AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.1.1 ATOMIC STRUCTURE, SYMBOLS, RELATIVE ATOMIC MASS, CHARGE AND ISOTOPES (PACK 7)

SCORE	PERCENTAGE
/584	%

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Q1.

This question is about the halogens.

(a) Which group in the periodic table is known as the halogens?

Tick **one** box.

Group 1 ☐

Group 2 ☐

Group 7 ☐

Group 0 ☐

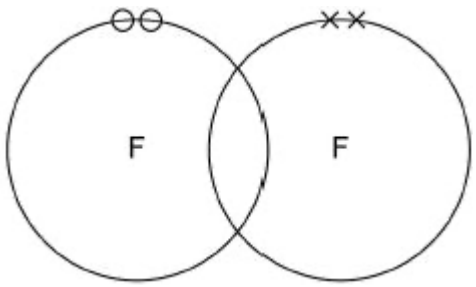
(1)

(b) A fluorine atom has 7 electrons in the outer shell.

The diagram below shows part of a dot and cross diagram to represent a molecule of fluorine (F_2).

Complete the dot and cross diagram.

You should show only the electrons in the outer shells.



(2)

(c) Chlorine reacts with potassium bromide solution.

Complete the word equation.

chlorine + potassium bromide → _____ + _____

(2)

(d) What type of reaction happens when chlorine reacts with potassium bromide solution?

Tick **one** box.

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decomposition ☐

displacement ☐

neutralisation ☐

precipitation ☐

(1)

(e) Complete the sentence.

Choose the answer from the box.

an atom	**an electron**	**a neutron**	**a proton**

Chlorine is more reactive than bromine.

This is because chlorine gains _____ more easily.

(1)

(f) How does the size of a chlorine atom compare with the size of a bromine atom?

Complete the sentence.

Choose the answer from the box.

bigger than	**the same size as**	**smaller than**

A chlorine atom is _____ a bromine atom.

(1)

(g) Give a reason for your answer to part **(f)**

Reason _____

_____

(1)

(h) Fluorine reacts with chlorine to produce ClF_3

Balance the chemical equation for the reaction.

$$Cl_2 + _____F_2 \longrightarrow 2\ ClF_3$$

(1)

(i) Explain why fluorine is a gas at room temperature.

Use the following words in your answer:

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energy **forces** **molecules** **weak**

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 13 marks)

Q2.

This question is about acids and bases.

(a) Which ion is found in all acids?

Tick **one** box.

Cl^- ☐ H^+ ☐ Na^+ ☐ OH^- ☐

(1)

(b) Zinc nitrate can be produced by reacting an acid and a metal oxide.

Name the acid and the metal oxide used to produce zinc nitrate.

Acid _____

Metal oxide _____

(2)

(c) In an equation, zinc nitrate is written as $Zn(NO_3)_2(aq)$.

What does (aq) mean?

Tick **one** box.

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Dissolved in water	☐
Insoluble	☐
Not all reacted	☐
Reactant	☐

(1)

(d) The pH of a solution is 8

Some hydrochloric acid is added to the solution.

Suggest the pH of the solution after mixing.

pH = _____

(1)

(e) **Table 1** shows the solubility of three solids in water at room temperature.

Table 1

Solid	**The mass of the solid that dissolves in 100 cm^3 of water**
Phosphorus oxide	50 g
Silicon dioxide	0 g
Sodium hydroxide	100 g

A teacher labelled these three solids **A**, **B** and **C**.

She gave a student the information shown in **Table 2**

Table 2

Solid	**Observation when added to water**	**pH of the solid in water**
A	colourless solution	14
B	colourless solution	2
C	solid does not dissolve	7

Describe a method that could be used to identify each of the three solids **A**, **B** and **C**.

You must use an indicator in the method.

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Use information in **Table 1** and **Table 2**

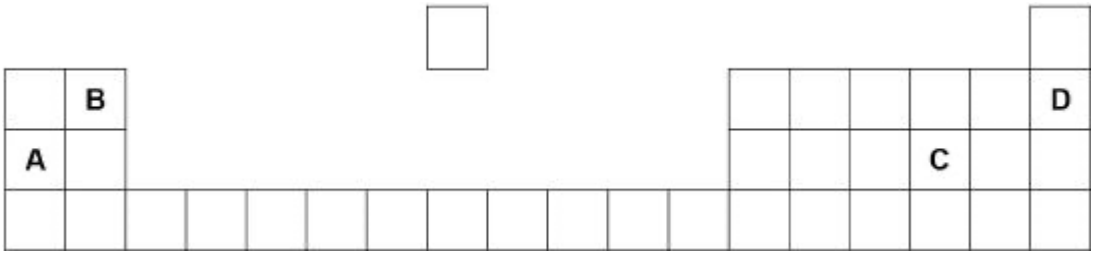
(4)
(Total 9 marks)

Q3.

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

(a) **Figure 1** shows the positions of four elements, **A**, **B**, **C**, and **D**, in the periodic table.

Figure 1



Which element is in Group 2?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

Group 2 metal carbonates break down when heated to produce a metal oxide and a gas.

metal carbonate ⟶ metal oxide + gas

(b) Name the two products when calcium carbonate ($CaCO_3$) is heated.

_____ and _____

(2)

(c) What type of reaction happens when a compound breaks down?

Tick **one** box.

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burning ☐

decomposition ☐

neutralisation ☐

reduction ☐

(1)

(d) The metal carbonate takes in energy from the surroundings to break down.

What type of reaction takes in energy from the surroundings?

Tick **one** box.

combustion ☐

electrolysis ☐

endothermic ☐

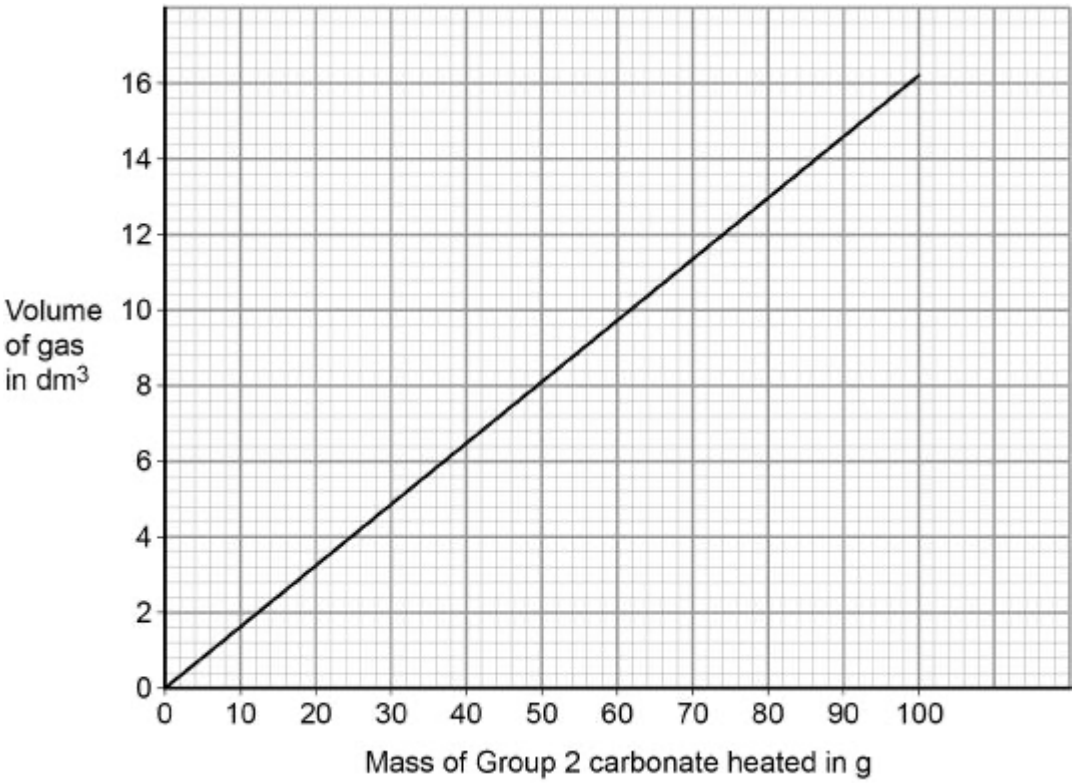
exothermic ☐

(1)

(e) **Figure 2** shows the volume of gas produced when a Group 2 metal carbonate is heated.

Figure 2

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The student collected 5.2 dm^3 of gas.

What mass of the Group 2 metal carbonate is heated?

Mass = _____ g

(1)

(f) Calculate the mass of the Group 2 carbonate needed to produce 24 dm^3 of gas.

Use your answer from part **(e)** to help you.

_____

_____

_____

_____

Mass = _____ g

(2)

(g) A student heated different masses of a Group 2 carbonate. The student measured the volume of gas produced.

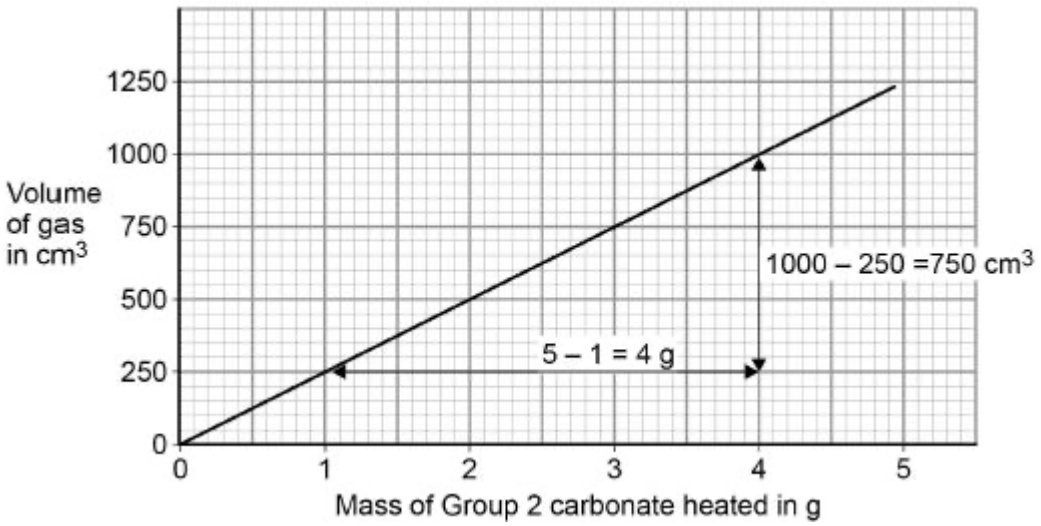
Figure 3 shows a graph of the student's results.

The student calculates the gradient of the line in **Figure 3**

The student makes **two** mistakes.

Figure 3

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$$\text{Correct formula for gradient} = \frac{\text{Increase in volume of gas}}{\text{Increase in mass of Group 2 metal carbonate heated}}$$

$$\text{Student's calculation} = \frac{4}{750} = 0.00533 \text{ cm}^3 \text{ per g}$$

Identify the **two** mistakes the student makes.

Calculate the correct gradient of the line.

Mistake 1 _____

_____

Mistake 2 _____

_____

Calculation _____

_____

Gradient = _____ cm^3 per g

(4)

(h) A student repeated the experiment with a different Group 2 metal carbonate (**X**CO_3).

The relative formula mass (M_r) of **X**CO_3 is 84

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

Calculate the relative atomic mass (A_r) of **X**.

Name metal **X**.

Use the periodic table.

_____

_____

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Relative atomic mass (A_r) = _____

Metal **X** is _____

(4)

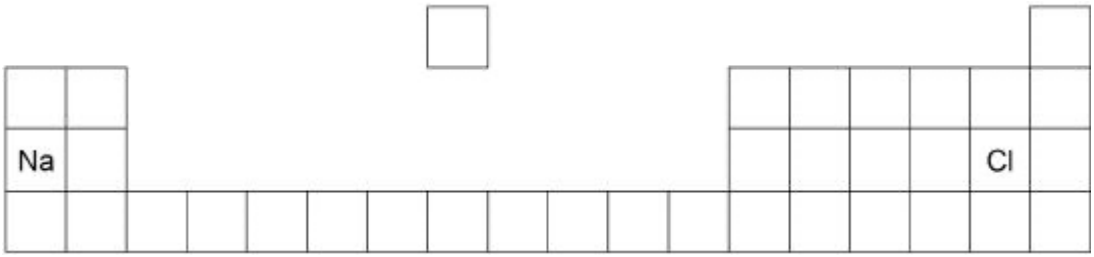
(Total 16 marks)

Q4.

This question is about sodium and chlorine.

Figure 1 shows the positions of sodium and chlorine in the periodic table.

Figure 1



(a) State **one** difference and **one** similarity in the electronic structure of sodium and of chlorine.

Difference _____

_____

Similarity _____

_____

(2)

(b) Sodium atoms react with chlorine atoms to produce sodium chloride (NaCl).

Describe what happens when a sodium atom reacts with a chlorine atom.

Write about electron transfer in your answer.

_____

_____

_____

_____

_____

_____

_____

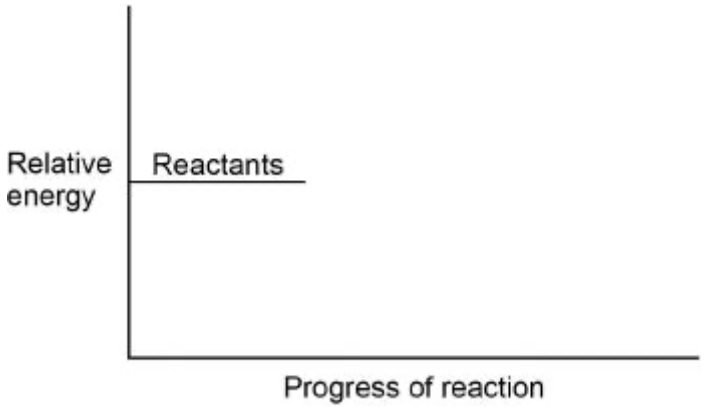
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(4)

(c) The reaction between sodium and chlorine is an exothermic reaction.

Complete the reaction profile for the reaction between sodium and chlorine.

Figure 2



(2)
(Total 8 marks)

Q5.

This question is about the halogens.

(a) Write the state symbol for chlorine at room temperature.

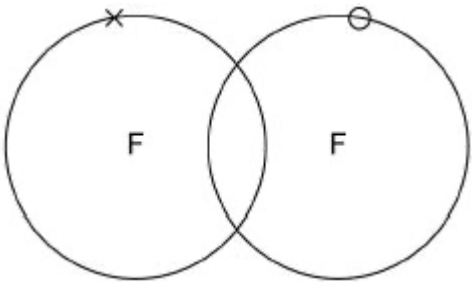
Cl_2 (_____)

(1)

(b) The diagram below represents one molecule of fluorine.

Complete the dot and cross diagram on the diagram above.

You should show only the electrons in the outer shells.



(2)

(c) A fluorine atom can be represented as $^{19}_{9}F$

What is the total number of electrons in a fluorine molecule (F_2)?

Tick **one** box.

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9 ☐ 14 ☐ 18 ☐ 38 ☐

(1)

(d) Aluminium reacts with bromine to produce aluminium bromide.

Complete the balanced chemical equation for this reaction.

_____Al + _____Br_2 ⟶ 2_____

(2)

(e) When chlorine reacts with potassium bromide, chlorine displaces bromine.

$$Cl_2 + 2\ KBr \longrightarrow Br_2 + 2\ KCl$$

Explain why chlorine is more reactive than bromine.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 9 marks)

Q6.

Group 2 metal carbonates thermally decompose to produce a metal oxide and a gas.

(a) Give the formula of each product when calcium carbonate ($CaCO_3$) is heated.

_____ and _____

(2)

(b) The relative formula mass (M_r) of a Group 2 metal carbonate is 197

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

Calculate the relative atomic mass (A_r) of the Group 2 metal in the metal carbonate.

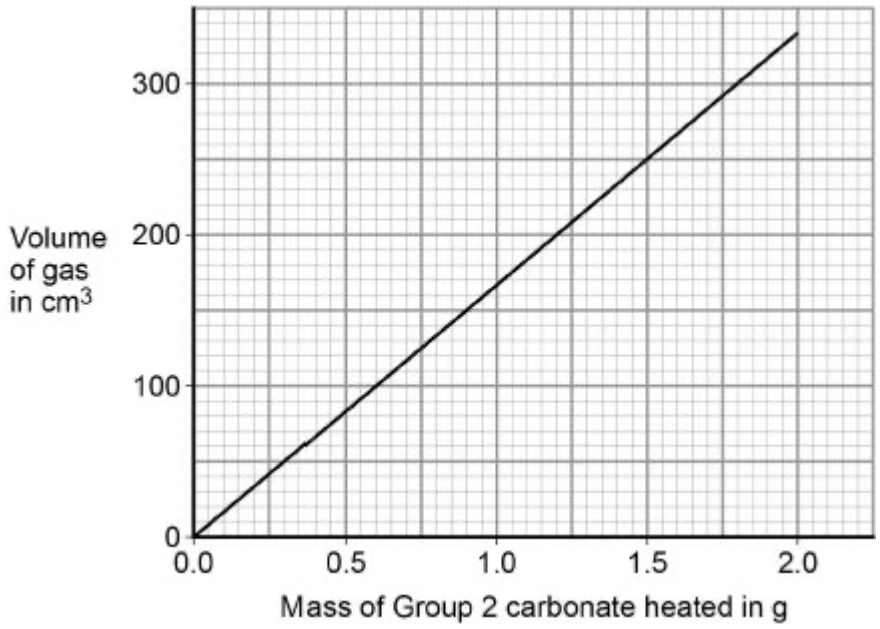
Name the Group 2 metal.

Relative atomic mass (A_r) = _____

Metal _____

(3)

The graph below shows the volume of gas produced when a different Group 2 carbonate, **W**, is heated.



(c) Calculate the gradient of the line in the graph above.

Give the unit.

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Gradient _____

Unit _____

(3)

(d) 24 dm^3 of gas is produced when one mole of a Group 2 carbonate is heated.

Determine the relative formula mass of the Group 2 carbonate **W**.

Use the graph above.

Relative formula mass (M_r) = _____

(4)

(Total 12 marks)

Q7.

This question is about iron.

Iron reacts with dilute hydrochloric acid to produce iron chloride solution and one other product.

(a) Name the other product.

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(1)

(b) Suggest how any unreacted iron can be separated from the mixture.

_____

_____

(1)

Magnesium reacts with iron chloride solution.

$$3\ Mg + 2\ FeCl_3 \longrightarrow 2\ Fe + 3\ MgCl_2$$

(c) 0.120 g of magnesium reacts with excess iron chloride solution.

Relative atomic masses (A_r): Mg = 24 Fe = 56

Calculate the mass of iron produced, in mg

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Mass of iron = _____ mg

(5)

(d) Explain which species is reduced in the reaction between magnesium and iron chloride.

$$3\ Mg + 2\ FeCl_3 \longrightarrow 2\ Fe + 3\ MgCl_2$$

Your answer should include the half equation for the reduction.

_____

_____

_____

_____

_____

STEMUP.CO.UK

_____

_____

_____

(3)

(Total 10 marks)

Q8.

Figure 1 represents an atom of sulfur.

Figure 1

$^{32}_{16}S$

(a) Complete the table below.

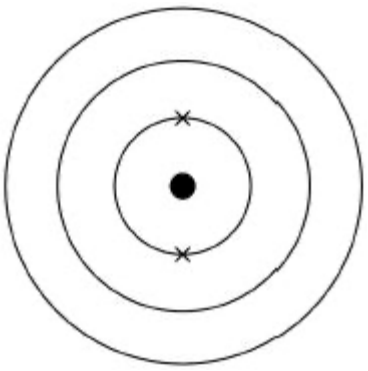
Particle	**Number of particles in a sulfur atom**
Electron	16
Neutron	
Proton	16

(1)

(b) Sulfur is in Group 6 of the periodic table.

Complete the electronic structure of the sulfur atom represented in **Figure 2**

Figure 2



(1)

(c) Sulfur reacts with oxygen to produce sulfur dioxide.

Complete the word equation for this reaction.

sulfur + _____

(1)

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(d) What effect is caused by sulfur dioxide?

Tick **one** box.

