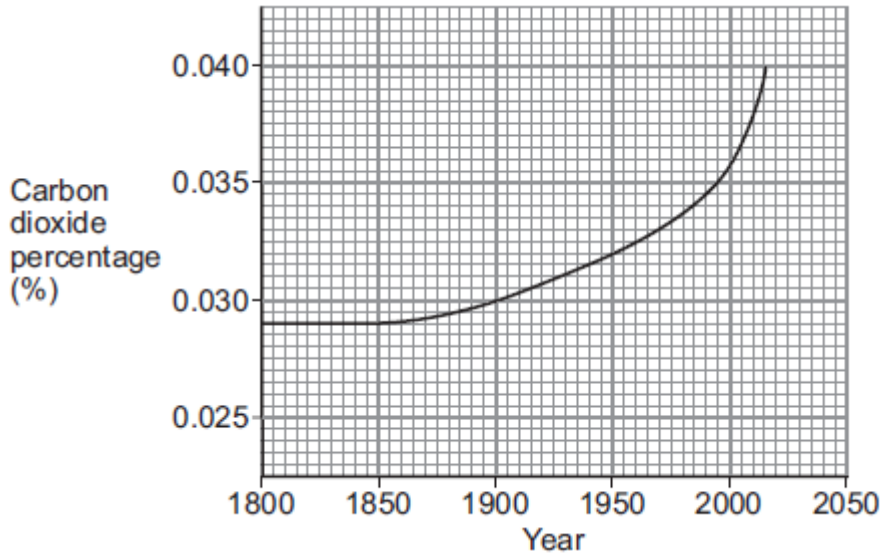
about 60%

about 80%

(1)

(c) **Figure 2** shows the carbon dioxide percentage (%) in the Earth's atmosphere since the year 1800.

Figure 2



(i) What was the carbon dioxide percentage in 1900?

_____ %

(1)

(ii) Describe, in detail, how the carbon dioxide percentage changed from 1900 to 2015.

(2)

(iii) Suggest **two** reasons for the change in the carbon dioxide percentage from 1900 to 2015.

1. _____

2. _____

(2)

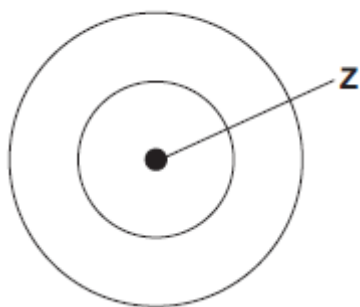
(Total 11 marks)

Q16.

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)

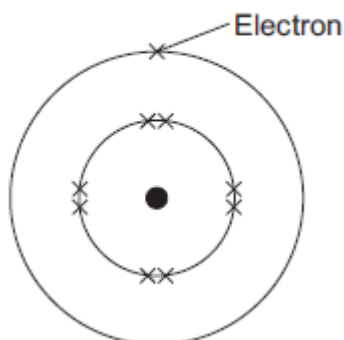
(iii) Name the sub-atomic particles in part **Z** of a boron atom.

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.

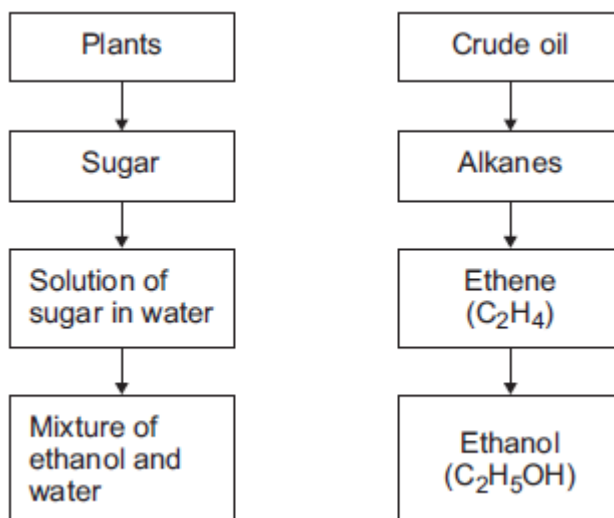
Figure 2



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

Q17.

Ethanol can be made from plants and from crude oil as shown in the diagram below.



- (a) Describe how the solution of sugar in water is used to produce the mixture of ethanol and water.

(2)

- (b) Ethanol has a boiling point of 78 °C.
Water has a boiling point of 100 °C.

Describe how distillation is used to separate a mixture of ethanol and water.