Acid rain ☐

Global dimming ☐

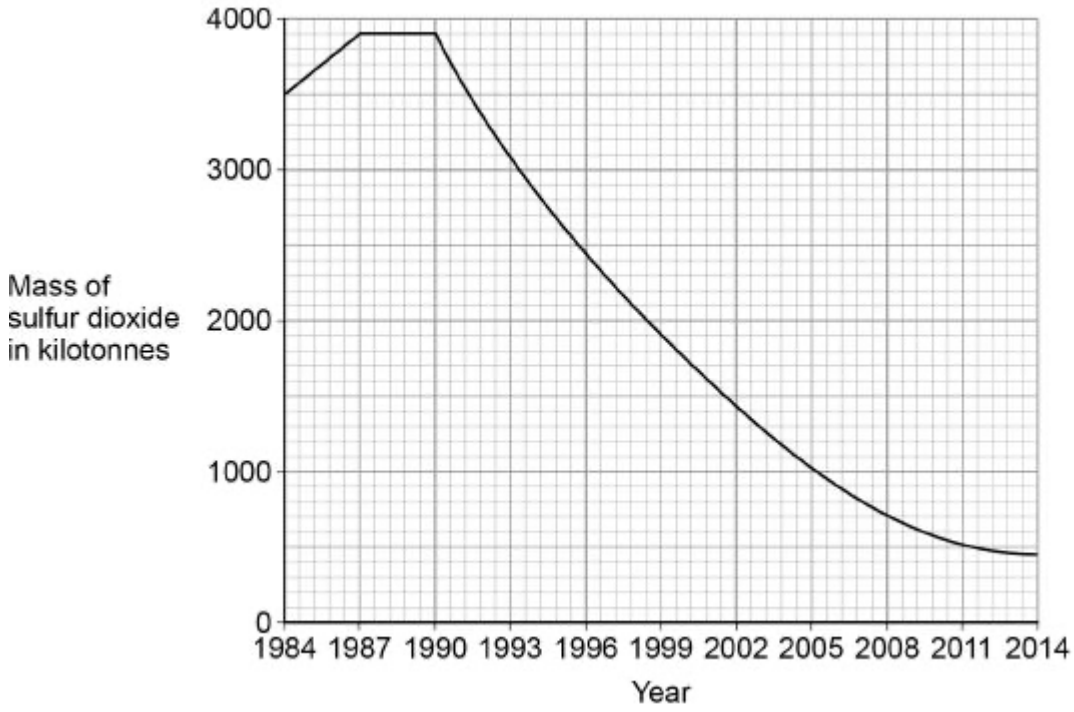
Global warming ☐

Sea levels rising ☐

(1)

(e) **Figure 3** shows the mass of sulfur dioxide in the Earth's atmosphere between 1984 and 2014

Figure 3



A student said:

'the mass of sulfur dioxide in the atmosphere decreased every year between 1984 and 2014'

Is the student correct?

Use data from **Figure 3** to justify your answer.

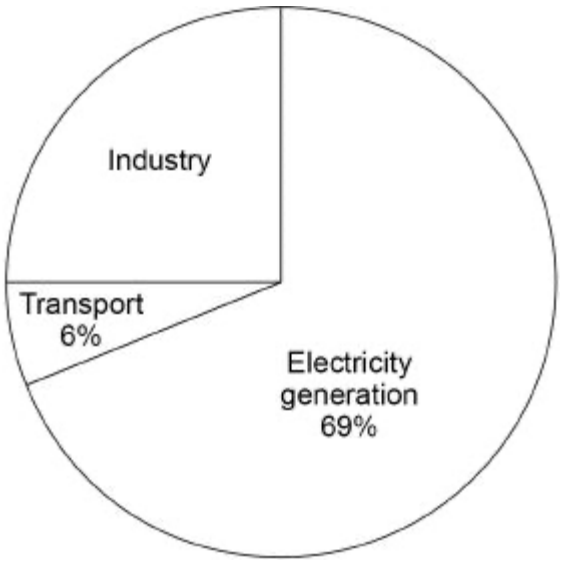
_____

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(3)

(f) **Figure 4** shows the percentage of sulfur dioxide released by human activities.

Figure 4



Calculate the percentage of sulfur dioxide released by industry.

Percentage = _____ %

(2)

(Total 9 marks)

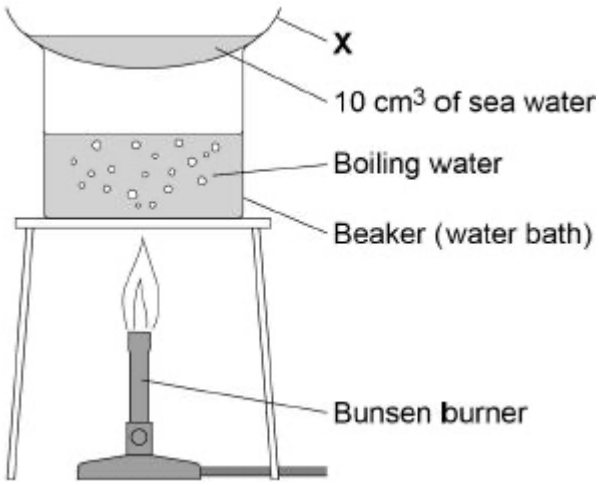
Q9.

A student tested a sea water sample for dissolved solids.

Figure 1 shows the apparatus.

Figure 1

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(a) What is apparatus **X** on **Figure 1**?

Tick **one** box.

Boiling tube ☐

Condenser ☐

Funnel ☐

Watch glass ☐

(1)

(b) The student did the test four times.

The student calculated the mass of solid on apparatus **X** after heating.

The table below shows the student's results.

	Test 1	**Test 2**	**Test 3**	**Test 4**
Mass of solid in grams	0.12	0.29	0.14	0.15

Calculate the mean mass of solid.

Do not include the anomalous result in your calculation.

Give your answer to 2 significant figures.

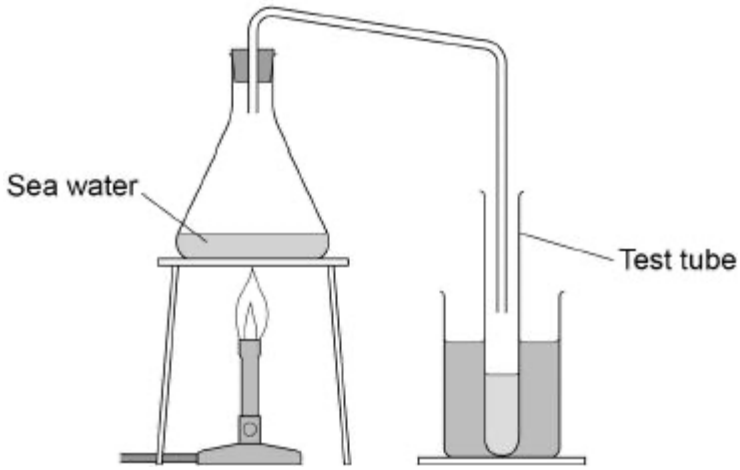
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Mean mass = _____ g

(3)

The student distilled a sample of sea water in the apparatus shown in **Figure 2**

Figure 2



(c) What change of state is happening at the surface of the sea water in **Figure 2**?

_____

(1)

(d) Describe how the water in the test tube in **Figure 2** is different from the sea water.

_____

_____

(1)

(e) Why does producing drinking water from sea water using distillation cost a lot of money?

_____

_____

(1)

(f) River water is filtered then sterilised to make drinking water.

Why are these **two** processes done?

Filtering _____

_____

Sterilising _____

_____

(2)

(Total 9 marks)

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Q10.

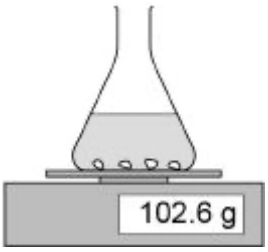
A student investigated the effect of the size of marble chips on the rate of the reaction between marble chips and hydrochloric acid.

This is the method used.

1. Add 10.0 g of marble chips into the flask.
2. Add 50 cm^3 of hydrochloric acid and start a timer.
3. Record the mass lost from the flask every 10 seconds.
4. Repeat steps 1 to 3 with different sizes of marble chips.

Figure 1 shows the apparatus.

Figure 1



(a) Draw **one** line from each type of variable to the correct example of the variable.

Type of variable	Example of variable
	Mass lost from flask
Independent	Size of flask
	Size of marble chips
Control	Time taken
	Volume of acid

(2)

(b) The equation for the reaction is:

$$CaCO_3(s) + 2HCl(aq)\ CaCl_2(aq) + H_2O(l) + CO_2(g)$$

Name the **three** products.

1. _____

2. _____

3. _____

(2)

(c) Another student suggests putting some cotton wool in the top of the flask.

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Suggest why this improves the investigation.

_____

_____

(1)

(d) The reaction produces 1.6 g of gas in 30 seconds.

Calculate the mean rate of the reaction in the first 30 seconds.

Use the equation:

$$\text{mean rate of reaction} = \frac{\text{mass of product produced in grams}}{\text{time in seconds}}$$

_____

_____

Mean rate of reaction = _____

(1)

(e) What is the unit for the mean rate of reaction calculated in part **(d)**?

Tick **one** box.

g ☐ g/s ☐ s ☐ s/g ☐

(1)

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

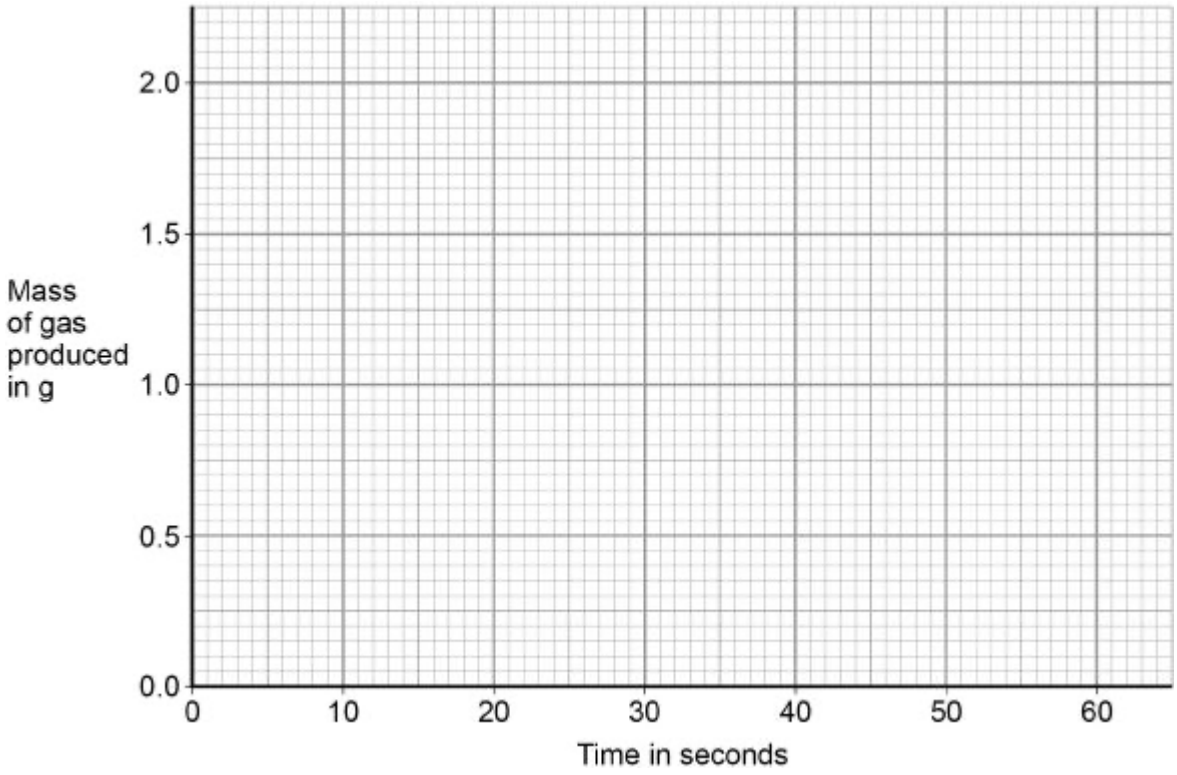
Time in seconds	**Mass of gas produced in g**
0	0.0
10	0.8
20	0.6
30	1.6
40	1.8
50	2.0
60	2.0

Plot the data from the table above on **Figure 2**

Draw a line of best fit.

Figure 2

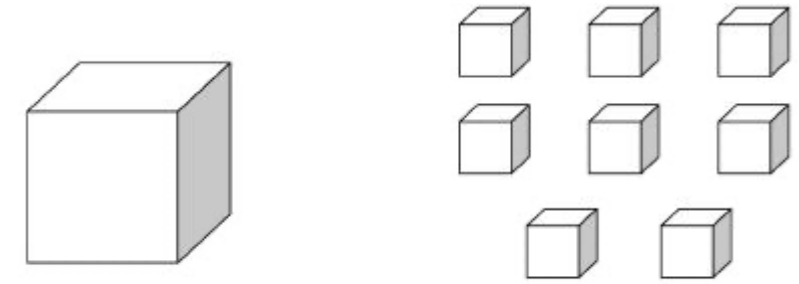
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(3)

(g) **Figure 3** shows a large marble chip and eight small marble chips.

Figure 3



Large marble chip **Eight small marble chips**

The large marble chip has the same total volume as the eight small marble chips, but a different surface area.

Why do the eight small marble chips react faster than the large marble chip?

Tick **one** box.

The eight small marble chips have a larger surface area, so less frequent collisions. ☐

The eight small marble chips have a larger surface area, so more frequent collisions. ☐

The eight small marble chips have a smaller surface area, so less frequent collisions. ☐

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The eight small marble chips have a smaller surface area, so more frequent collisions. ☐

(1)

(Total 11 marks)

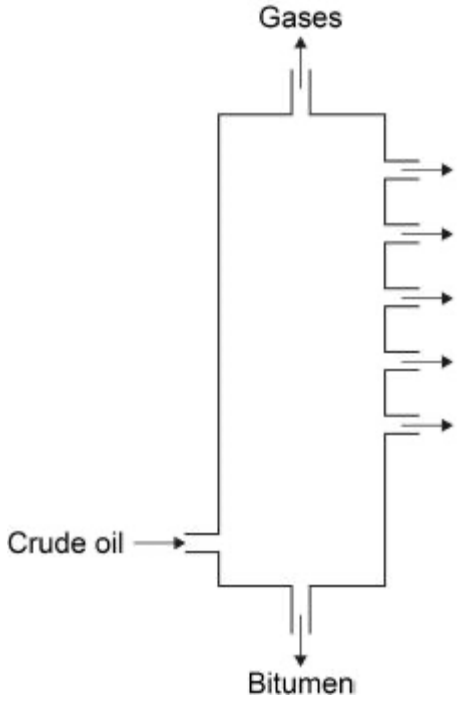
Q11.

Crude oil is a mixture of hydrocarbons.

(a) The hydrocarbons in crude oil are separated into fractions by fractional distillation.

Figure 1 shows a fractional distillation column.

Figure 1



Crude oil vapour passes up the column.

Complete the sentence.

Choose the answer from the box.

condenses	**dissolves**	**freezes**	**melts**

Each fraction _____ at a different level.

(1)

(b) Why do the fractions separate?

Tick **one** box.

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The fractions have different boiling points. ☐

The fractions have different flammability. ☐

The fractions have different melting points. ☐

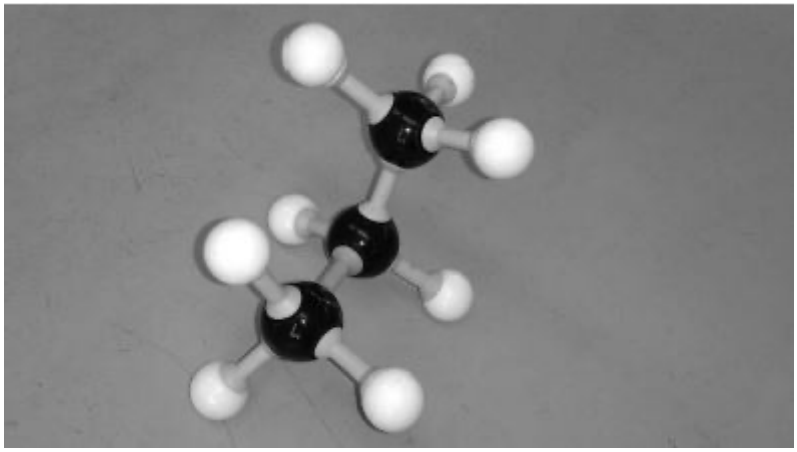
The fractions have different viscosity. ☐

(1)

Most of the hydrocarbons in crude oil are alkanes.

(c) **Figure 2** represents an alkane molecule.

Figure 2



Name the alkane.

_____

(1)

(d) Methane (CH_4) is an alkane.

What is the general formula for alkanes?

Tick **one** box.

C_nH_n ☐

C_nH_{2n} ☐

C_nH_{2n-2} ☐

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C_nH_{2n+2} ☐

(1)

(e) Alkanes burn in oxygen.

Balance the equation for methane burning.

$$_____CH_4 + _____O_2 \rightarrow _____CO_2 + _____H_2O$$

(1)

(f) Ethene is an alkene.

Which reagent is used to test for alkenes?

Tick **one** box.

Anhydrous copper sulfate ☐

Bromine water ☐

Damp litmus paper ☐

Limewater ☐

(1)

The table below shows data from a life cycle assessment (LCA) for the disposal of 10 000 biodegradable plastic bags.

	Burning and using the energy to generate electricity	**Landfill**
Mass of carbon dioxide produced in kg	25	15
Mass of solid residue in kg	0.050	0.070
Mass of sulfur dioxide produced in kg	0.20	0.30

(g) Why are life cycle assessments (LCA) done?

_____

_____

(1)

(h) Compare the **two** methods for the disposal of biodegradable plastic bags.

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Use information from the table above.

(4)

(Total 11 marks)

Q12.

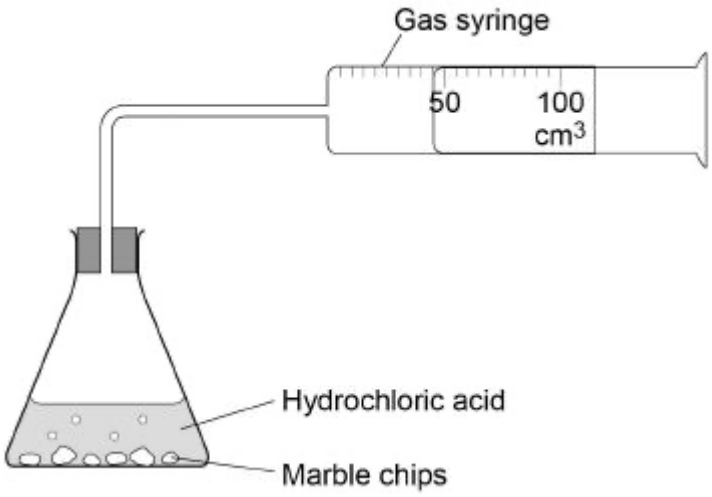
A student investigated the effect of the size of marble chips on the rate of the reaction between marble chips and hydrochloric acid.

This is the method used.

1. Add 10 g of marble chips into the flask.
2. Add 50 cm^3 of hydrochloric acid, connect the gas syringe and start a timer.
3. Record the volume of gas produced every 10 seconds.

Figure 1 shows the apparatus.

Figure 1



(a) Complete the equation for the reaction.

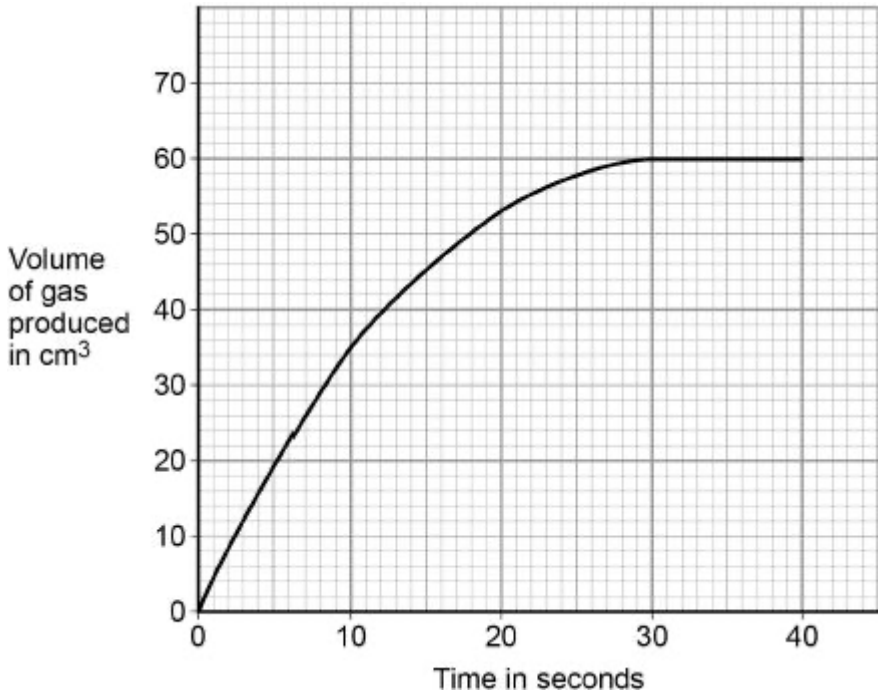
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$CaCO_3$ + _____HCl ⟶ _____

(2)

Figure 2 shows the student's results.

Figure 2



(b) Describe the trend shown in **Figure 2**

Use values in your answer.

_____

_____

_____

_____

_____

_____

(3)

(c) Describe how you would use **Figure 2** to find the rate of the reaction at 15 seconds.

You do **not** need to do a calculation.

_____

_____

_____

_____

(2)

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(d) Give the units for the rate of this reaction.

_____

(1)

The table below shows the results of the investigation.

Relative size of marble chips	**Volume of gas produced in cm^3 after given time in seconds**					
	10 s	**20 s**	**30 s**	**40 s**	**50 s**	**60 s**
Small	35	53	60	60	60	60
Medium	21	39	51	58	60	60
Large	14	29	39	48	58	60

(e) Give **one** conclusion about how the size of the marble chips affects the rate of the reaction.

_____

_____

(1)

(f) Suggest why all three sizes of marble chips produce a maximum volume of 60 cm^3 of gas.

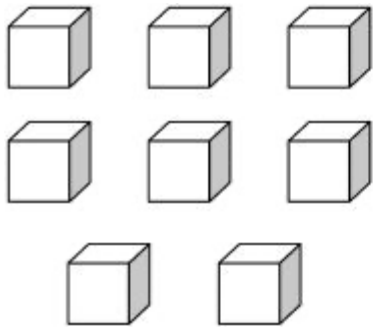
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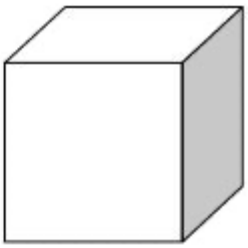
_____

(1)

(g) **Figure 3** shows eight small cubes, each 1 cm × 1 cm × 1 cm, and one large cube, 2 cm × 2 cm × 2 cm

Figure 3





Total volume of small cubes = 8 cm^3

Volume of large cube = 8 cm^3

Total surface area of small cubes = 48 cm^2

Calculate the surface area of the large cube.

_____

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Surface area of the large cube = _____ cm^2

(2)

(h) Explain why the size of the marble chips affects the rate of the reaction.

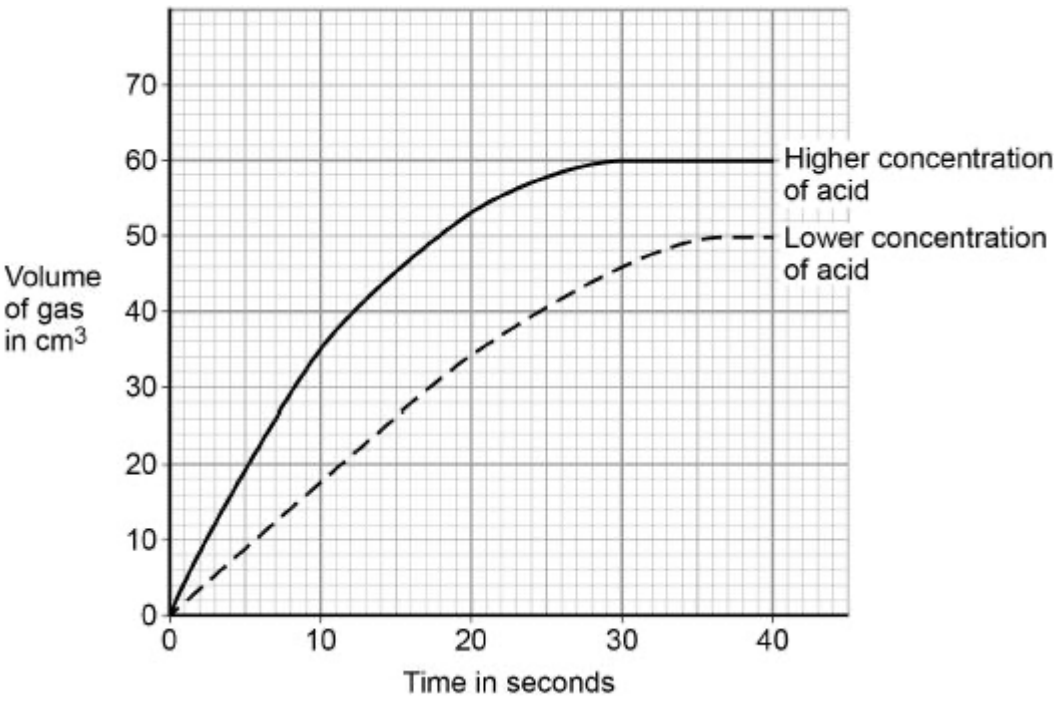
Give your answer in terms of 'collision theory'.

(2)

(i) The student repeated the investigation with small marble chips using hydrochloric acid with a lower concentration.

Figure 4 shows the volume of gas produced during the first 40 seconds.

Figure 4



Explain why the results for the lower concentration of acid are different from the results for the higher concentration of acid.

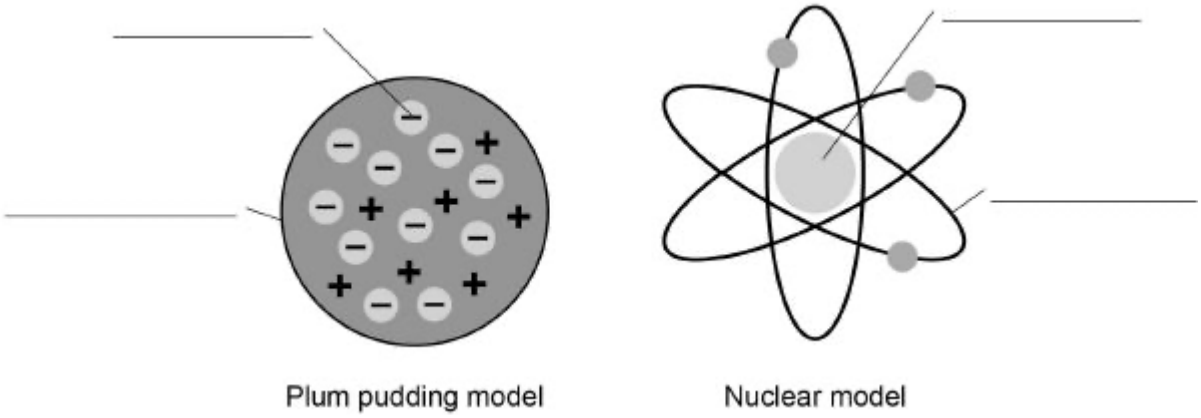
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(3)
(Total 17 marks)

Q13.

Figure 1 shows two models of the atom.

Figure 1



(a) Write the labels on **Figure 1**

Choose the answers from the box.

atom	**electron**	**nucleus**
neutron	**orbit**	**proton**

(4)

(b) Explain why the total positive charge in every atom of an element is always the same.

(2)

(c) The results from the alpha particle scattering experiment led to the nuclear model.

Alpha particles were fired at a thin film of gold at a speed of 7% of the speed of light.

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Determine the speed of the alpha particles.

Speed of light = 300 000 000 m/s

_____

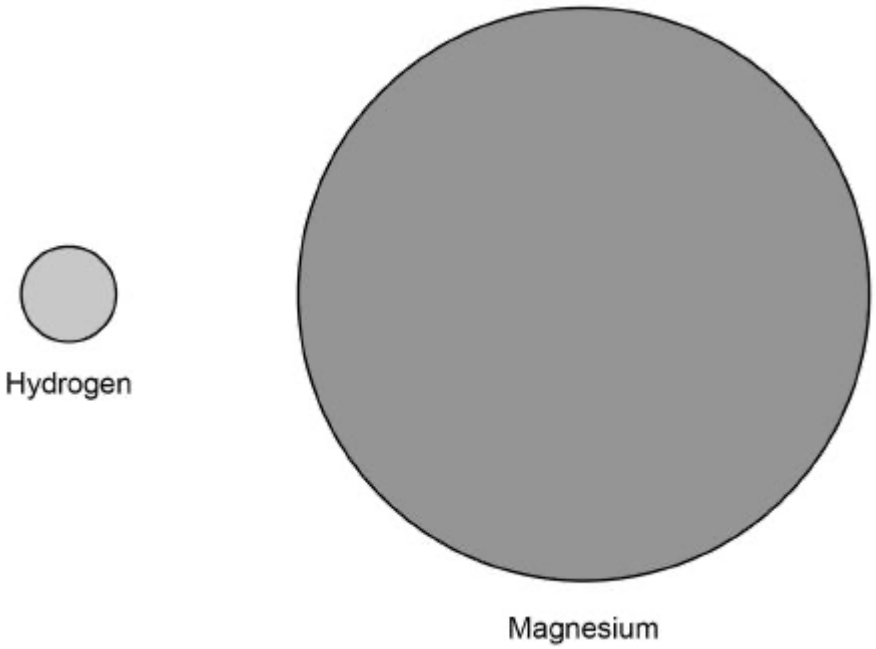
_____

Speed = _____ m/s

(2)

(d) **Figure 2** shows two atoms represented as solid spheres.

Figure 2



A hydrogen atom has a radius of 2.5×10^{-11} m

Determine the radius of a magnesium atom.

Use measurements from **Figure 2**

_____

_____

Radius = _____ m

(2)

(Total 10 marks)

Q14.

The table below shows the relative mass and charge of the particles in an atom.

Name of particle	Relative mass	Charge
proton	1	+1

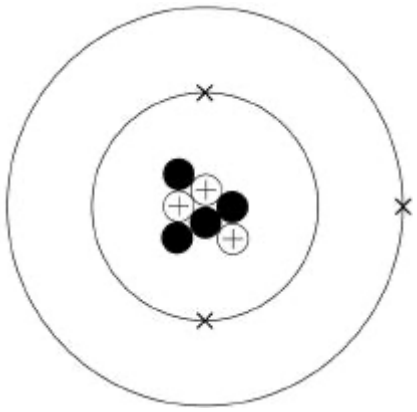
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neutron		
electron	very small	

(a) Complete the table above.

(3)

(b) The diagram below represents a lithium atom.



Give the number of protons, neutrons and electrons in the lithium atom shown in the diagram above.

Number of protons _____

Number of neutrons _____

Number of electrons _____

(3)

(c) Scientific models of the atom have changed over time.

Draw **one** line from each description of the atomic model to the stage in the development of the atomic model.

Description of atomic model	**Stage in the development of the atomic model**
	Dalton atoms
A ball of positive charge with electrons embedded in it	
	Neutrons discovered
	Nucleus of atoms discovered
Spherical atoms	
	Plum pudding model

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(2)
(Total 8 marks)

Q15.

An argon atom can be represented as $^{40}_{18}Ar$

(a) What does the number 40 represent in $^{40}_{18}Ar$?

_____

_____

(1)

(b) How many protons does this atom of argon have?

Tick **one** box.

18 ☐

22 ☐

40 ☐

58 ☐

(1)

(c) How many neutrons does this atom of argon have?

Tick **one** box.

18 ☐

22 ☐

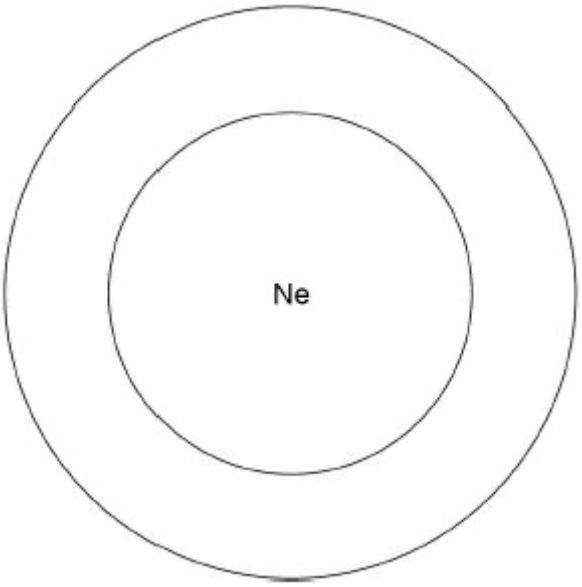
40 ☐

58 ☐

(1)

The diagram below shows the energy levels (shells) in a neon atom.

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(d) A neon atom has 10 electrons.

Complete the diagram above to show the electronic structure of a neon atom.

Use **x** to represent an electron.

(1)

(e) The nucleus of a neon atom has a charge.

What is the charge?

Tick **one** box.

Negative ☐

Neutral ☐

Positive ☐

(1)

(f) A neon atom has 10 protons, 10 electrons and 10 neutrons.

Explain why there is no overall charge on a neon atom.

_____

_____

_____

_____

(2)

(g) There are two different types of neon atom.

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What are these different types of atom called?

Tick **one** box.

Compounds ☐

Ions ☐

Isotopes ☐

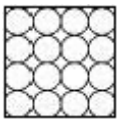
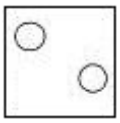
Molecules ☐

(1)

(h) Neon is a gas.

The states of matter can be shown by a simple particle model.

Draw **one** line from each state of matter to the correct particle model.

State of matter	**Particle model**
Gas	
Liquid	
Solid	

(2)

(Total 10 marks)

Q16.

Neon is an element. Neon is used in advertising signs.

Figure 1 shows a neon sign.

Figure 1

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(a) Explain why the atoms of neon give out electromagnetic radiation when the tube is connected to an electricity supply.

(4)

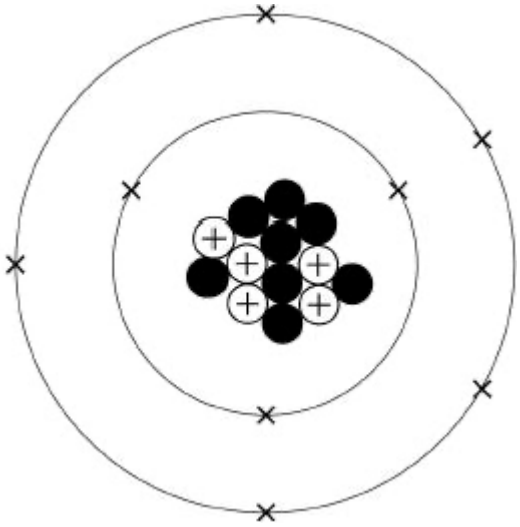
Some elements can have different isotopes.

(b) An isotope of carbon can be shown as $^{13}_{6}C$

Figure 2 shows an **incorrect** diagram of the structure of an atom of $^{13}_{6}C$

Figure 2

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Explain why the diagram of the atomic structure shown in **Figure 2** is incorrect.

Give a reason for your answer.

(4)

Carbon-14 ($^{14}_{6}C$) is a radioactive isotope of carbon. Carbon-14 undergoes **beta** decay.

Figure 3 shows an incomplete nuclear equation for the radioactive decay of carbon-14.

Figure 3

$$^{14}_{6}C \longrightarrow {}^{14}_{7}N + ____$$

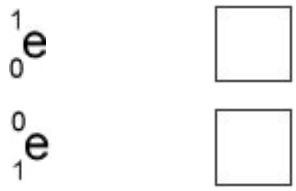
(c) Which of the following correctly completes the nuclear equation in **Figure 3**?

Tick **one** box.

$^{0}_{-1}e$ ☐

$^{-1}_{0}e$ ☐

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(1)

(d) Explain the change in atomic number in the nuclear equation shown in **Figure 3**.

_____

_____

_____

_____

(2)

(e) The half-life of carbon-14 is 5730 years.

Carbon-14 is used for carbon dating. Carbon dating can tell us how old some objects are.

A skeleton was carbon dated. The results showed that there was only 12.5% of the original amount of carbon-14 left in the skeleton.

Calculate the age of the skeleton.

_____

_____

_____

_____

Age of skeleton = _____ years old

(2)

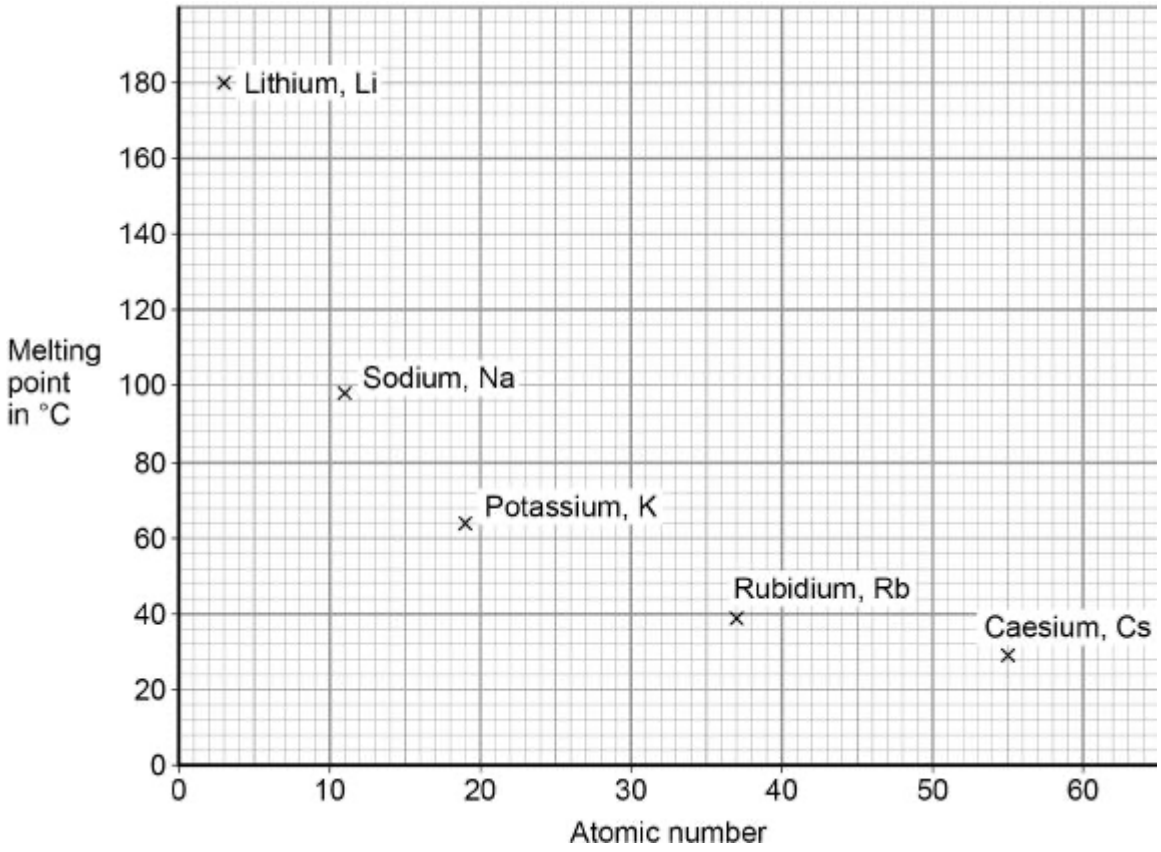
(Total 13 marks)

Q17.

This question is about Group 1 metals.

The graph below shows the melting points of Group 1 metals plotted against their atomic number.

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(a) Describe the trend shown by the melting points of Group 1 metals as the atomic number increases.

_____

_____

(1)

(b) Determine the atomic number and melting point of caesium.

Use the graph above.

Atomic number of caesium = _____

Melting point of caesium = _____ °C

(1)

Lithium is a Group 1 metal.

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

How many electrons does the **outer shell** of a lithium atom contain?

Tick **one** box.

1 ☐

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3 ☐

4 ☐

7 ☐

(1)

(d) Lithium reacts with oxygen to produce lithium oxide.

Draw **one** line from each substance to the correct description of the substance.

Substance	Description
	compound
Lithium oxide	element
	metal
Oxygen	mixture
	polymer

(2)

(e) Balance the equation for the reaction of lithium with oxygen.

$$____ Li + O_2 \longrightarrow 2Li_2O$$

(1)

(f) What type of bonding is present in lithium oxide?

Tick **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

(1)

(g) Calculate the relative formula mass (M_r) of lithium oxide (Li_2O).

Relative atomic masses (A_r): Li = 7 O = 16

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_____

_____

_____

Relative formula mass = _____

(2)

(Total 9 marks)

Q18.