(3)

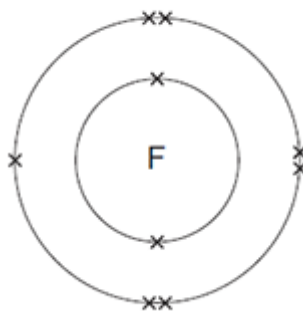
(Total 5 marks)

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
-----	------	----------

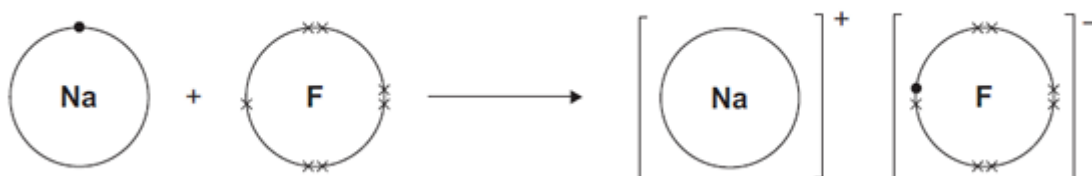
The relative formula mass (M_r), in grams, of sodium fluoride is one _____ of the substance.

(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 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.

(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.

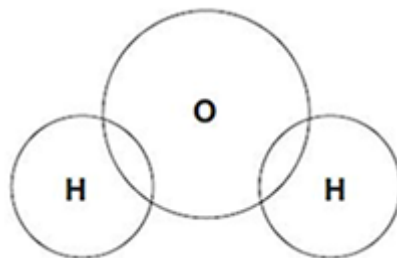
You should refer to the numbers of sub-atomic particles in the nucleus of each isotope.

(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 (×) 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?

(1)

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

(1)

(Total 11 marks)

Q20.

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.

Figure 1

						H													
Li																			
Na																			
K							Fe												
Rb																			

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

_____ (1)

(ii) Complete the sentence.

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

(1)

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

Tick (✓) **one** box.

Lithium (Li)

Sodium (Na)

Potassium (K)

(1)

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

Tick (✓) **two** boxes.

Iron has a higher density than potassium.

Iron is softer than potassium.

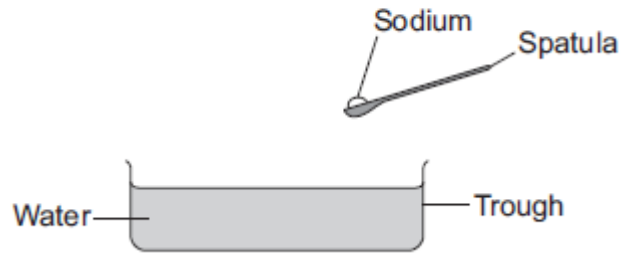
Iron reacts vigorously with water.

Iron forms ions that have different charges.

(2)

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

Figure 2



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

1. _____

2. _____

3. _____

(3)
(Total 11 marks)

Q21.

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.

Li																		F			
Na																		Cl			
K										Cu								Br			
Rb																		I			

- (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)

Q22.

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

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

															V
	W													Z	
X															

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?

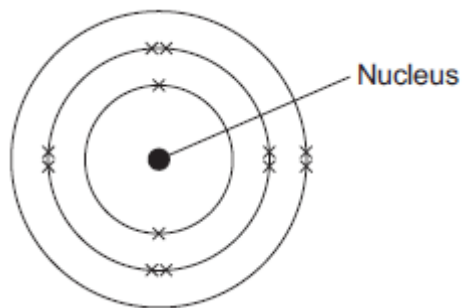
(1)

(Total 5 marks)

Q23.

This question is about magnesium.

(a) (i) The electronic structure of a magnesium atom is shown below.



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

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

The nucleus contains protons and _____

The particles with the smallest relative mass that move around the nucleus are called

Atoms of magnesium are neutral because they contain the same number of electrons and _____

(3)

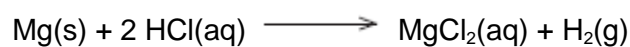
(ii) A magnesium atom reacts to produce a magnesium ion.

Which diagram shows a magnesium ion?

Tick (✓) **one** box.

(1)

(b) Magnesium and dilute hydrochloric acid react to produce magnesium chloride solution and hydrogen.



(i) State **two** observations that could be made during the reaction.

1. _____

2. _____

(2)

- (ii) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Describe a method for making pure crystals of magnesium chloride from magnesium and dilute hydrochloric acid.