A teacher demonstrated the temperature change when hydrochloric acid is added to sodium hydroxide.

This is the method used.

1. Add 25.0 cm^3 of sodium hydroxide solution to a polystyrene cup.
2. Measure the temperature of the sodium hydroxide solution.
3. Add 25.0 cm^3 of hydrochloric acid to the sodium hydroxide solution.
4. Stir the solution.
5. Measure the maximum temperature of the solution.

(a) Draw **one** line from each measurement to the most suitable piece of equipment to use to make the measurement.

Measurement	Equipment
	balance
Temperature of solution	beaker
	measuring cylinder
Volume of hydrochloric acid	metre rule
	thermometer

(2)

(b) The teacher did the experiment four times.

The table below shows the teacher's results.

Experiment	Maximum temperature rise in °C
1	6.1

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2	7.8
3	6.1
4	6.4

Calculate the mean maximum temperature rise.

Do **not** use the anomalous result in your calculation.

_____

_____

_____

_____

Mean maximum temperature rise = _____ °C

(2)

(c) How could the accuracy of the experiment be improved?

Tick **one** box.

Add 20.0 cm^3 of hydrochloric acid ☐

Use a lid on the polystyrene cup ☐

Use a metal beaker ☐

Use a thermometer with a resolution of 1 °C ☐

(1)

The reaction between hydrochloric acid and sodium hydroxide is a neutralisation reaction.

The reaction produces a salt and one other product.

(d) Complete the word equation for the reaction.

hydrochloric acid + sodium hydroxide ⟶ _____ + _____

(2)

(e) Universal indicator is used to measure the pH of solutions.

Hydrochloric acid is pH 1

Sodium hydroxide is pH 13

Draw **one** line from the pH to the colour of universal indicator in a solution with that pH.

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pH	Colour of universal indicator
	green
1	orange
	purple
13	red
	yellow

(2)

(Total 9 marks)

Q19.

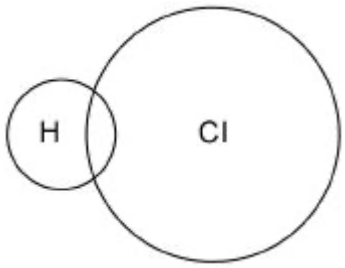
This question is about hydrogen chloride.

(a) A hydrogen atom contains 1 electron and a chlorine atom contains 17 electrons.

Complete **Figure 1** to show a dot and cross diagram for a hydrogen chloride molecule.

Show the outer electrons only.

Figure 1



(2)

Hydrogen gas (H_2) reacts with chlorine gas to produce hydrogen chloride.

(b) Complete the balanced chemical equation for the reaction between hydrogen and chlorine.

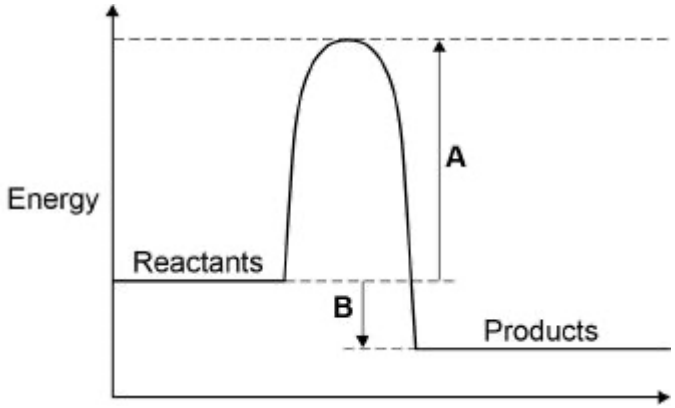
$$H_2 + _____ \rightarrow _____$$

(2)

Figure 2 shows the reaction profile diagram for the reaction between hydrogen and chlorine.

Figure 2

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(c) What do **A** and **B** represent on **Figure 2**?

A _____

B _____

(2)

(d) How does the reaction profile diagram show that the reaction is exothermic?

_____

_____

(1)

(e) Hydrogen chloride gas dissolves in water to form hydrochloric acid.

Hydrochloric acid contains hydrogen ions and chloride ions.

Explain why hydrogen chloride gas does not conduct electricity but hydrochloric acid is able to conduct electricity.

_____

_____

_____

_____

_____

_____

(3)

(Total 10 marks)

Q20.

A teacher demonstrated the extraction of copper from copper oxide.

This is the method used.

1. Mix 1.30 g of zinc and 1.59 g of copper oxide.
2. Heat the mixture strongly.

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3. When the mixture starts to glow, stop heating.
4. Let the glow spread through the mixture.
5. Leave the mixture to cool.
6. Add hydrochloric acid to the cooled mixture.
7. Filter the mixture obtained in step 6.

(a) A student concluded that an exothermic reaction had taken place.

Explain how an observation made during the demonstration shows this.

(2)

(b) The equation for the reaction between zinc and copper oxide is:

$$Zn + CuO \longrightarrow ZnO + Cu$$

1.59 g of copper oxide reacted.

Calculate the mass of copper produced.

Relative atomic masses (A_r): Cu = 63.5 O = 16 Zn = 65

Mass of copper produced = _____ g

(3)

(c) Explain why steps 6 and 7 result in only copper being obtained as the residue.

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(4)

(d) The ionic equation for the reaction is:

$$Zn + Cu^{2+} \longrightarrow Zn^{2+} + Cu$$

Which statement about the reaction between zinc and copper ions is correct?

Tick **one** box.

- Copper ions have been oxidised because the copper ions have gained electrons. ☐
- Copper ions have been oxidised because the copper ions have lost electrons. ☐
- Zinc has been oxidised because the zinc atoms have gained electrons. ☐
- Zinc has been oxidised because the zinc atoms have lost electrons. ☐

(1)

(Total 10 marks)

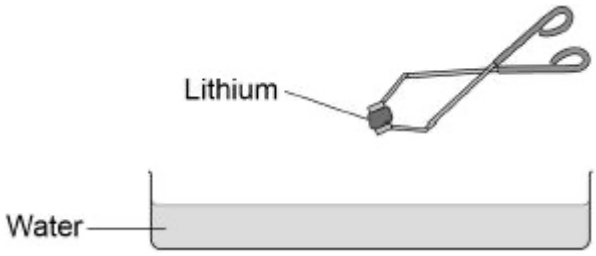
Q21.

This question is about Group 1 elements.

A teacher demonstrated the reaction of Group 1 elements with water.

Figure 1 shows the apparatus.

Figure 1



(a) What name is given to Group 1 elements?

Tick **one** box.

- Alkali metals ☐
- Halogens ☐
- Noble gases ☐

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Non-metals ☐

(1)

(b) The teacher wore safety glasses and used tongs to handle the elements.

Suggest **one** other safety precaution the teacher should take.

_____

_____

(1)

Table 1 shows the teacher's results.

Table 1

Element	**Observations**
Lithium	• bubbles form • lithium moves slowly on surface
Sodium	• bubbles form • sodium moves quickly on surface • sodium melts to form a ball
Potassium	• bubbles form • potassium moves very quickly on surface • potassium melts to form a ball • a lilac flame is seen

(c) Describe the trend in reactivity in Group 1.

Give **two** observations from **Table 1** which provide evidence for the trend.

_____

_____

_____

_____

_____

_____

(3)

(d) Rubidium is a Group 1 element.

Rubidium is below potassium in the periodic table.

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Suggest why the teacher did **not** demonstrate the reaction between rubidium and water.

_____

_____

(1)

(e) Complete the balanced equation for the reaction between sodium and water.

_____ Na + _____ H_2O ⟶ _____ NaOH + H_2

(1)

(f) What is the name of the compound with the formula NaOH?

Tick **one** box.

- Sodium dioxide ☐
- Sodium hydrate ☐
- Sodium hydroxide ☐
- Sodium oxide ☐

(1)

Table 2 shows the diameter of atoms of Group 1 elements.

Element	**Diameter of atom in nanometres**
Lithium	0.304
Sodium	0.372
Potassium	**X**
Rubidium	0.496
Caesium	0.530

(g) Predict value **X** in **Table 2**.

X = _____ nanometres

(1)

(h) 1 nanometre is 10^{-9} metres.

What is the diameter of a lithium atom in metres?

Tick **one** box.

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3.04×10^{-8} m ☐

3.04×10^{-9} m ☐

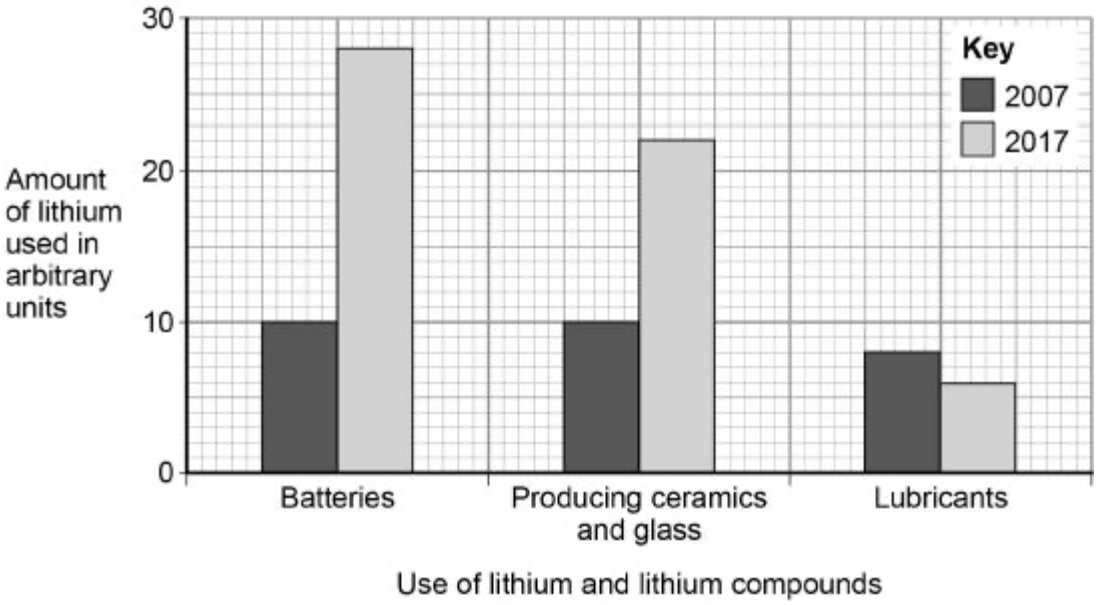
3.04×10^{-10} m ☐

3.04×10^{-11} m ☐

(1)

Figure 2 shows the use of lithium and lithium compounds in 2007 and 2017.

Figure 2



(i) Describe how the use of lithium and lithium compounds changed between 2007 and 2017.

You must include data from **Figure 2** in your answer.

_____

_____

_____

_____

_____

_____

(3)

(Total 13 marks)

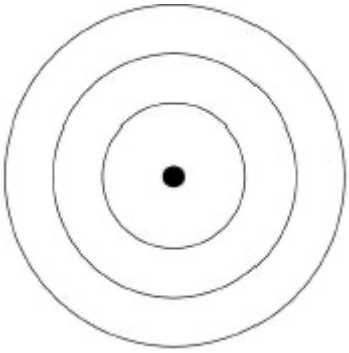
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Q22.

This question is about Group 1 elements.

(a) A sodium atom is represented as $^{23}_{11}Na$

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



(1)

A teacher demonstrated the reaction between lithium and water.

The teacher repeated the demonstration using sodium and then potassium with water.

(b) The teacher wore eye protection.

Suggest **two** other safety precautions the teacher should take.

1. _____

_____

2. _____

_____

(2)

(c) Universal indicator is added to the solution formed in the reaction between potassium and water. The universal indicator becomes purple in colour.

Which ion causes universal indicator to turn purple?

Tick **one** box.

H^+ ☐

K^+ ☐

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OH^- ☐

O^{2-} ☐

(1)

(d) The table below gives the diameter of atoms of Group 1 elements.

Element	**Diameter of atom in nm**
Lithium	0.304
Sodium	0.372
Potassium	0.454
Rubidium	0.496
Caesium	0.530

Explain how the diameter of the atom affects the reactivity of Group 1 elements.

(4)

(Total 8 marks)

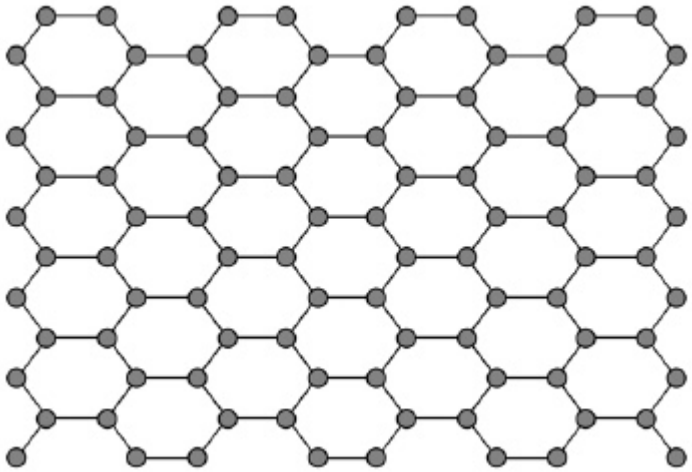
Q23.

This question is about structure and bonding.

(a) **Figure 1** shows part of one layer of graphene.

Figure 1

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Which element is graphene made from?

Tick **one** box.

Carbon ☐

Copper ☐

Hydrogen ☐

Sodium ☐

(1)

(b) Each atom in graphene has one delocalised electron.

Complete the sentence.

Choose the answer from the box.

act as a lubricant	**be used as a fuel**
conduct electricity	**dissolve in water**

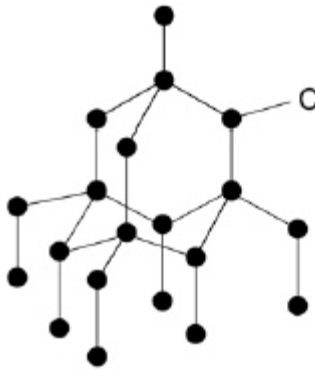
Delocalised electrons allow graphene to _____ .

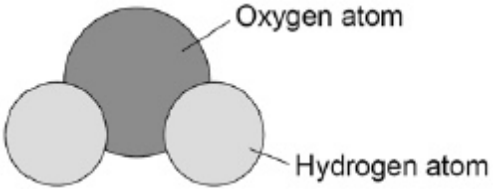
(1)

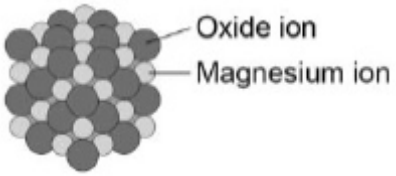
(c) Which structure is a fullerene?

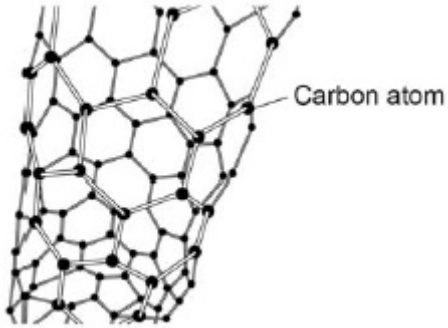
Tick **one** box.

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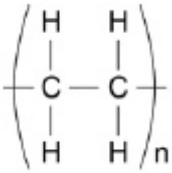




(1)

Figure 2 shows part of a large hydrocarbon molecule.

Figure 2



(d) Which **two** elements are in all hydrocarbons?

1. _____

2. _____

(2)

(e) Complete the sentence.

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Choose the answer from the box.

an atom	a metal	a polymer	a salt

The large molecule represented in **Figure 2** is _____ .

(1)

(f) Complete the sentence.

Choose the answer from the box.

attract	bond	slide	vibrate

Metals can be stretched into wires

because the layers of atoms can _____ .

(1)

(Total 7 marks)

Q24.

This question is about electrolysis.

(a) How many different elements are in the formula $AgNO_3$?

Tick **one** box.

2 ☐ 3 ☐ 5 ☐ 6 ☐

(1)

(b) How many atoms are in the formula $AgNO_3$?

Tick **one** box.

2 ☐ 3 ☐ 5 ☐ 6 ☐

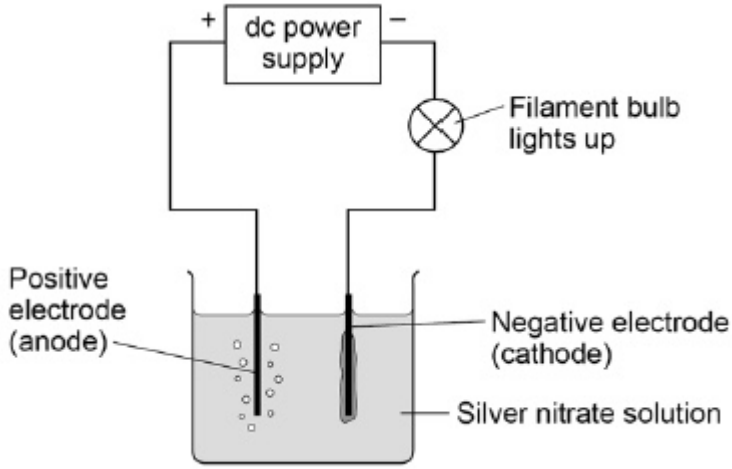
(1)

An electric current is passed through silver nitrate solution.

Figure 1 shows the apparatus.

Figure 1

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The solution contains four ions:

- Ag^+
- H^+
- NO_3^-
- OH^-

(c) Where do the H^+ and OH^- ions come from?

Tick **one** box.

Air	☐
Electrodes	☐
Silver nitrate	☐
Water	☐

(1)

(d) Ag^+ ions and H^+ ions are attracted to the negative electrode (cathode).

Give a reason why.

_____

_____

(1)

(e) Silver is produced at the negative electrode (cathode) and not hydrogen.

What does this tell you about the reactivity of silver?

Tick **one** box.

Silver is less reactive than hydrogen	☐
Silver is less reactive than	☐

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oxygen

Silver is more reactive than nitrate ☐

Silver is more reactive than water ☐

(1)

(f) The hydroxide ion (OH^-) is attracted to the positive electrode (anode).

The equation shows what happens at the positive electrode (anode).

$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$

Name the gas produced at the positive electrode (anode).

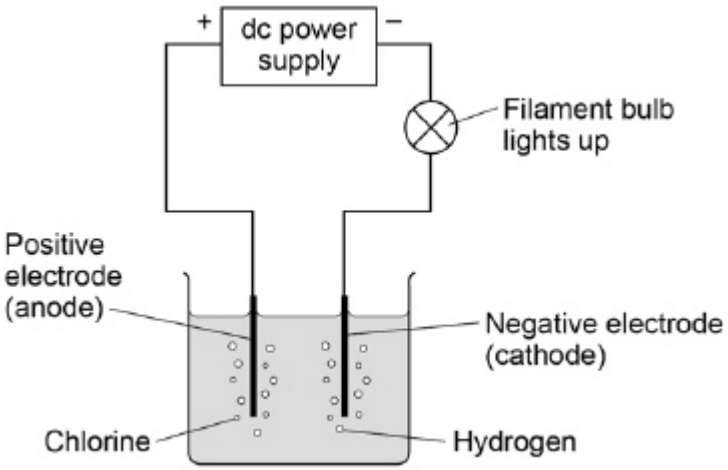
_____

(1)

(g) An electric current is passed through sodium chloride solution.

Figure 2 shows the apparatus.

Figure 2



After passing an electric current through sodium chloride solution one product is sodium hydroxide (NaOH) solution.

The presence of sodium hydroxide can be shown by adding an indicator.

Name an indicator.

Give the colour of the indicator in sodium hydroxide solution.

Indicator _____

Colour _____

(2)

(Total 8 marks)

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Q25.

This question is about compounds of oxygen.

The reaction between carbon and oxygen is exothermic.

(a) What does exothermic reaction mean?

_____

_____

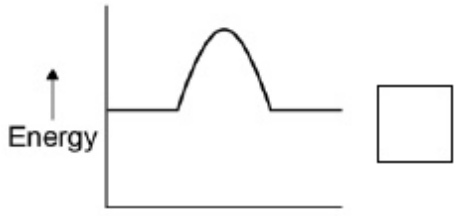
(1)

(b) Which is the correct reaction profile (energy level diagram) for an exothermic reaction?

Tick **one** box.







(1)

(c) The percentage by mass of oxygen in carbon dioxide (CO_2) is calculated by the equation:

$$\text{percentage by mass} = \frac{\text{number of atoms of O} \times \text{Relative atomic mass of oxygen (O)}}{\text{relative molecular mass of carbon dioxide } (CO_2)} \times 100$$

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

Calculate the percentage by mass of oxygen in carbon dioxide (CO_2).