In your method you should name the apparatus you will use.

You do **not** need to mention safety.

(6)

(Total 12 marks)

Q24.

This question is about atoms.

Atoms contain electrons, neutrons and protons.

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

Tick (✓) **one** box.

Electron

Neutron

Proton

(1)

(ii) Which of these particles does **not** have an electrical charge?

Tick (✓) **one** box.

Electron

Neutron

Proton

(1)

(b) How are the elements in the periodic table arranged?

Tick (✓) **one** box.

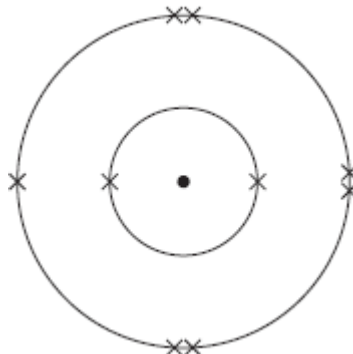
In order of increasing atomic number

In order of increasing mass number

In order of increasing reactivity

(1)

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



(i) How many protons are in an atom of fluorine?

Tick (✓) **one** box.

2

7

9

(1)

(ii) The boiling point of fluorine is $-188\text{ }^{\circ}\text{C}$.

What is the state of fluorine at room temperature?

Tick (✓) **one** box.

Solid

Liquid

Gas

(1)

(d) Fluorine reacts with copper to form an ionic compound.

(i) Explain, in terms of electrons and electronic structure, what happens to a fluorine atom when it reacts with copper.

Use Above **Figure** 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)

Q25.

This question is about metals.

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

Tick (✓) **one** box.

aluminium	<input type="checkbox"/>
gold	<input type="checkbox"/>
magnesium	<input type="checkbox"/>

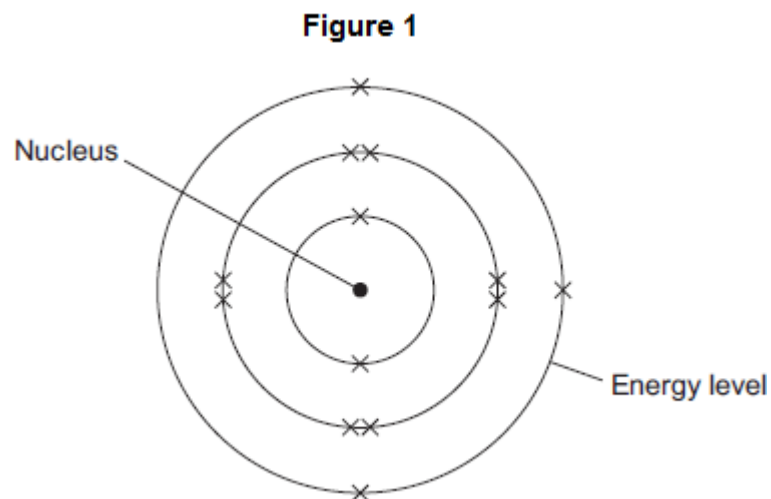
(1)

- (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.

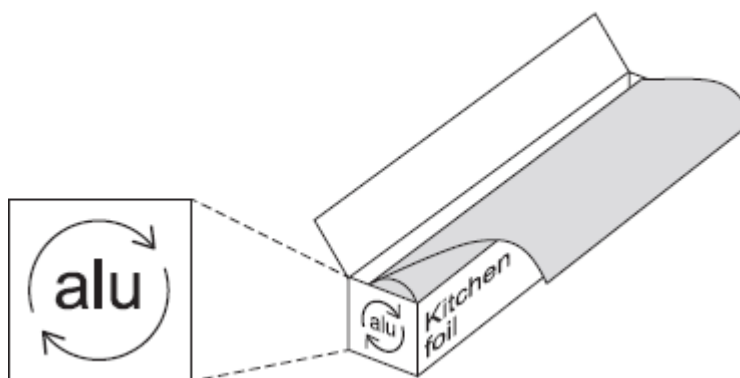
In the periodic table, aluminium is in Group _____ .

(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)

Q26.

Copper is a transition metal.

(a) (i) Where is copper in the periodic table?

Tick (✓) **one** box.

in the central block

in Group 1

in the noble gas group

(1)

(ii) What is a property of copper?

Tick (✓) **one** box.

breaks easily

conducts electricity

does not conduct heat

(1)

(b) Copper ores are quarried by digging large holes in the ground, as shown in **Figure 1**.

Figure 1



© photlurg/iStock/Thinkstock

Give **two** reasons why quarrying is bad for the environment.

(2)

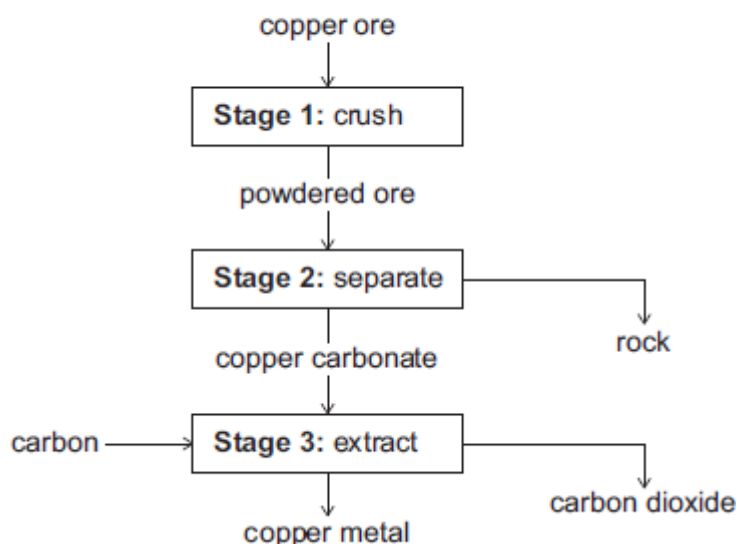
(c) Some copper ores contain only 2% copper.

Most of the ore is rock that is not needed.

In one ore, the main compound is copper carbonate (CuCO_3).

Figure 2 shows the stages used in the extraction of copper from this ore.

Figure 2



(i) Why is **Stage 2** important?

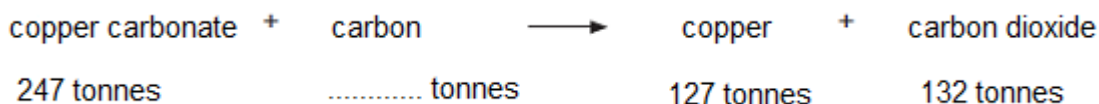
(1)

(ii) The equation for the reaction in **Stage 3** is:



From the symbol equation, a company calculated that 247 tonnes of copper carbonate are needed to produce 127 tonnes of copper and 132 tonnes of carbon dioxide are released.

Calculate the mass of carbon needed to make 127 tonnes of copper.



(2)

(iii) Suggest **one** reason why it is important for the company to calculate the mass of reactants in **Stage 3**.

(1)

(Total 8 marks)

Q27.

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.

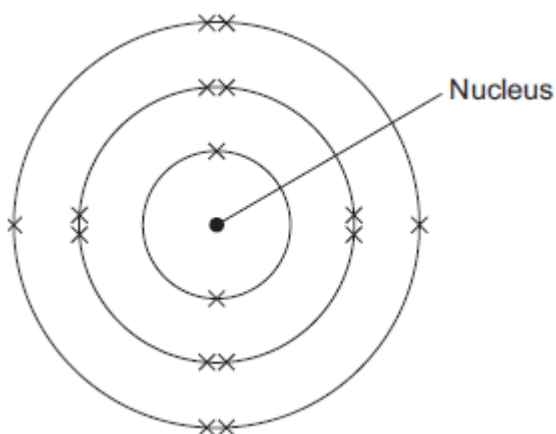
(2)

(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.

(2)

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



What is the chemical symbol of this non-metal?

Tick (✓) **one** box.

Ar

O

S

Si

(1)

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

Complete the sentences.

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

(1)

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

(1)

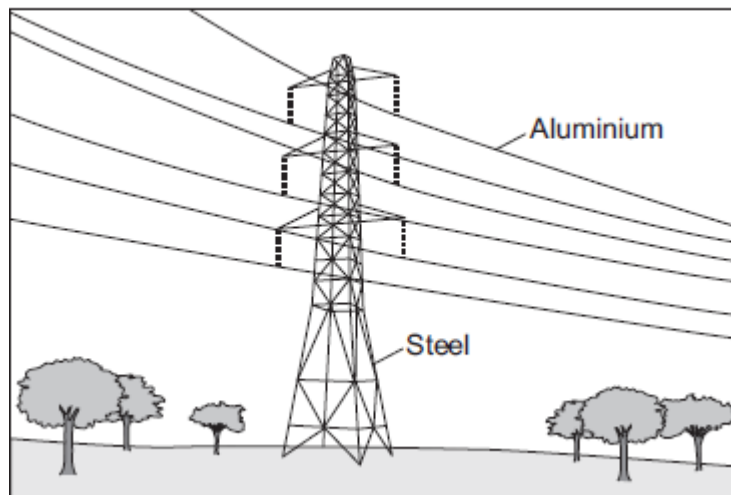
(Total 9 marks)

Q28.