_____

_____

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Percentage by mass of oxygen = _____ %

(3)

Hydrogen peroxide decomposes to produce water and oxygen.

(d) Balance the chemical equation.

$$_____\ H_2O_2 \rightarrow _____ H_2O + O_2$$

(1)

(e) 6.8 g of hydrogen peroxide decomposes to produce 3.6 g of water.

Calculate the mass of oxygen produced when 68 g of hydrogen peroxide decomposes.

Mass of oxygen = _____ g

(2)

(Total 8 marks)

Q26.

This question is about atoms and chemical elements.

Mendeleev's periodic table has groups of elements with similar properties.

Figure 1 shows part of Mendeleev's periodic table.

Figure 1

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1	1 H							
2	7 Li	9.4 Be	11 B	12 C	14 N	16 O	19 F	
3	23 Na	24 Mg	27.3 Al	28 Si	31 P	32 S	35.5 Cl	
4	39 K	40 Ca	44	48 Ti	51 V	52 Cr	55 Mn	56 59 59 63 Fe, Co, Ni, Cu

(a) Compare Mendeleev's periodic table with the modern periodic table.

Which group is missing from Mendeleev's periodic table?

Tick **one** box.

Group 1 ☐

Group 2 ☐

Group 7 ☐

Group 0 ☐

(1)

(b) In the early periodic tables some elements were placed in the wrong groups.

Mendeleev overcame some of these problems in his periodic table.

Give **two** ways Mendeleev did this.

1. _____

_____

2. _____

_____

(2)

Atoms were thought to be tiny spheres that could not be divided.

(c) Draw **one** line from each scientist to the discovery the scientist made.

Scientist	**Discovery the scientist made**
	Discovered electrons

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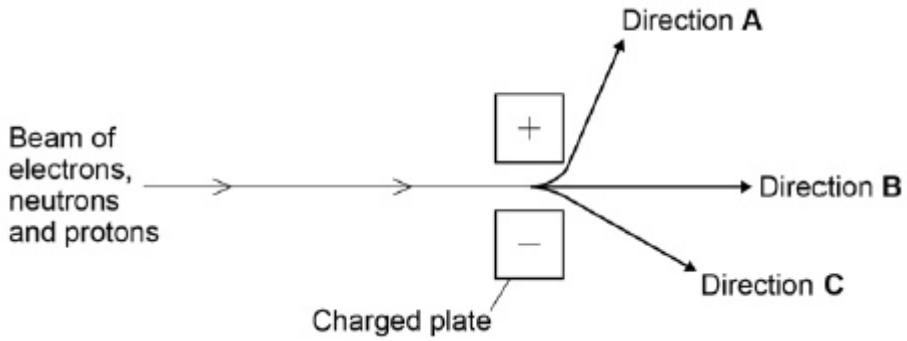
Neils Bohr	Electrons orbit the nucleus
	Existence of neutrons
James Chadwick	Mass of atom concentrated at centre
	Proton found in nucleus

(2)

(d) A beam of electrons, neutrons and protons can be separated by passing them through an electric field.

Figure 2 shows the directions of the three particles after entering the electric field.

Figure 2



Charged particles are attracted to the oppositely charged plate in the electric field.

Which direction, **A**, **B** or **C**, does each particle follow?

Complete the table.

Particle	**Direction**
Electron	
Neutron	
Proton	

(2)

(e) Calculate the mass of one atom of sodium.

Use the equation:

$$\text{mass of one atom of sodium} = \frac{\text{relative atomic mass}}{\text{Avogadro constant}}$$

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Avogadro constant = 6.02×10^{23}

Give your answer to 2 significant figures.

Mass = _____ g

(3)

(f) The radius of a sodium atom is 227 picometres.

1 picometre = 10^{-12} metres (m)

The radius of a nucleus is $\frac{1}{10\,000}$ of that of the atom.

Which calculation shows the radius of a sodium atom's nucleus?

Tick **one** box.

$227 \times 10\,000$ m ☐

$227 \times \frac{1}{10\,000}$ m ☐

$227 \times 10^{-12} \times 10\,000$ m ☐

$227 \times 10^{-12} \times \frac{1}{10\,000}$ m ☐

(1)

(Total 11 marks)

Q27.

This question is about subatomic particles.

(a) Subatomic particles in an atom are electrons, protons and neutrons.

Complete the table to show when each subatomic particle was discovered.

Date of discovery	Subatomic particle
1897	
1920	

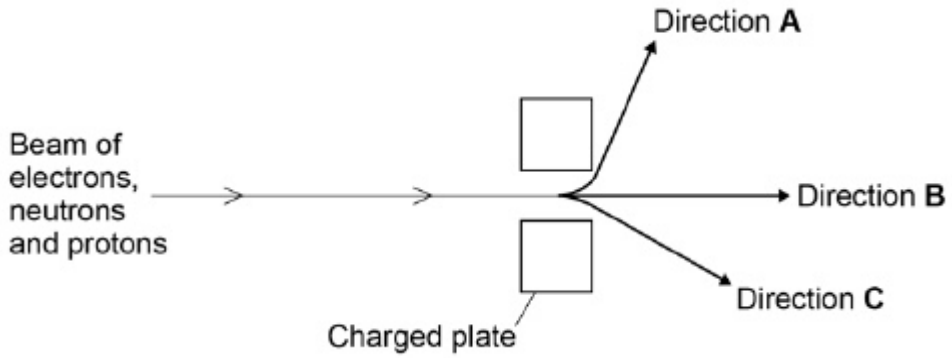
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1932	

(2)

(b) A beam of electrons, neutrons and protons travelling at the same speed is passed through two oppositely charged plates.

The diagram shows the directions of three particles after passing through the charged plates.



The charges on the electric plates are **not** shown.

The heavier the particle the less the deflection.

Explain which directions the electrons, neutrons and protons will take.

(4)

(c) Calculate the mass of one atom of sodium.

Avogadro constant = 6.02×10^{23} per mole.

Give your answer to 3 significant figures.

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Mass of one atom of sodium = _____ g

(2)

(d) The radius of a sodium atom is 227 picometres (pm)

1 picometre = 1×10^{-12} m

What is the approximate radius of the nucleus of a sodium atom?

Tick **one** box.

2.27×10^{-12} m ☐

2.27×10^{-14} m ☐

2.27×10^{-24} m ☐

4.54×10^{-14} m ☐

(1)

(Total 9 marks)

Q28.

Tablets to cure indigestion contain a mixture that has been designed as a useful product.

(a) Complete the sentence.

Choose the answer from the box.

catalyst	**formulation**	**hydrocarbon**	**solvent**

Tablets to cure indigestion are an example of a _____ .

(1)

The table shows the substances in one tablet.

Substance	**Mass in mg**
Sodium hydrogencarbonate	64
Calcium carbonate	522
Magnesium carbonate	68

(b) The total mass of these substances in the tablet is 654 mg

What is the approximate fraction of magnesium carbonate in the total mass of these substances?

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Tick **one** box.

$\frac{1}{10}$ ☐ $\frac{1}{100}$ ☐ $\frac{1}{1000}$ ☐ $\frac{1}{10\,000}$ ☐

(1)

(c) The tablets also contain sugar.

Suggest why.

_____

_____

(1)

(d) Sodium hydrogencarbonate cures indigestion by reacting with acid in the stomach.

What type of reaction is this?

Tick **one** box.

Combustion ☐

Displacement ☐

Neutralisation ☐

(1)

A student adds an indigestion tablet to dilute hydrochloric acid.

(e) The gas produced is bubbled through limewater.

The gas turns the limewater milky.

Name the gas produced.

_____

(1)

(f) Water is also produced.

Which **two** statements are reasons why water is a liquid at room temperature?

Tick **two** boxes.

Water has a boiling point of 100 °C ☐

Water has a giant covalent structure ☐

Water has a melting point lower than room temperature ☐

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Water has delocalised electrons ☐

Water is made of ions ☐

(2)

(g) Calcium chloride is also produced.

- The formula for a calcium ion is Ca^{2+}
- The formula for a chloride ion is Cl^-

What is the formula of calcium chloride?

Tick **one** box.

CaCl ☐ Ca_2Cl ☐ $CaCl_2$ ☐ Ca_2Cl_2 ☐

(1)

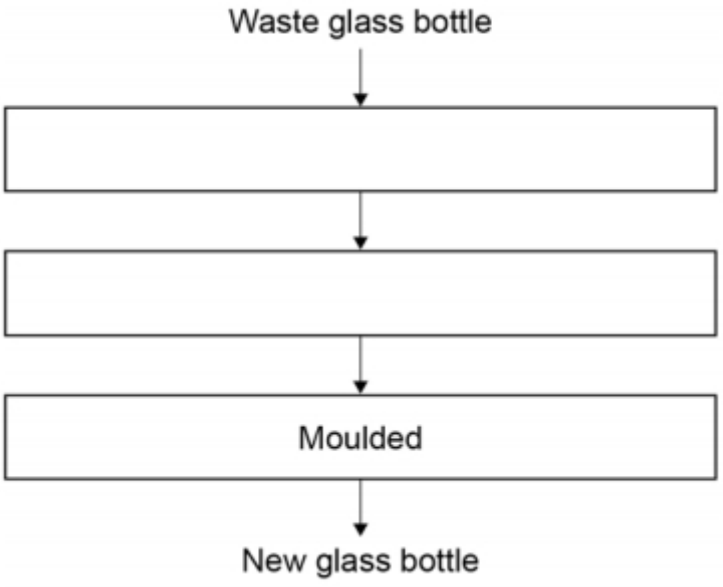
(h) The tablets are stored in glass bottles.

The flow chart shows part of a flowchart for recycling glass.

Complete the flow chart.

Choose the answers from the box.

crushed	**electrolysed**	**frozen**	**melted**	**oxidised**



(2)

(Total 10 marks)

Q29.

The table shows the gases in the Earth's atmosphere today.

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Gas	Percentage (%)
N_2	78.0
O_2	21.0
Ar	0.9
Other gases	**X**

(a) What is the percentage of **X**?

Tick **one** box.

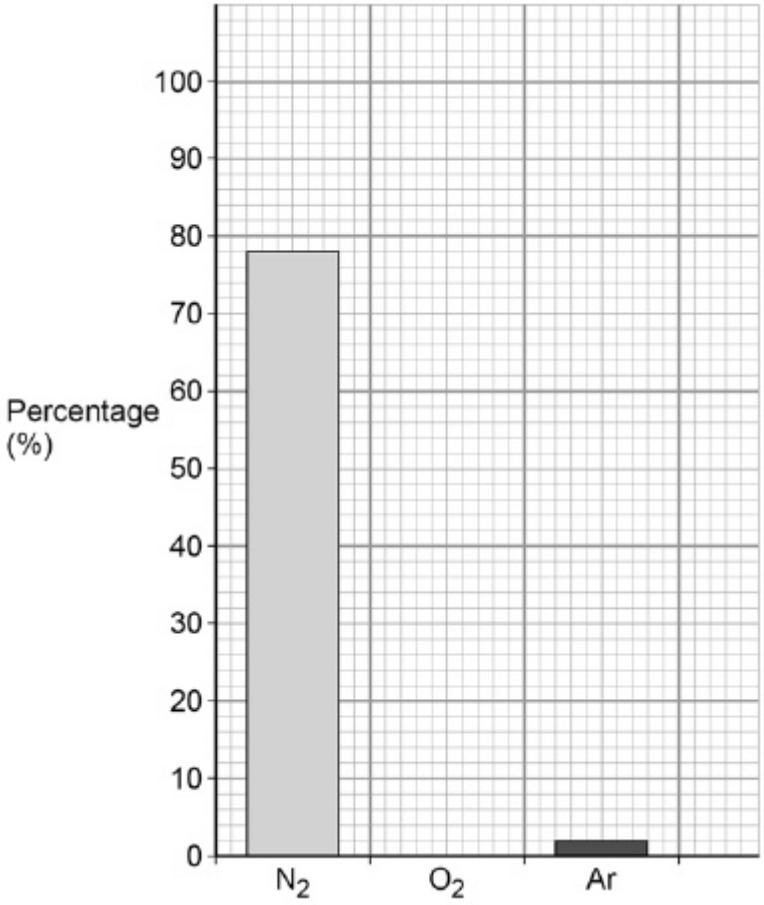
0.01% ☐ 0.1% ☐ 1% ☐ 10% ☐

(1)

(b) Complete **Figure 1**.

Plot the data from the table on **Figure 1**.

Figure 1



(1)

(c) What is the name of the gas with symbol Ar?

Tick **one** box.

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Aluminium ☐

Argon ☐

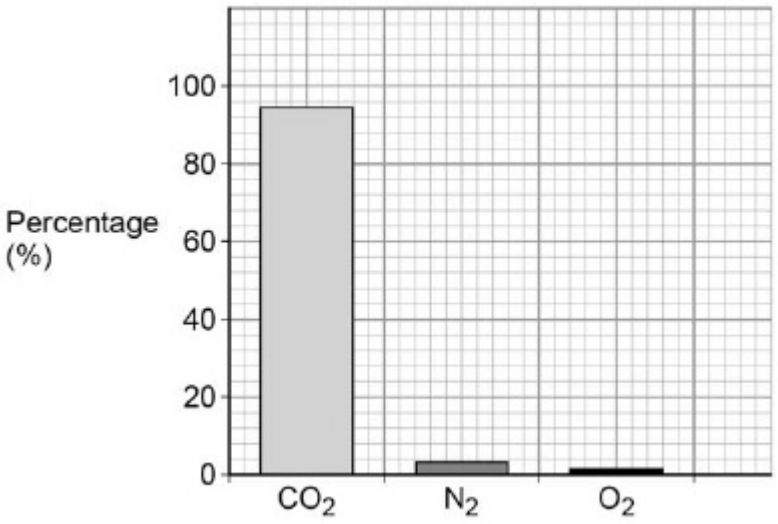
Arsenic ☐

Astatine ☐

(1)

(d) **Figure 2** shows the gases in the atmosphere of Mars today.

Figure 2



Some theories suggest that the Earth's early atmosphere was the same as the atmosphere of Mars today.

Describe the change in the percentage of oxygen from the Earth's early atmosphere to the Earth's atmosphere today.

Use values from the table and **Figure 2**.

_____

_____

_____

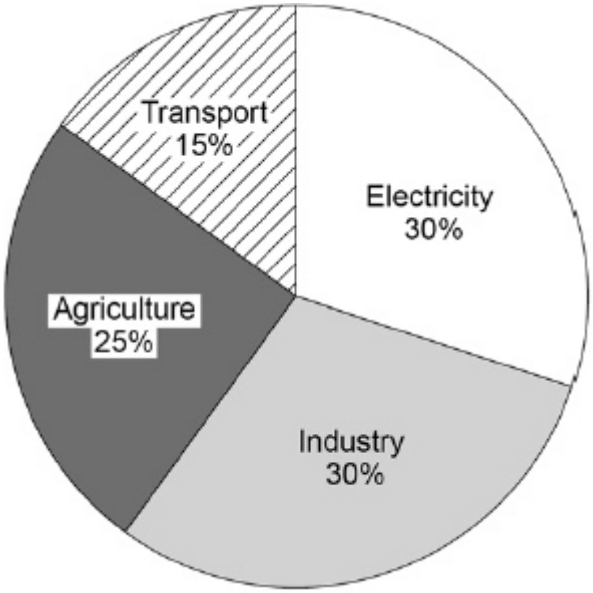
_____

(2)

(e) **Figure 3** shows the percentage of greenhouse gases from human activities.

Figure 3

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Compare the contribution of each activity to the total amount of greenhouse gases.

Use data from **Figure 3**.

(4)

(f) Suggest **one** way greenhouse gas emissions could be reduced.

(1)

(g) Give **one** reason why it is difficult for some countries to reduce emissions of greenhouse gases.

(1)

(Total 11 marks)

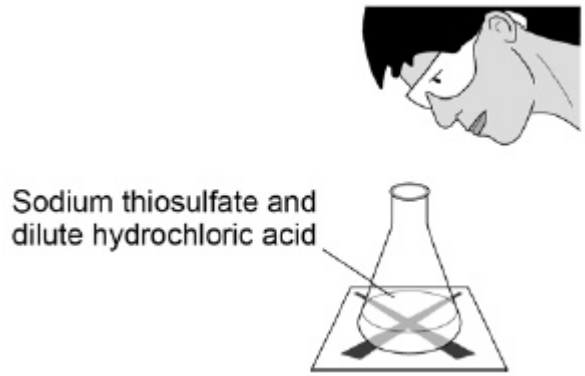
Q30.

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A student investigated the effect of concentration on the rate of the reaction between sodium thiosulfate and dilute hydrochloric acid.

Figure 1 shows the apparatus the student used.

Figure 1



(a) The symbol equation for the reaction is:

$$Na_2S_2O_3 + 2HCl \rightarrow 2NaCl + SO_2 + H_2O + S$$

Complete the word equation for the reaction.

sodium thiosulphate + hydrochloric acid → _____ + sulfur dioxide + water + sulfur

(1)

(b) The table shows the results.

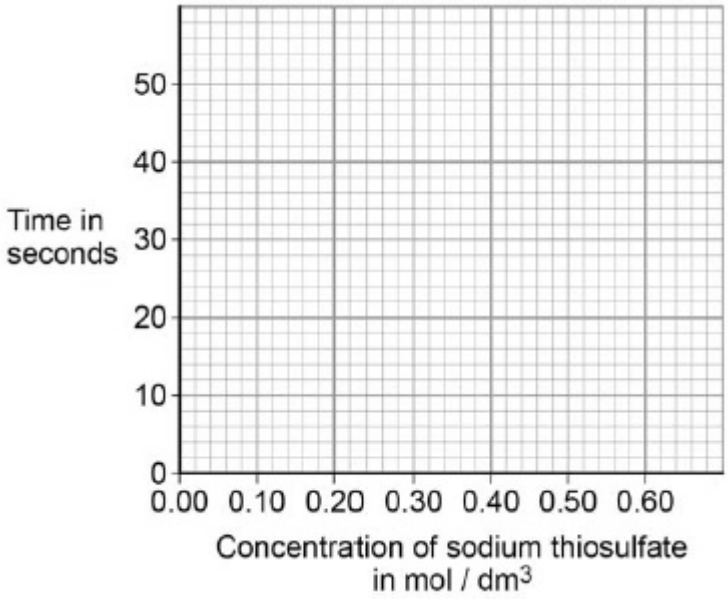
Concentration of sodium thiosulfate in mol/dm^3	**Time for student to no longer see the cross in seconds**
0.10	41
0.20	21
0.30	20
0.40	10
0.50	8

Plot the data from the table on **Figure 2**.

Draw a line of best fit.

Figure 2

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(3)

(c) The student determined the time for a concentration of 0.15 mol/dm^3

What is the concentration when the reaction is 20 seconds faster?

You should show your working on **Figure 2**.

_____

Concentration = _____ mol/dm^3

(2)

(d) Estimate the time taken for the reaction when the concentration of sodium thiosulfate is 0.60 mol/dm^3

_____

Time taken = _____ s

(1)

(Total 7 marks)

Q31.

This question is about copper and its compounds.

(a) The table shows information about bioleaching and phytomining.

Bioleaching and phytomining are used to extract copper from low grade ores.

	Bioleaching	**Phytomining**
Metal extracted from	Waste from quarrying	Contaminated ground
Speed of process	Very slow	Slow, made more efficient using

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		quick-growing plants
Pollution	Produces a solution of toxic chemicals which may run off into rivers Takes a long time to stop the process if river pollution occurs	Involves combustion of plants but decontaminates polluted ground

Compare phytomining and bioleaching.

Use the information in the table.

(4)

(b) Describe how copper sulfate solution is obtained from the plants used in phytomining.

(2)

(c) Copper is displaced from a solution of copper sulfate using iron.

Write a balanced symbol equation for this reaction.

(2)

(d) How does this displacement reaction take place?

Tick **one** box.

Electron sharing ☐

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Electron transfer ☐

Proton transfer ☐

(1)

(e) Describe how copper conducts electricity.

_____

_____

_____

_____

(2)

(f) Suggest how anhydrous copper sulfate is used to test for water.

_____

_____

_____

_____

(2)

(Total 13 marks)

Q32.

This question is about the periodic table.

In 1864 John Newlands suggested an arrangement of elements.

Figure 1 shows the arrangement Newlands suggested.

Figure 1

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

(a) Give **two** differences between column 1 in **Figure 1** and Group 1 in the modern periodic table.