This question is about metals.

Figure 1 shows the metals used to make pylons and the wires of overhead cables.

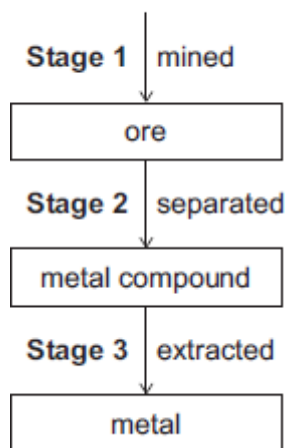
Figure 1



(a) An ore contains a metal compound.

A metal is extracted from its ore in three main stages, as shown in **Figure 2**.

Figure 2



Explain why **Stage 2** needs to be done.

(2)

(b) Cast iron from a blast furnace contains 96% iron and 4% carbon.

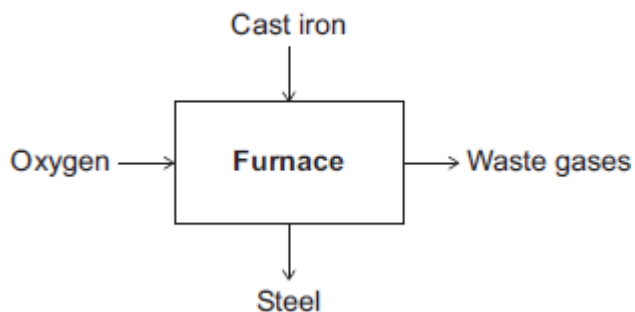
(i) Cast iron is not suitable for the manufacture of pylons.

Give **one** reason why.

(1)

(ii) Most cast iron is converted into steel, as shown in **Figure 3**.

Figure 3



Describe how cast iron is converted into steel.

Use **Figure 3** to help you to answer this question.

(2)

(c) Aluminium and copper are good conductors of electricity.

(i) State **one** property that makes aluminium more suitable than copper for overhead cables.

(1)

(ii) How can you tell that copper is a transition metal and aluminium is **not** a transition metal from the position of each metal in the periodic table?

(2)

(iii) Copper can be extracted from solutions of copper salts by adding iron.

Explain why.

(2)

(Total 10 marks)

Q29.

This question is about carbon and gases in the air.

(a) Carbon atoms have protons, neutrons and electrons.

Complete the table by writing the relative mass of a neutron and an electron.

Name of particle	Relative mass
proton	1
neutron	
electron	

(2)

(b) What is the total number of protons and neutrons in an atom called?

Tick (✓) **one** box.

The atomic number

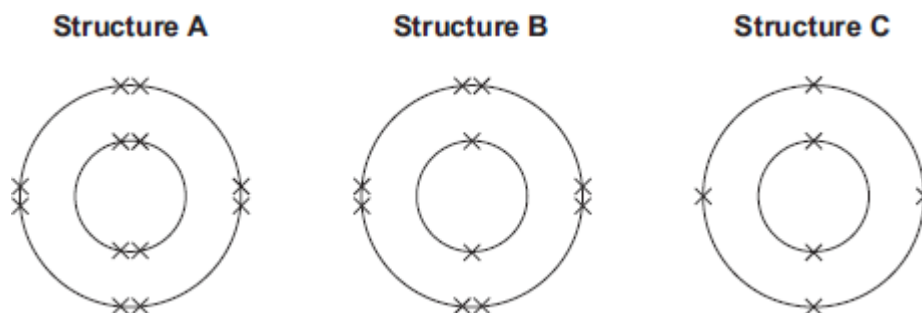
The mass number

One mole of the atom

(1)

(c) An atom of carbon has six electrons.

Which structure, **A**, **B** or **C**, represents the electronic structure of the carbon atom?



The carbon atom is structure

(1)

(d) Carbon reacts with oxygen to produce carbon dioxide (CO₂).

(i) How many different elements are in one molecule of carbon dioxide?

(1)

(ii) What is the total number of atoms in one molecule of carbon dioxide?

(1)

(e) Sometimes carbon reacts with oxygen to produce carbon monoxide (CO).

(i) Calculate the relative formula mass (M_r) of carbon monoxide.

Relative atomic masses (A_r): C = 12; O = 16

M_r of carbon monoxide = _____

(1)

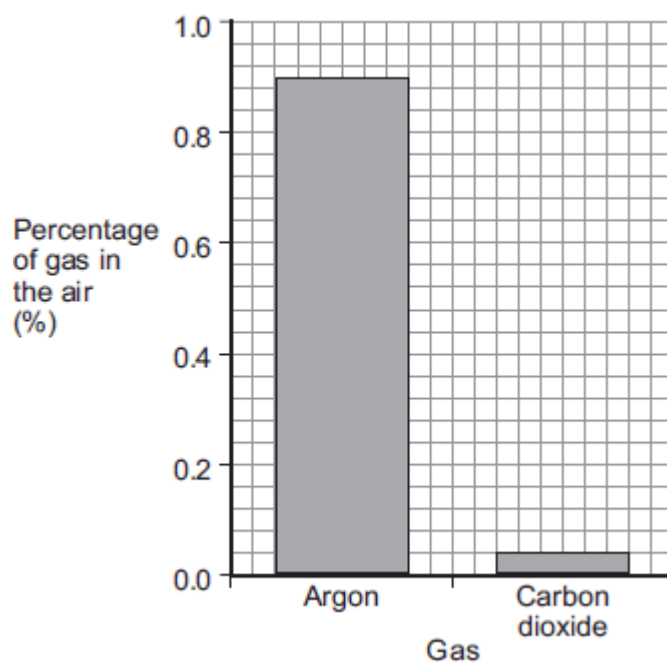
- (ii) Calculate the percentage by mass of carbon in carbon monoxide.

Percentage by mass of carbon in carbon monoxide = _____%

(1)

- (f) Carbon dioxide is one of the gases in the air.

- (i) The graph shows the percentage of argon and the percentage of carbon dioxide in the air.



What is the percentage of argon in the air?

Percentage of argon = _____%

(1)

- (ii) An instrumental method is used to measure the amount of carbon dioxide in the air.

Give **one** reason for using an instrumental method.

(1)

(Total 10 marks)

Q30.

This question is about atoms and isotopes.

- (a) Atoms contain protons, neutrons and electrons.

A lithium atom has the symbol ${}^7_3\text{Li}$

Explain, in terms of sub-atomic particles, why the mass number of this lithium atom is 7.

(3)

(b) Amounts of substances can be described in different ways.

Complete the sentences.

One mole of a substance is the relative formula mass in

The relative atomic mass of an element compares the mass of an atom of an element with the mass of an atom of

(2)

(c) Two isotopes of oxygen are ${}^{18}_8\text{O}$ and ${}^{16}_8\text{O}$

Describe the similarities and differences between the isotopes ${}^{18}_8\text{O}$ and ${}^{16}_8\text{O}$

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

(3)

(Total 8 marks)

Q31.

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

Group 1		2																	
																			He
Na																			

(a) Choose the correct chemical symbol to complete each sentence.

(i) The element that is an alkali metal is _____ .

(1)

(ii) The element that is a transition metal is _____ .

(1)

(iii) The element in Group 4 is _____ .

(1)

(iv) The element with a full outer energy level (shell) of electrons is

_____ .

(1)

(b) Which other element goes in the shaded box?

(1)

(Total 5 marks)

Q32.

In 1866 John Newlands produced an early version of the periodic table.

Part of Newlands' periodic table is shown below.

Column	1	2	3	4	5	6	7
	H	Li	Be	B	C	N	O
	F	Na	Mg	Al	Si	P	S
	Cl	K	Ca	Cr	Ti	Mn	Fe

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)

Q33.

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?

(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.



(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)

Q34.

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

Group	1	2											3	4	5	6	7	0		
	Li														N					
												Al								
	K						Fe				Cu				As				Br	

Choose the correct chemical symbols to complete each sentence.

(a) The **two** metals that react vigorously with water are _____ and _____.

(1)

(b) The element used as a catalyst in the Haber process is _____.

(1)

(c) The **two** elements with five electrons in their outer shell (highest energy level) are _____ and _____.

(1)

(d) Iron has ions with different charges.

The other metal that has ions with different charges is _____ .

(1)

(Total 4 marks)