Use the periodic table to help you.

1. _____

_____

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2. _____

_____

(2)

(b) In 1869 Mendeleev produced his periodic table.

Complete the sentence.

Choose the answer from the box.

insoluble	**magnetic**	**undiscovered**	**unreactive**

Mendeleev left gaps in his periodic table for elements that were

_____ .

(1)

(c) How are the elements ordered in the modern periodic table?

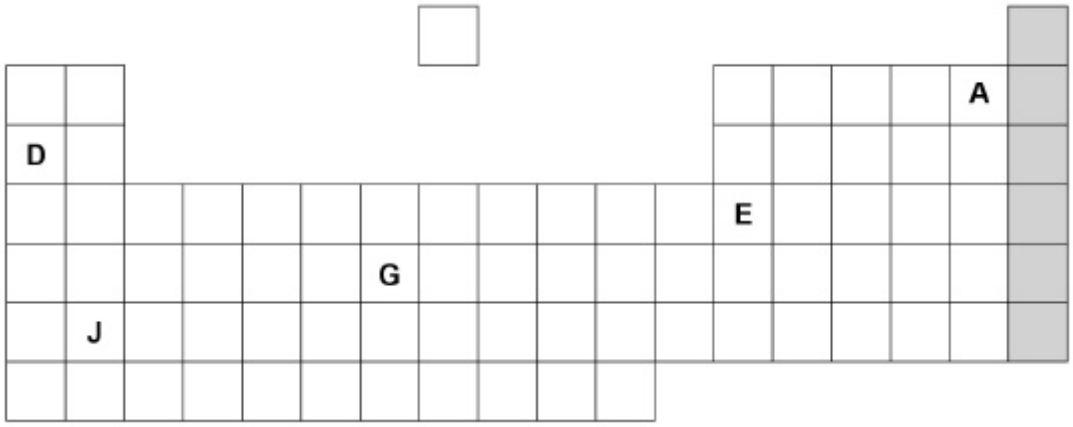
Tick **one** box.

- Atomic mass ☐
- Atomic number ☐
- Melting point ☐
- Reactivity ☐

(1)

Figure 2 shows part of the modern periodic table.

Figure 2



(d) Complete the sentences about the elements in **Figure 2**.

Choose the answers from the box.

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A	D	E	G	J

Sodium is an alkali metal and is represented by the letter _____.

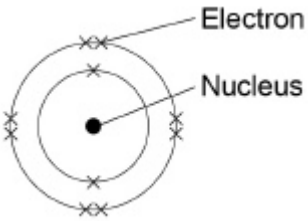
An element in group 3 is represented by the letter _____.

A gaseous non-metal element is represented by the letter _____.

(3)

(e) **Figure 3** shows the electronic structure of an atom.

Figure 3



This element is in the shaded group on **Figure 2**.

Why is this element unreactive?

_____

_____

(1)

(f) Name the group of elements in the shaded column on **Figure 2**.

_____

(1)

(Total 9 marks)

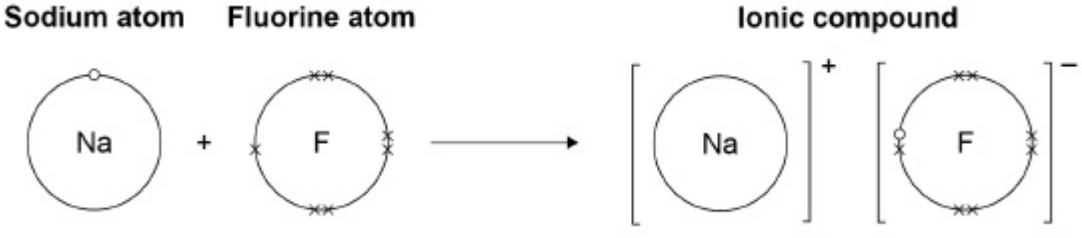
Q33.

A sodium atom and a fluorine atom react together to form an ionic compound.

Figure 1 shows the electron arrangements in the atoms and the ionic compound.

Only the outer shell electrons are shown.

Figure 1



(a) What is the name of the ionic compound shown in **Figure 1**?

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Tick **one** box.

Sodium fluorate ☐

Sodium fluoride ☐

Sodium fluorine ☐

(1)

(b) What type of force acts between the ions in an ionic compound?

Tick **one** box.

Electrostatic ☐

Frictional ☐

Gravitational ☐

Magnetic ☐

(1)

(c) What are **two** properties of ionic compounds?

Tick **two** boxes.

Conducts electricity when molten ☐

High melting point ☐

Low boiling point ☐

Small molecules ☐

Weak bonds between particles ☐

(2)

(d) Describe what happens when a sodium atom reacts with a fluorine atom to form an ionic compound.

Use **Figure 1**.

_____

_____

_____

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_____

_____

_____

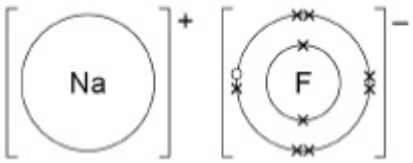
_____

_____

(4)

(e) **Figure 2** shows the structure of the ionic compound formed in the reaction.

Figure 2



Suggest **one** limitation of using **Figure 2** to show the structure of this compound.

_____

_____

(1)

(Total 9 marks)

Q34.

The pH scale is a measure of the acidity or alkalinity of a solution.

(a) Draw one line from each solution to the pH value of the solution.

Solution	pH value of the solution
	5
Acid	7
	9
Neutral	11
	13

(2)

(b) Which ion in aqueous solution causes acidity?

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Tick **one** box.

H^+ ☐

Na^+ ☐

O^{2-} ☐

OH^- ☐

(1)

(c) When sulfuric acid is added to sodium hydroxide a reaction occurs to produce two products.

The equation is:

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

How many elements are in the formula H_2SO_4?

Tick **one** box.

3 ☐

4 ☐

6 ☐

7 ☐

(1)

(d) What is this type of reaction?

Tick **one** box.

Decomposition ☐

Displacement ☐

Neutralisation ☐

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Reduction ☐

(1)

(e) Name the salt produced.

_____

(1)

(f) Describe how an indicator can be used to show when all the sodium hydroxide has reacted with sulfuric acid.

_____

_____

_____

_____

_____

_____

(3)

(Total 9 marks)

Q35.

John Newlands arranged the known elements into a table in order of atomic weight.

Figure 1 shows part of Newlands' table.

Figure 1

Group	**1**	**2**	**3**	**4**	**5**	**6**	**7**
	H	Li	Be	B	C	N	O
	F	Na	Mg	Al	Si	P	S
	Cl	K	Ca				

(a) What are the names of the elements in Group 5 of Newlands' table?

Tick **one** box.

Calcium and sulfur ☐

Carbon and silicon ☐

Chlorine and silver ☐

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Chromium and tin ☐

(1)

(b) In what order is the modern periodic table arranged?

Tick **one** box.

Atomic mass ☐

Atomic number ☐

Atomic size ☐

Atomic weight ☐

(1)

(c) Give **two** differences between Group 1 of Newlands' table and Group 1 of the periodic table.

_____

_____

_____

_____

(2)

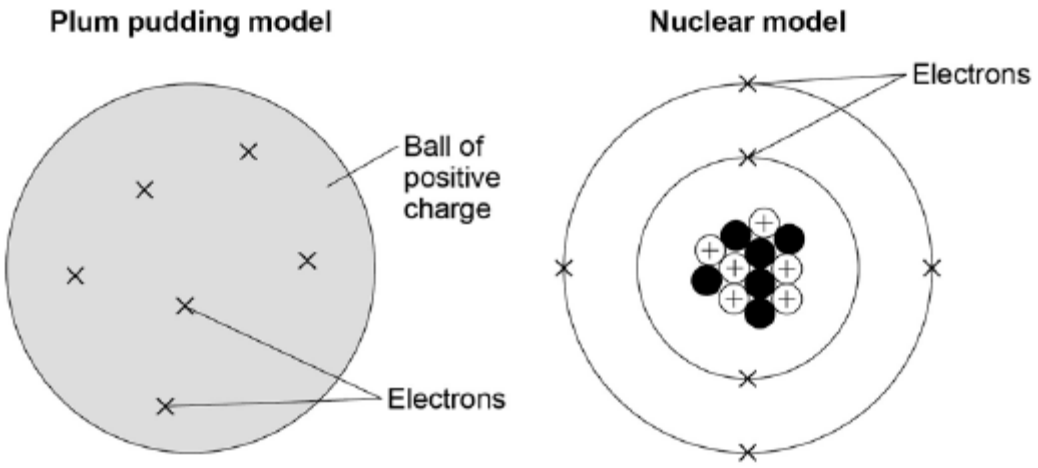
(d) In 1864, atoms were thought to be particles that could not be divided up into smaller particles.

By 1898, the electron had been discovered and the plum pudding model of an atom was proposed.

Figure 2 shows the plum pudding model of an atom of carbon and the nuclear model of an atom of carbon.

Figure 2

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Compare the position of the subatomic particles in the plum pudding model with the nuclear model.

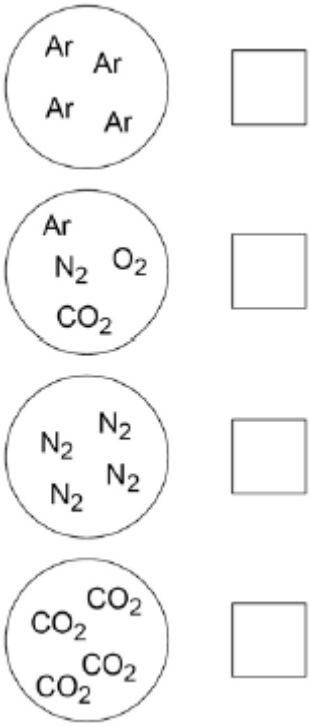
(4)

(e) Models are used to show the differences between elements, compounds and mixtures.

Which circle shows a model of a mixture?

Tick **one** box.

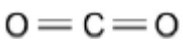
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(1)

(f) **Figure 3** shows a model of carbon dioxide.

Figure 3



What does each line between the atoms in **Figure 3** represent?

Tick **one** box.

Covalent bond ☐

Intermolecular force ☐

Ionic bond ☐

Metallic bond ☐

(1)

(Total 10 marks)

Q36.

This question is about calcium.

(a) What type of compound is calcium oxide?

Tick **one** box.

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An acid ☐

A base ☐

A carbonate ☐

A salt ☐

(1)

(b) Ionic compounds, such as calcium oxide, have high melting points.

Complete the sentences. Use words from the box.

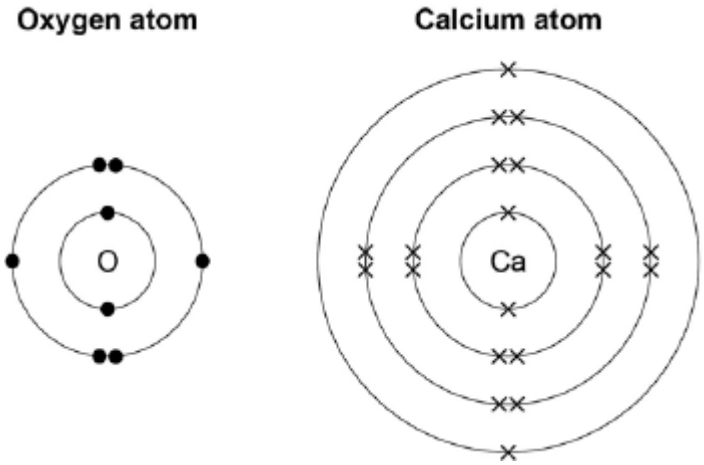
bonds	**forces**	**ions**
	layers	

Calcium oxide has a giant ionic lattice in which there are strong electrostatic

_____ of attraction in all directions.

(1)

(c) The figure below shows the electronic structure of an oxygen atom and a calcium atom.



Describe how the calcium atom and the oxygen atom forms calcium oxide.

You should give the charge on each ion formed.

_____

_____

_____

_____

_____

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_____

_____

_____

(4)

(Total 6 marks)

Q37.

Elements are made up of atoms.

(a) What is the approximate radius of an atom?

Tick **one** box.

1×10 m ☐

1×10^{-1} m ☐

1×10^{-10} m ☐

1×10^{-100} m ☐

(1)

(b) The figure below shows the atoms of five elements.

$^{6}_{3}R$ $^{7}_{3}S$ $^{23}_{11}T$ $^{39}_{19}U$ $^{85}_{37}V$

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

Complete the sentence.

All of the elements in the figure above are in Group

_____ of the periodic table.

(1)

(c) Which **two** atoms in the figure above are isotopes of the same element?

Explain your answer fully.

_____

_____

_____

_____

_____

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(3)

(d) The halogens are in Group 7 of the periodic table.

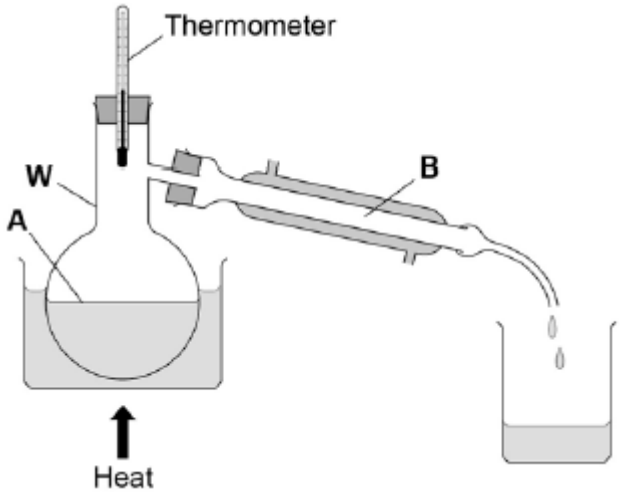
Explain the trend in reactivity of the halogens.

(6)

(Total 11 marks)

Q38.

The apparatus in the figure below is used to separate a mixture of liquids in a fuel.



(a) What is apparatus **W** on above the figure above?

Tick **one** box.

Beaker ☐

Boiling Tube ☐

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Flask ☐

Jug ☐

(1)

(b) What is the name of this method of separation?

Tick **one** box.

Crystallisation ☐

Electrolysis ☐

Filtration ☐

Distillation ☐

(1)

(c) Name the changes of state taking place at **A** and **B** in the figure above.

Use words from the box.

boiling	**condensing**	**freezing**	**melting**

Change of state at **A**: _____

Change of state at **B**: _____

(2)

(d) **Table 1** shows the boiling points of the hydrocarbons in the fuel.

Table 1

Hydrocarbon	**Boiling point in °C**
Pentane	36
Hexane	69
Heptane	98
Octane	125

Which hydrocarbon will be the last to collect in the beaker?

Tick **one** box.

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Pentane ☐

Hexane ☐

Heptane ☐

Octane ☐

(1)

(e) The fuel is a mixture of liquids that has been designed as a useful product.

What name is given to this type of mixture?

Tick **one** box.

Catalyst ☐

Formulation ☐

Polymer ☐

Solvent ☐

(1)

(f) Describe how this fuel is different from crude oil.

_____

_____

_____

_____

(2)

(g) A student measured the melting point of a solid hydrocarbon four times.

The student's results are in **Table 2**.

Table 2

	Trial 1	**Trial 2**	**Trial 3**	**Trial 4**
Melting point in °C	35	48	37	37

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Calculate the mean melting point of the hydrocarbon, leaving out any anomalous result.

Give your answer to two significant figures.

_____

_____

Mean melting point = _____ °C

(2)

(Total 10 marks)

Q39.

This question is about drinking water.

(a) Name **two** methods of treating water from rivers, lakes or the sea to produce drinking water.

Tick **two** boxes.

Anaerobic digestion ☐

Cracking ☐

Desalination ☐

Electrolysis ☐

Sterilising ☐

(2)

(b) The table below shows the amounts of dissolved ions in a sample of drinking water.

Dissolved ion	**Mass in mg per dm^3**
Cl^-	250
Na^+	200
NO_3^+	40

What is the name of the ion with the symbol Cl^-?

Tick **one** box.

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Calcium ion ☐

Carbonate ion ☐

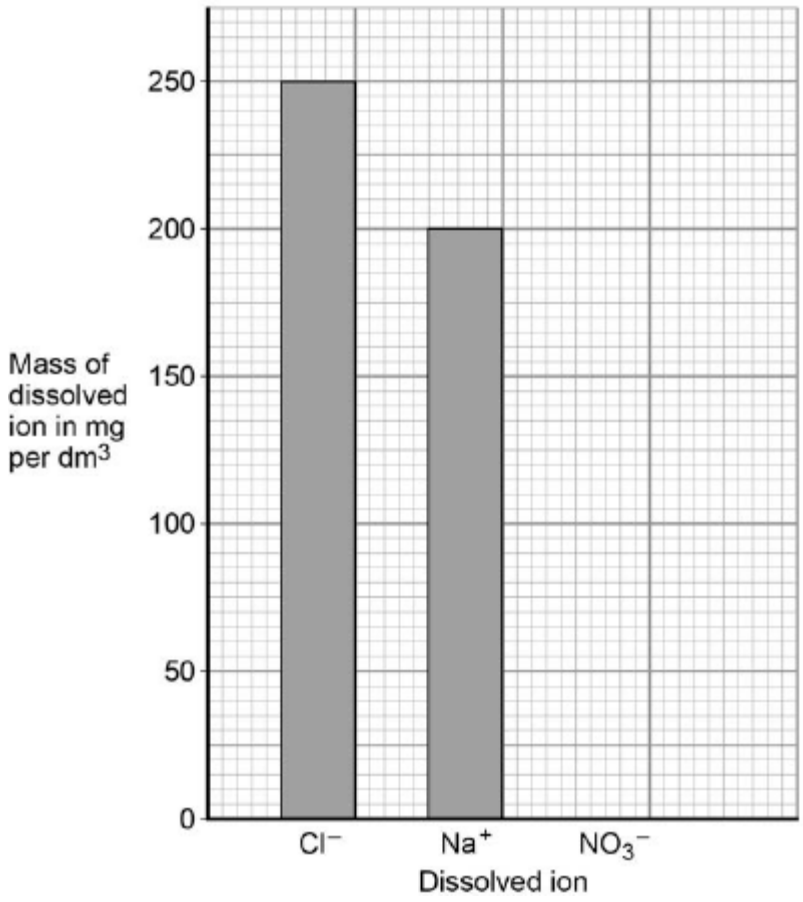
Chloride ion ☐

Chlorine ion ☐

(1)

(c) Use the information in the table above to complete the bar chart in **Figure 1**.

Figure 1



(1)

(d) Look at the questions labelled **A, B, C, D**.

A How many substances are there in drinking water?

B How much fluoride is in drinking water?

C Is fluoride soluble in drinking water?

D Should fluoride be added to drinking water?

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Which **one** of the questions cannot be answered by science alone?

Tick **one** box.

A		B		C		D	

(1)

(e) Give **two** reasons why the answer you have chosen cannot be answered by science alone.

1. _____

_____

2. _____

_____

(2)

(f) A sample of drinking water contains 1.5 mg of fluoride per dm^3 of water.
A person drinks 1 dm^3 of this water.

The recommended daily amount of fluoride is 4.0 mg.

Which calculation gives the percentage of the recommended daily amount of fluoride in 1 dm^3 of this water?

Tick **one** box.

$\frac{1.5}{4.0} \times 100$ ☐

$\frac{1.5}{100} \times 4.0$ ☐

$\frac{4.0}{1.5} \times 100$ ☐

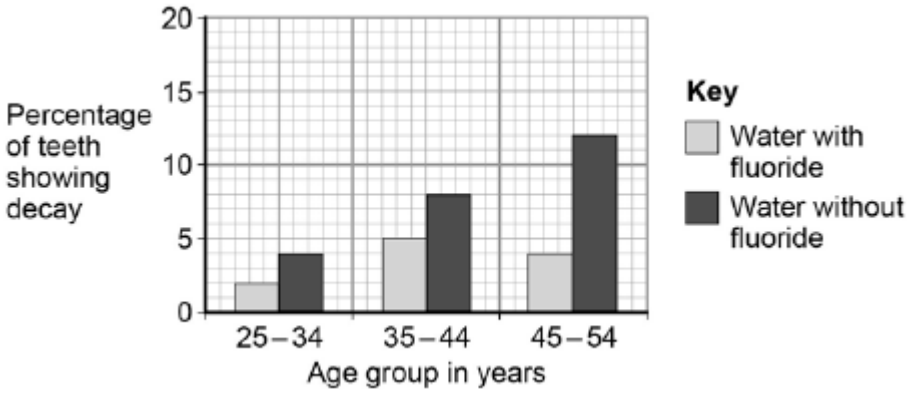
$\frac{100}{1.5} \times 4.0$ ☐

(1)

(g) **Figure 2** shows the effect of fluoride in drinking water on tooth decay in different age groups.

Figure 2

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Describe the pattern of tooth decay in **Figure 2** for water without fluoride.

Use data to justify your answer.

_____

_____

_____

_____

(2)

(h) Describe the effect of adding fluoride to drinking water for the age groups in **Figure 2**.

_____

_____

_____

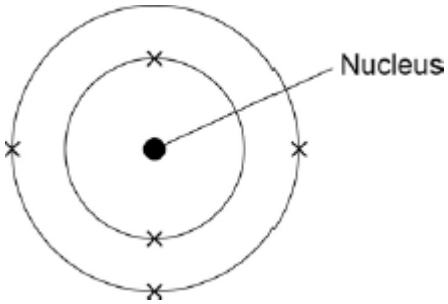
_____

(2)

(Total 12 marks)

Q40.

The figure below shows an atom of boron.



(a) When the mass of the boron atom is calculated, the mass of the electrons is ignored.

Why is the mass of the electrons ignored?

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_____

_____

(1)

(b) How many electrons are there in the boron atom?

_____

(1)

(c) What is the electrical charge on the nucleus of the boron atom?

Tick **one** box.

+1 ☐

+5 ☐

+6 ☐

+11 ☐

(1)

(d) The mass number of boron is 11.

Use the figure above to calculate the number of neutrons in the nucleus of the boron atom.

Explain how you worked out the answer.

Number of neutrons = _____

Explanation _____

_____

_____

(3)

(e) Phosphorus has a mass number of 31 and has 16 neutrons.

What percentage of the mass number of phosphorus is the number of neutrons?

Give your answer to two significant figures.

_____

_____

Percentage = _____

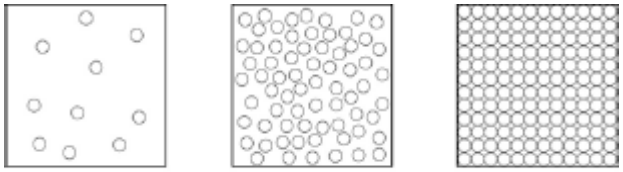
(2)

(Total 8 marks)

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Q41.

The figure below shows a simple model of the three states of matter.



(a) What is the correct equation to work out the density of a material?

_____

(1)

(b) A student explains density to his teacher using the particle model in the figure above.

His teacher says there are limitations to the model.

Give **two** limitations of the particle model in the figure above.

1. _____

_____

2. _____

_____

(2)

(c) When the gas in a container with a fixed volume is heated, the pressure increases as the temperature increases.

Explain why the pressure increases.

Use the model in the figure above to help you.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 7 marks)

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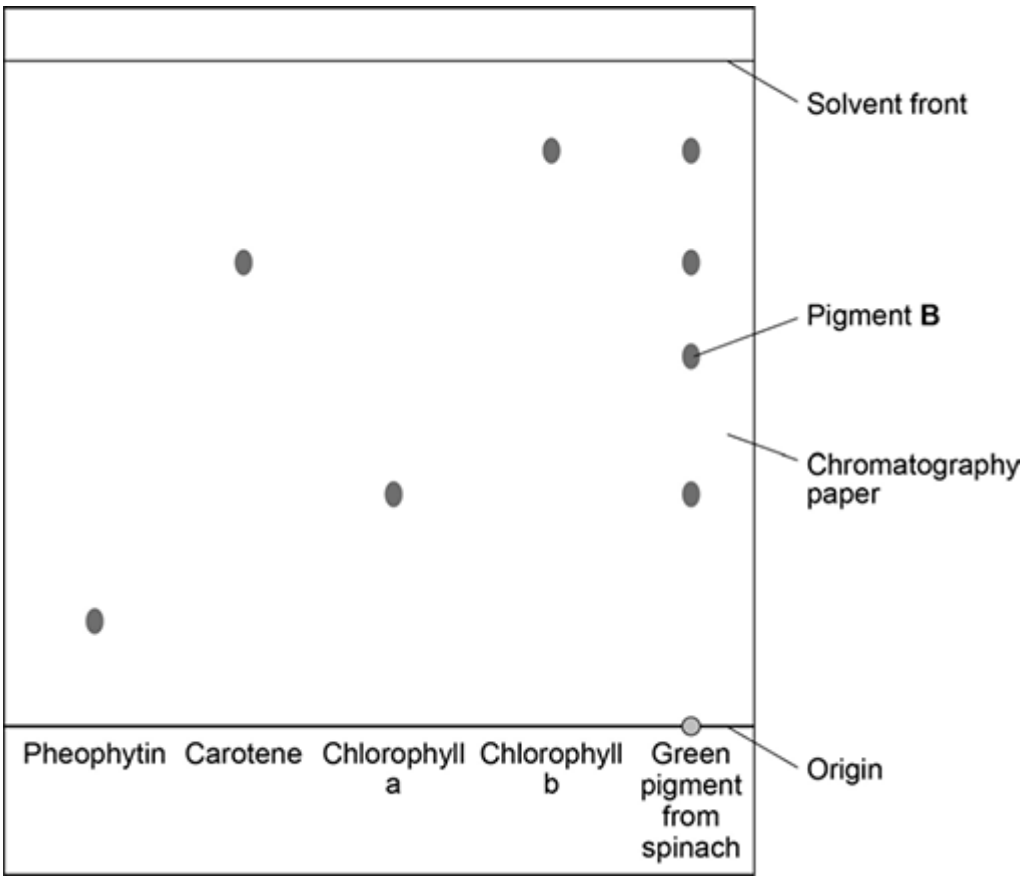
Q42.

A student used paper chromatography to identify the pigments in spinach leaves.

She used propanone as a solvent.

Figure 1 shows the student's results.

Figure 1



(a) Name the mobile phase and the stationary phase in the student's experiment.

Mobile phase _____

Stationary phase _____

_____

(2)

(b) What does **Figure 1** tell you about the green pigment from spinach?

_____

_____

_____

_____

_____

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(3)

(c) Write the equation that links distance moved by solvent, distance moved by solute and R_f value.

(1)

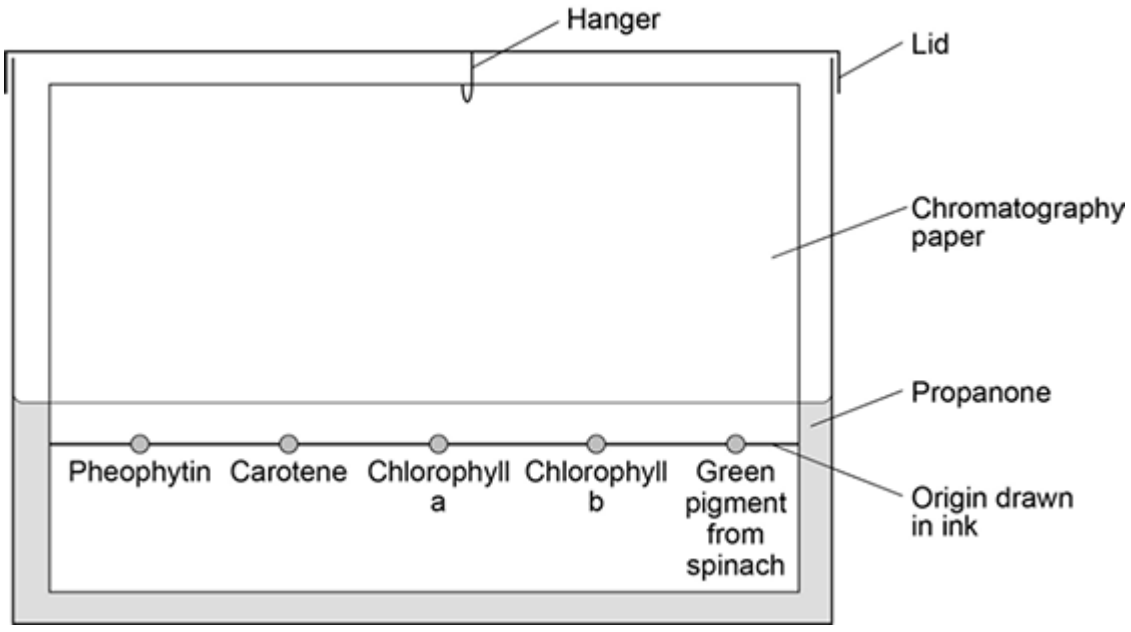
(d) Use **Figure 1** to calculate the R_f value for pigment **B**.

R_f value = _____

(3)

(e) Another student set up the apparatus shown in **Figure 2**.

Figure 2



This student did not set up the apparatus correctly.

Identify the errors the student made.

Explain how the errors she made would affect her results.

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(4)
(Total 13 marks)

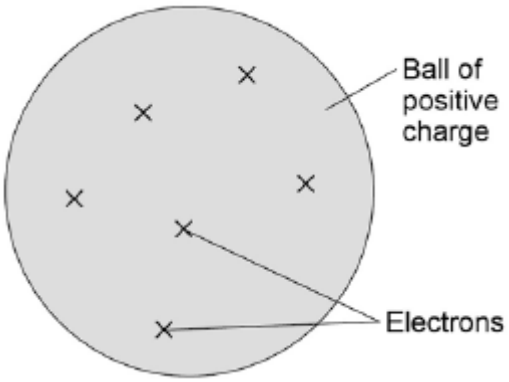
Q43.

Figure 1 shows the plum pudding model of the atom.

This model was used by some scientists after the discovery of electrons in 1897.

Figure 1

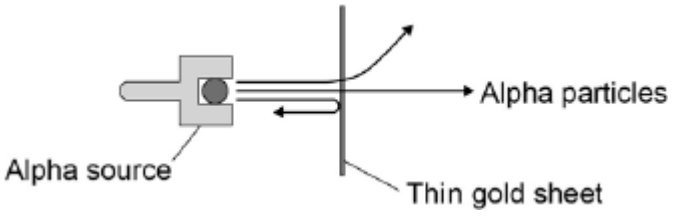
Plum-pudding model



In 1911 the scientists Geiger and Marsden investigated the effect of firing alpha particles at very thin sheets of gold foil.

Their experiment is shown in **Figure 2**. The arrows show the paths taken by alpha particles in the experiment.

Figure 2



(a) Explain why scientists replaced the plum pudding model of the atom with the nuclear model of the atom as a result of the experiment.

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(4)

(b) According to modern measurements:

- the radius of an atom is about 1×10^{-10}m
- the radius of an atomic nucleus is about 1×10^{-14}m

Show that these values fit with the nuclear model of the atom.

(2)

(c) In 1931 a scientist discovered that there are hydrogen atoms with mass number 2 as well as hydrogen atoms with mass number 1.

A year later, another scientist discovered neutrons.

Explain why the discovery of neutrons could explain the presence of hydrogen atoms with different mass numbers.

(3)

(d) How would the results of the experiment shown in **Figure 2** change if neutrons were used instead of alpha particles to bombard a thin sheet of gold?

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_____

_____

_____

_____

_____

(2)

(Total 11 marks)

Q44.

The elements in the periodic table are arranged in groups.

(a) What is similar about the elements in the same group?

Tick **one** box.

Chemical properties ☐

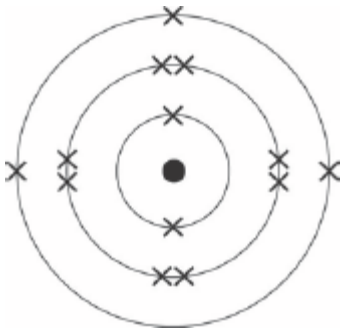
Atomic numbers ☐

Relative atomic masses ☐

(1)

(b) **Figure 1** shows the arrangement of electrons in an atom.

Figure 1



What group of the periodic table is this atom in?

Group _____

(1)

(c) Why are the elements in Group 0 unreactive?

Tick **one** box.

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They are all gases at room temperature ☐

They all have the same atomic number ☐

They are all in the same group of the periodic table ☐

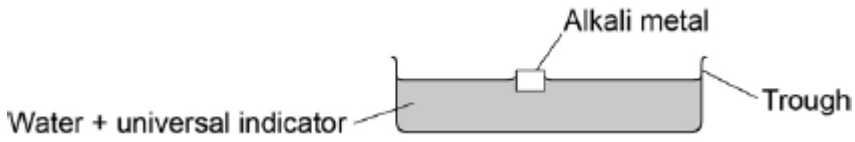
They all have a stable arrangement of electrons ☐

(1)

(d) A teacher demonstrates the reaction of some alkali metals with water.

Look at **Figure 2**.

Figure 2



The students write what they see.

1. The alkali metals float on water.
2. The alkali metals fizz when they react with water.
3. The universal indicator changes from green to purple.
4. The sodium disappears faster than the lithium.

Give a reason for each of the four things that the students see.

1. The alkali metals float on water.

Reason _____
_

_____

2. The alkali metals fizz when they react with water.

Reason _____
_

_____

3. The universal indicator changes from green to purple.

Reason _____
_

_____

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4. The sodium disappears faster than the lithium.

Reason _____

_

_____

(4)

(Total 7 marks)

Q45.

The table below shows information about some elements.

Element	Melting point in °C	Boiling point in °C
Fluorine	–202	–188
Chlorine	–101	–35
Bromine	–7	59
Iodine	114	184
Astatine		

(a) Look at the table above.

Describe the trend in melting point from fluorine to astatine.

_____

_____

(1)

(b) Estimate the boiling point of astatine.

Use the table above to help you.

Boiling point of astatine = _____ °C

(1)

(c) Room temperature is 20 °C.

Which element in the table above is a liquid at room temperature?

_____

(1)

(d) To which group of the periodic table do the elements in the table above belong?

Tick **one** box.

Group 0 ☐

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Group 1 ☐

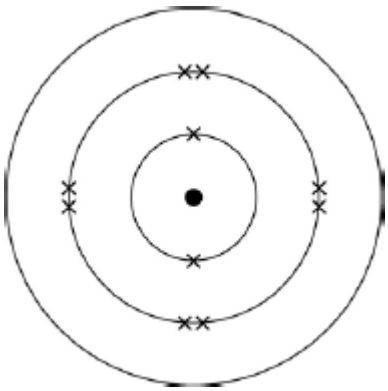
Group 5 ☐

Group 7 ☐

(1)

(e) A chlorine atom has 17 electrons.

On the figure below, use crosses to show the arrangement of electrons in the outer shell of a chlorine atom.



(1)

(f) Chlorine reacts with sodium bromide solution to produce bromine and sodium chloride solution.

Complete the symbol equation for the reaction.

___Cl_2 + _____ NaBr ⟶ _____ + _____

(2)

(g) Which element in the table above will react with sodium chloride solution?

Give a reason for your answer.

_____

_____

_____

_____

_____

_____

(2)

(Total 9 marks)

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Q46.

The elements in Group 1 of the periodic table are metals.

(a) The elements in Group 1 are called the alkali metals.

Why are they called the alkali metals?

_____

_____

_____

_____

(2)

(b) Explain the increase in reactivity of elements further down the group.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(c) Lithium oxide is an ionic compound.

Draw a dot and cross diagram to show how lithium and oxygen combine to form lithium oxide.

Only show the electrons in the outer shell of each atom.

Give the charges on the ions formed.

(4)

(Total 10 marks)

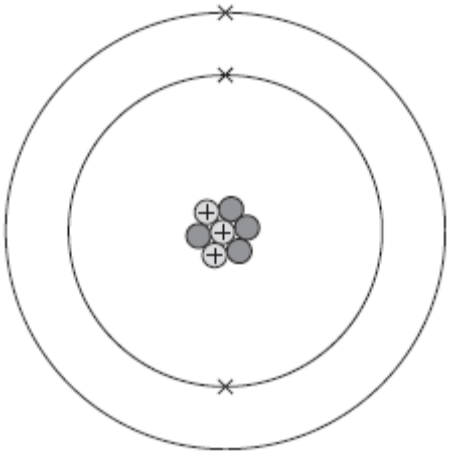
Q196.

(a) The structure in the diagram represents an atom of lithium.

The atom contains three types of particles:

- protons
- neutrons
- electrons.

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Describe the atomic structure of lithium.

Use the diagram to help you.

Include in your answer:

- the number of each type of particle
- where in the atom each particle is found.

(4)

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

Which element is in the same group as lithium?

Draw a ring around the correct answer.

beryllium **magnesium** **sodium**

(1)
(Total 5 marks)

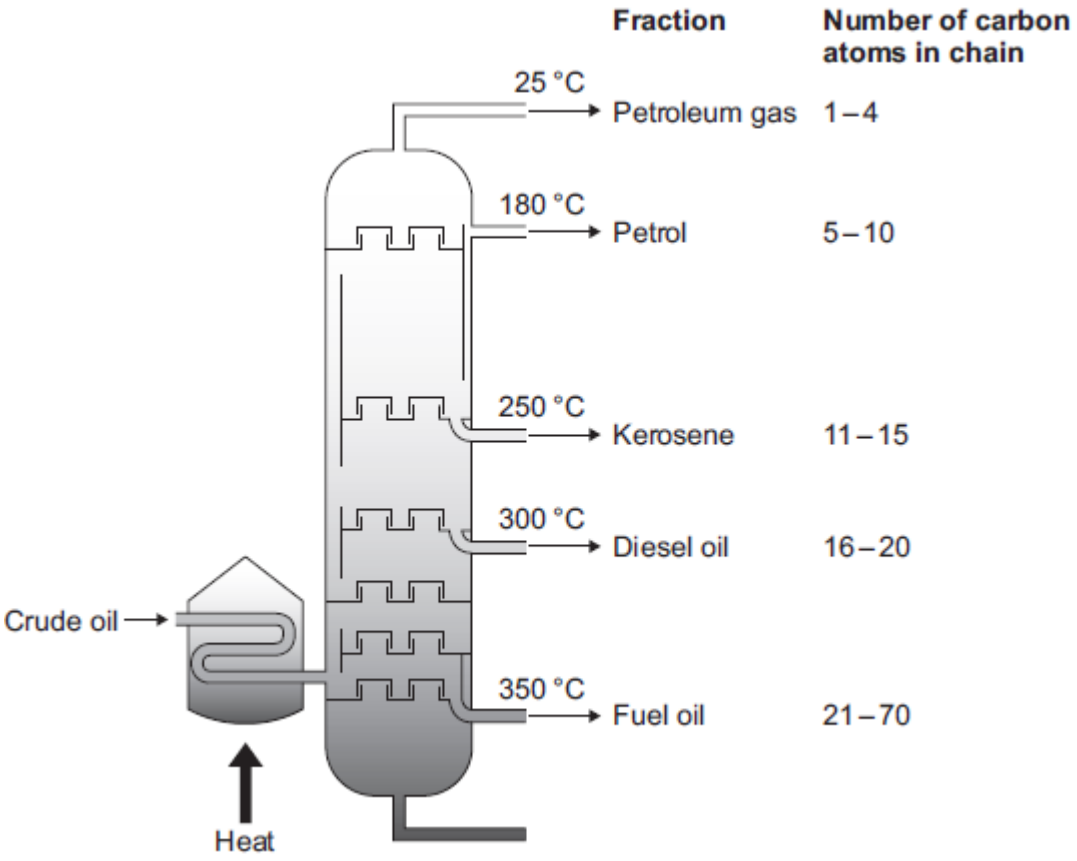
Q197.

Many fuels are produced from crude oil.

(a) Crude oil is separated into fractions by distillation in a fractionating column.

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A fractionating column is shown below.



(i) Describe how crude oil is separated into fractions by fractional distillation.

_____

_____

_____

_____

_____

_____

(3)

(ii) Some properties of hydrocarbons change as the size of the molecules increases.

Describe the trends in boiling point and viscosity as the number of carbon atoms in the molecule increases.

Boiling point _____

_____

Viscosity _____

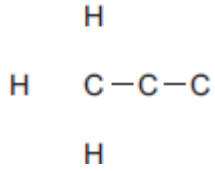
_____

(2)

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(b) LPG (liquefied petroleum gas) is a fuel. LPG contains propane (C_3H_8).

(i) Complete the displayed (structural) formula for propane.



(1)

(ii) Burning fuels releases energy. Name **two** products formed when LPG is burnt.

_____

_____

(2)

(iii) Some cars are now designed to use LPG as a fuel. LPG is about 50p per litre cheaper than petrol.

Suggest **one** reason why most car owners use cars designed to use petrol and not LPG as a fuel.

_____

_____

(1)

(Total 9 marks)

Q198.

This question is about lithium.

(a) A lithium atom has an atomic number of 3 and a mass number of 7.

Describe the atomic structure of lithium.

Include in your answer:

- the number of each type of particle
- where in the atom each particle is found.

_____

_____

_____

_____

_____

_____

_____

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_____

(4)

(b) (i) Name **one** other element with similar chemical properties to lithium.

Use the Chemistry Data Sheet to help you name the element.

_____

(1)

(ii) Why are lithium and the element you named in part (i) classed as different elements?

_____

_____

(1)

(Total 6 marks)

Q199.

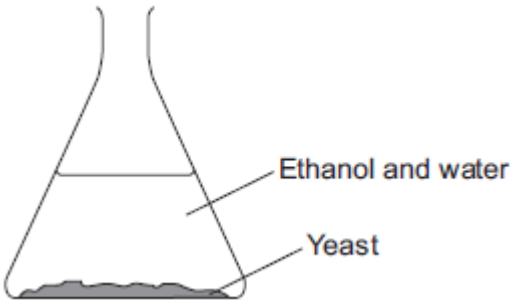
This question is about ethanol. The boiling point of ethanol is 78 °C.

Ethanol can be produced by fermentation of sugar with yeast.

A student:

- put yeast and water in a conical flask
- added sugar to the yeast and water
- left the mixture for a few days to ferment.

The diagram shows the conical flask after the mixture had fermented to produce ethanol and carbon dioxide.



.

(a) Write the word equation for the reaction taking place to produce ethanol.

_____

(1)

(b) (i) Suggest how the student could separate yeast from the mixture of ethanol and water.

_____

_____

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(1)

(ii) Suggest how the student could separate ethanol from the mixture of ethanol and water.

_____

_____

(1)

(Total 3 marks)

Q200.

Helium is found underground. Scientists think that the helium reserves will last for a further 50 years. Helium is much lighter than air and escapes from the Earth's atmosphere when released.

Helium has many uses. Helium is used in medical scanners and space telescopes to keep them cool. Divers and some hospital patients breathe a mixture of helium and oxygen. Party balloons are filled with helium gas.

A party balloon and a diver are shown in **Figure 1**.

Figure 1



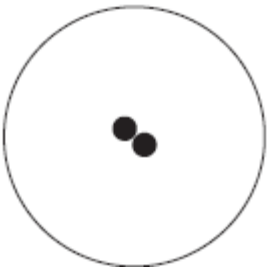
(a) Helium has a mass number of 4 and an atomic number of 2.

Figure 2 shows an incomplete diagram of the structure of a helium atom. A proton is shown as ●

Complete **Figure 2** to show the atomic structure of helium.

Represent an electron as **x** and a neutron as ○

Figure 2



(3)

(b) Helium is in Group 0 of the periodic table.

Why are the elements in Group 0 unreactive?

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_____

_____

(1)

(c) Many scientists think that helium should **not** be used in party balloons.

Suggest **two** reasons why.

1. _____

_____

2. _____

_____

(2)

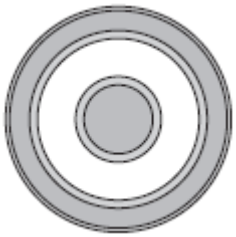
(Total 6 marks)

Q201.

Scientists in the 16th century used the symbol shown in **Figure 1** for gold.

Figure 1

Gold



The scientists thought platinum was made from gold and silver, so they used the symbol for gold in the symbol for platinum. The symbol for platinum is shown in **Figure 2**.

Figure 2

Platinum



(a) Gold and platinum are elements.

What is meant by the term **element**?

_____

_____

(1)

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(b) Why is it incorrect to represent platinum as shown in **Figure 2**?

_____

_____

(1)

(c) Scientists now use a formula such as Ag_2O to represent a substance.

What does the formula Ag_2O tell you about this substance?

_____

_____

_____

_____

(2)

(Total 4 marks)

Q202.

Lithium batteries are used in laptops.



The batteries contain a lithium compound.
The formula of the compound is $LiCoO_2$

(a) Complete the table to show the number of atoms of each element in the formula, $LiCoO_2$

Lithium has been completed for you

Element	**Number of atoms in the formula $LiCoO_2$**
Lithium, Li	1
Cobalt, Co	
Oxygen, O	

(2)

(b) Some laptops have caught fire.

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Scientists think sparks caused the fires.
The sparks caused small particles of lithium in the batteries to react with oxygen.

(i) Suggest where the oxygen reacting with the lithium came from.

_____

_____

(1)

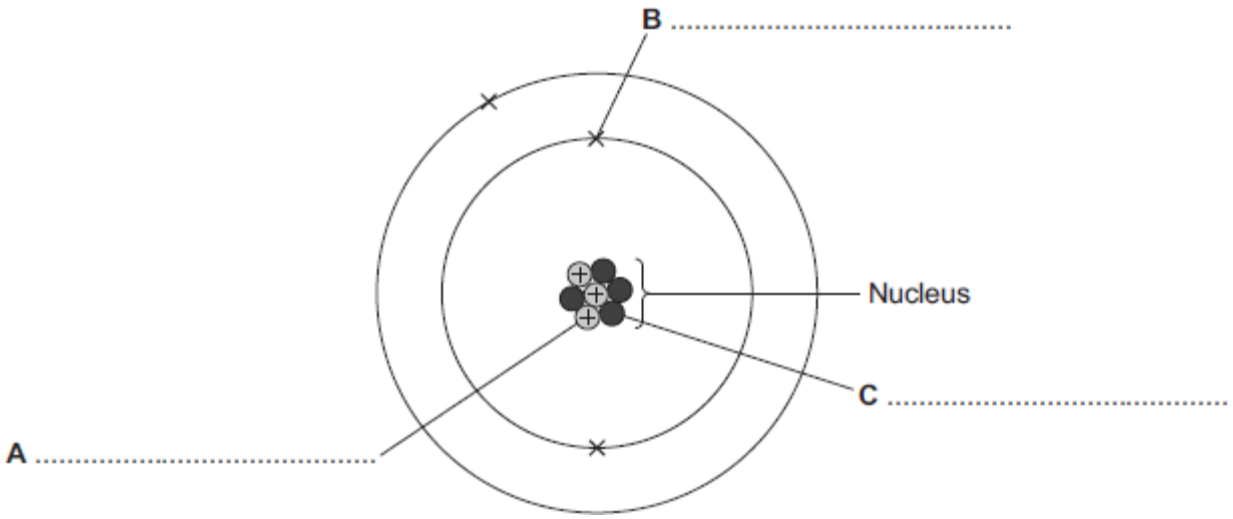
(ii) Name the product of the reaction between lithium and oxygen.

_____

(1)

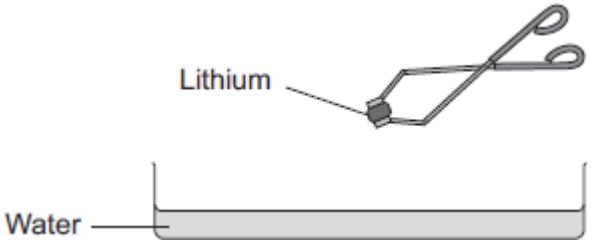
(c) The diagram below shows the structure of a lithium atom.

Name the particles labelled **A**, **B** and **C** on the diagram.



(3)

(d) Lithium hydroxide and hydrogen are produced when lithium reacts with water.



(i) Describe what you would **see** when lithium is added to water.

_____

_____

_____

_____

(2)

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(ii) Complete the word equation for the reaction between lithium and water.

lithium + water ⟶ _____ + _____

(1)

(Total 10 marks)

Q203.

Lithium batteries are used in laptops.

The batteries contain a lithium compound, $LiCoO_2$

The batteries are sealed to stop water and air entering them.



(a) Some laptops have caught fire.

Scientists concluded sparks caused the fires. The sparks caused small particles of lithium in the batteries to react with oxygen. Lithium oxide (Li_2O) was produced.

(i) Write a balanced symbol equation for the reaction between lithium and oxygen.

_____ + _____ → _____

(2)

(ii) The batteries were sealed.

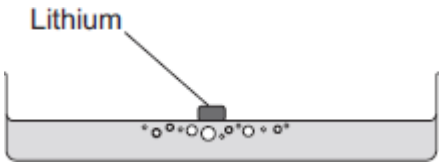
Suggest where the oxygen that reacted with the lithium came from.

_____

_____

(1)

(b) A teacher demonstrated how lithium reacts with water.



The students observed:

- the lithium reacting on the surface of the water

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- bubbles of gas where lithium was in contact with the water.

The solution remaining in the trough was tested and found to be alkaline.

(i) Explain the students' observations, naming the substances produced.

_____

_____

_____

_____

_____

_____

(3)

(ii) The teacher then investigated the reaction of sodium with water.

Suggest how sodium would react with water.

Explain why.

_____

_____

_____

_____

(2)

(Total 8 marks)

Q204.

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

The following is a list of elements.

calcium	**carbon**	**chlorine**	**copper**

Complete the sentences.

Choose your answers **only** from the elements shown in the box above.

The element with the chemical symbol C is _____ .

The element in the same group as fluorine is _____ .

The element with the atomic number of 20 is _____ .

(Total 3 marks)

Q205.

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Aluminium chloride is used in antiperspirants.



(a) The formula of aluminium chloride is $AlCl_3$

(i) How many atoms in total are shown in the formula $AlCl_3$?

_____

(1)

(ii) How many different types of atom are shown in the formula $AlCl_3$?

_____

(1)

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

Aluminium chloride is

a compound.
an element.
a mixture.

(1)

(b) An aluminium atom contains three different types of particles.

Complete the table to show:

- the relative charge on a proton
- the names of the other two particles.

Name of particle	Relative charge
Proton	
	0
	-1

(3)

(Total 6 marks)

Q206.

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Aluminium chloride is used in antiperspirants.



(a) The balanced symbol equation for the formation of aluminium chloride is:

$$2Al + 3Cl_2 \rightarrow 2AlCl_3$$

Name the reactants shown in the equation.

Give the numbers of atoms of each reactant shown in the equation.

_____

_____

_____

_____

(2)

(b) (i) An aluminium atom contains three different types of sub-atomic particles.

Name the three types of particles and give their relative electrical charges.

_____

_____

_____

_____

_____

_____

(3)

(ii) State why an aluminium atom has no overall charge.

_____

_____

_____

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_____

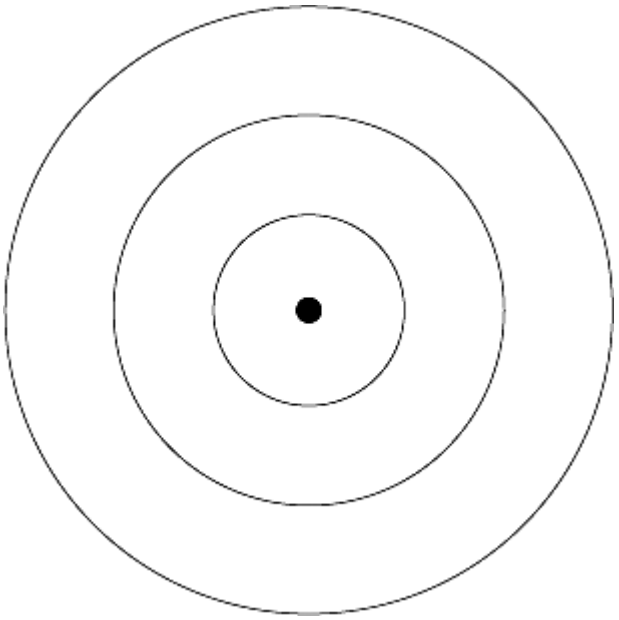
(1)

(Total 6 marks)

Q207.

Sodium is a reactive element.

(a) Complete the diagram to show the electronic structure of a sodium atom.



(2)

(b) Sodium reacts with chlorine to form sodium chloride.

Explain how in terms of electrons, atoms and ions.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 6 marks)

Q208.

Gold, silver and bronze medals were made for a competition.

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Photograph supplied by iStockphoto/Thinkstock

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

(i) Gold is found as a pure metal in the Earth because gold is

coloured.
reactive.
unreactive.

(1)

(ii) Gold is an element because all of its

atoms
molecules
symbols

are the same.

(1)

(b) The atomic number of silver is 47.
The mass number of a silver atom is 108.

Use this information to work out the number of protons and neutrons in a silver atom.

Draw **one** line from each particle in **List A** to the correct number in **List B**.

List A Particle	**List B Number**
	47
Proton	

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Neutron	61
	108

(2)

(c) Bronze is an alloy of copper and tin.

(i) What is an alloy?

_____

_____

(1)

(ii) Medals made of copper or bronze cost the same.

Bronze is used to make medals instead of pure copper.

Give **one** reason why.

_____

_____

(1)

(Total 6 marks)

Q209.

Lithium chloride can be used to colour flames dark red.

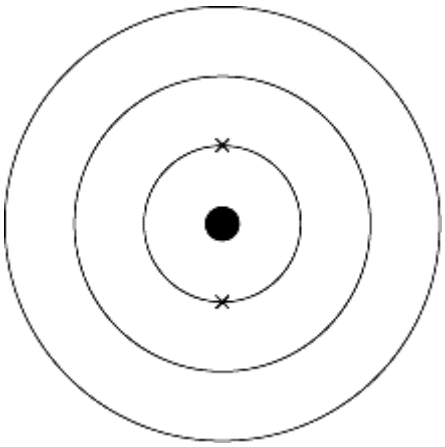


By Alchimista (Own work) [CC-BY-SA-3.0] via Wikimedia Commons

(a) A chlorine atom has 17 electrons.

Complete the diagram to show the electronic structure of a chlorine atom.

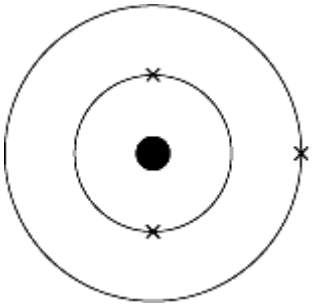
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(1)

(b) Lithium chloride (LiCl) can be made by reacting lithium with chlorine.

The electronic structure of a lithium atom is shown below.



Describe what happens to a lithium atom when the atom reacts with chlorine.

_____

_____

_____

_____

_____

_____

(3)

(Total 4 marks)

Q210.

A gold medal was made for a competition.

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By Fighting Irish 1977 (Flickr: 2012 Olympics Gold Medal) [CC-BY-2.0], via Wikimedia Commons

(a) The mass number of gold is 197.

Describe the structure of a gold atom.

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

(4)

(b) Bronze medals are made from an alloy of copper.

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By Edgars Košovojs (Own work) [CC-BY-SA-3.0 or GFDL], via Wikimedia Commons

Copper can be extracted by phytomining.

(i) Why is phytomining being used to extract copper?

_____

_____

(1)

(ii) Give the main steps involved in the phytomining process.

_____

_____

_____

_____

_____

_____

(3)

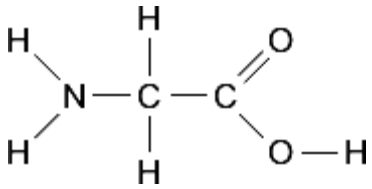
(Total 8 marks)

Q211.

Two scientists, Miller and Urey, investigated how simple gases that may have been present in the Earth's early atmosphere led to the formation of chemicals such as glycine. Glycine is found in living organisms.

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The displayed (structural) formula of glycine is:



(a) Name **three** simple gases that could have been present in the Earth's early atmosphere that might combine to form glycine.

1. _____

2. _____

3. _____

(3)

(b) Describe the main differences between the Earth's early atmosphere and the atmosphere today.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(c) Air is a source of some gases used in industrial processes.

Name the process used to separate the gases in air.

Give the reason why this process can be used to separate the gases.

_____

_____

_____

_____

(2)

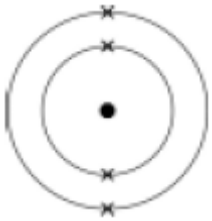
(Total 9 marks)

Q212.

A substance made of only one type of atom is called an element.

(a) The diagram represents the structure of an atom.

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(i) What does the diagram tell you about this atom?

_____

_____

_____

_____

_____

_____

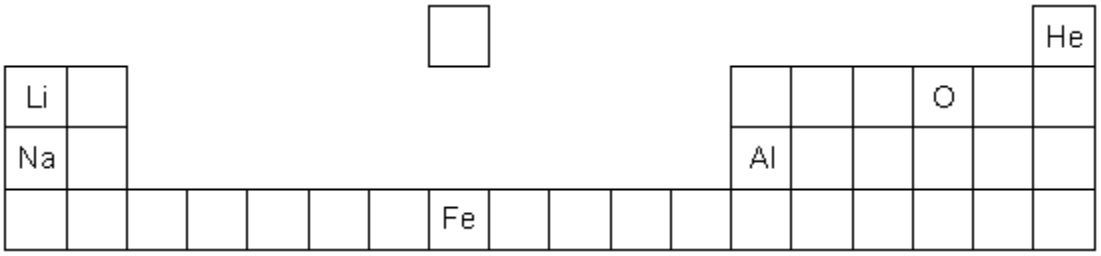
(3)

(ii) The atom of a different element has an atomic number of 5 and a mass of 11.
How many neutrons are in this atom?

_____

(1)

(b) The chemical symbols and positions of six elements in the periodic table are shown.



Draw a straight line from each description to its correct symbol.

Description	**Symbol**
	Al
A metal with a low density that does not corrode easily	
	Fe
It has properties similar to those of sodium, Na	
	_____

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It is a transition metal	He
It is a noble gas	Li
	O

(4)

(Total 8 marks)

Q213.

Atoms are made up of three main particles.

(a) Complete the table to show the names and charges of the particles in an atom.

Name of particle	Charge
proton	
	0
electron	–1

(2)

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

(b) Why are lithium and sodium in the Group 1 of the periodic table?

_____

_____

(1)

(c) Helium is in Group 0 of the periodic table.

(i) Give **one** property of helium that is the same as other gases in Group 0.

_____

(1)

(ii) Give **one** property of helium that is different from other gases in Group 0.

_____

(1)

(Total 5 marks)

Q214.

Crude oil is a mixture of alkanes from which useful fuel fractions can be obtained.

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Fraction	A hydrocarbon in this fraction	Boiling point of alkane in °C
petroleum gases	Propane	–42
petrol (gasoline)	Octane	+126
paraffin (kerosene)	Dodecane	+216
diesel	Eicosane	+344

(a) (i) Suggest the lowest temperature to which crude oil needs to be heated to vaporise all of these fuel fractions.

Temperature _____ °C

(1)

(ii) Dodecane boils at +216 °C. At what temperature will dodecane gas condense to liquid?

Temperature _____ °C

(1)

(iii) Describe what happens in a fractionating column that allows these fractions to be collected.

_____

_____

_____

_____

_____

_____

(3)

(b) Propane is a fuel because it burns in air releasing heat energy.

(i) Complete the balancing of the two chemical equations for propane burning in air.

$2C_3H_8$ + _____ O_2 → _____ CO_2 + _____ H_2O

$2C_3H_8$ + _____ O_2 → _____ CO + _____ H_2O

(2)

(ii) The products of the two chemical reactions in (b)(i) are different.

Explain why.

_____

_____

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_____

_____

_____

(2)

(Total 9 marks)

Q215.

There was little or no nitrogen in Earth's early atmosphere, but a gaseous compound of nitrogen was present in small amounts.

(a) Name this gaseous compound.

_____

(1)

(b) In 1892, Lord Rayleigh compared nitrogen from the air with very pure nitrogen obtained from nitrogen compounds. The density of the nitrogen was:

nitrogen from the air = 1.2572 grams per litre

nitrogen from nitrogen compounds = 1.2511 grams per litre.

Rayleigh and Sir William Ramsay proved that atmospheric nitrogen was not pure but contained five other gases, which together made up about 1 % of the Earth's atmosphere.

The gases were argon (0.94 %) and traces of helium, neon, krypton and xenon. The five gases are similar in that they show no chemical reactions but have different physical properties, eg density, melting point, boiling point.

(i) Suggest **one** reason why scientists did **not** find these five gases in the atmosphere at an earlier date.

_____

_____

(1)

(ii) Give **one** way of separating the five gases from each other.

_____

_____

(1)

(iii) From the information given in the question, which prediction can be safely made?

Tick (✓) **one** box.

Nitrogen makes up about 78 % of the atmosphere. ☐

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Argon has a density greater than the density of nitrogen. ☐

Neon, krypton and xenon have a density lower than the density of nitrogen. ☐

Nitrogen from nitrogen compounds must contain a very light gas such as hydrogen. ☐

(1)

(Total 4 marks)

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