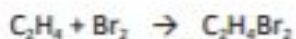


Medic Paths Chemistry Question Pack - Atoms and Periodic Table

GCSE Chemistry Question Part 1

Q1. This question is about the reaction of ethene and bromine.

The equation for the reaction is:

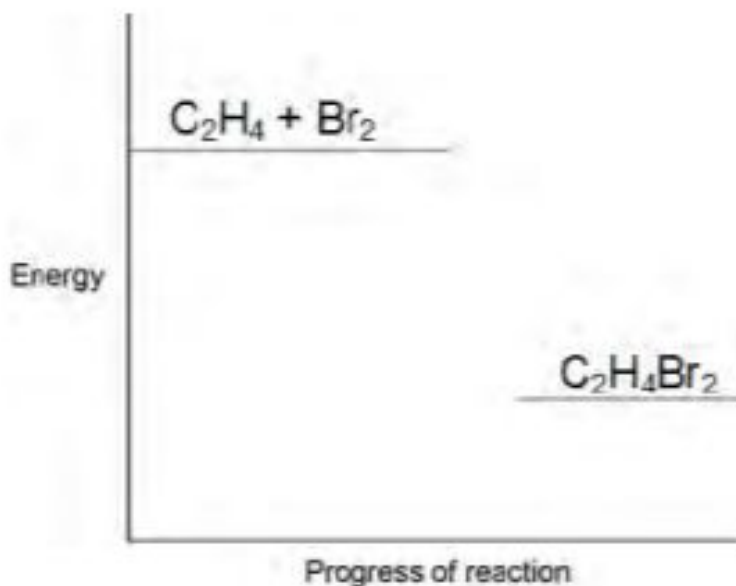


(a) Complete the reaction profile in **Figure 1**.

Draw labelled arrows to show:

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

Figure 1



(3)

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

Explain how a covalent bond holds two atoms together.

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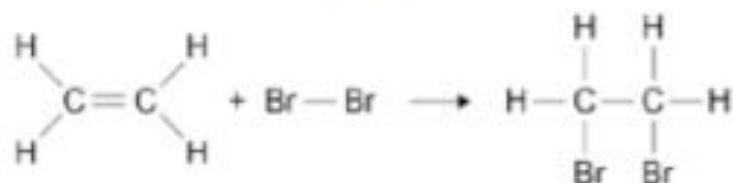
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(2)

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

Figure 2



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

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

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

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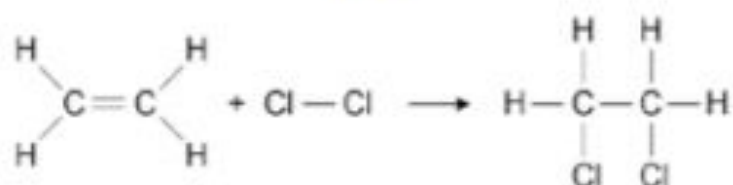
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Bond energy kJ / mole

(3)

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

Figure 3



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

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

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(6)
(Total 14 marks)

Q2.(a) Dmitri Mendeleev was one of the first chemists to classify the elements by arranging them in order of their atomic weights. His periodic table was published in 1869.

How did Mendeleev know that there must be undiscovered elements **and** how did he take this into account when he designed his periodic table?

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(2)

(b) By the early 20th century protons and electrons had been discovered.

Describe how knowledge of the numbers of protons and electrons in atoms allow chemists to place elements in their correct order and correct group.

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(3)

(c) The transition elements are a block of elements between Groups 2 and 3 of the periodic table.

(i) Transition elements have similar properties.

Explain why, in terms of electronic structure.

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(2)

- (ii) There are **no** transition elements between the Group 2 element magnesium and the Group 3 element aluminium.

Give a reason why, in terms of electronic structure.

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(1)
(Total 8 marks)

- Q3.** By 1869, about 60 elements had been discovered. Mendeleev arranged these elements in a table, in order of their atomic weight. He also put elements with similar chemical properties in the same columns.

Mendeleev and part of his table are shown below.



	Group							
	1	2	3	4	5	6	7	8
Period 1	H							
Period 2	Li	Be	B	C	N	O	F	
Period 3	Na	Mg	Al	Si	P	S	Cl	
Period 4	K Cu	Ca Zn	-	-	Ti As	V Se	Cr Br	Mn Fe Co Ni

- (a) (i) Name **one** element in Group 1 of Mendeleev's table that is not in Group 1 of the periodic table on the Data Sheet.
Give a reason why this element should not be in Group 1.

Name of element

Reason

.....

(2)

- (ii) Which group of the periodic table on the Data Sheet is missing from Mendeleev's table?

.....

(1)

- (b) The gaps (-) in Mendeleev's table were for elements that had not been discovered.

- (i) Compare Mendeleev's table with the periodic table on the Data Sheet.

Name **one** of the elements in Period 4 that had not been discovered by 1869.

.....

(1)

- (ii) Mendeleev was able to make predictions about the undiscovered elements. This eventually led most scientists to accept his table.

Suggest what predictions Mendeleev was able to make about these undiscovered elements.

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(2)

- (c) In terms of their electronic structure:

- (i) state why lithium and sodium are both in Group 1

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.....
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(1)

- (ii) explain why sodium is more reactive than lithium.

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(3)
(Total 10 marks)

Q4. The table shows some properties of gases in dry air

Gas in dry air	Density in kg/m ³	Melting point in °C	Boiling point in °C	Percentage (%) in air
Nitrogen	1.2506	-210	-196	78.08
Oxygen	1.4290	-219	-183	20.95
Carbon dioxide	1.977	-57	-57	0.033
Helium	0.1785	-272	-269	0.00052
Neon	0.8999	-249	-246	0.0019
Argon	1.7837	-189	-186	0.934
Krypton	3.74	-157	-153	0.00011
Xenon	5.86	-112	-108	0.0000087

- (a) In 1895, Lord Rayleigh isolated nitrogen from dry air by removing the other known gases, oxygen and carbon dioxide.
He then discovered that nitrogen from dry air had a different density to pure nitrogen produced from chemical reactions.
He concluded that nitrogen extracted from dry air was mixed with another gas.
The density of nitrogen extracted from dry air was higher than the density of pure nitrogen.

Use the information above to explain why.

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(2)

- (b) Gases from the air are separated to provide raw materials used in many different industrial processes.

Steps in dry air separation:

Step 1: Filter to remove solid particles

Step 2: Remove carbon dioxide

Step 3: Cool the remaining air to $-200\text{ }^{\circ}\text{C}$

Step 4: Separate by allowing the liquefied gases to warm up.

(i) Carbon dioxide is removed before the air is cooled to $-200\text{ }^{\circ}\text{C}$.

Suggest **one** reason why.

.....
.....

(1)

(ii) Which two gases do **not** condense when the remaining air is cooled to $-200\text{ }^{\circ}\text{C}$?

.....and

(1)

(iii) Two gases in air do **not** separate completely when the liquefied gases are allowed to warm up.

Name these **two** gases and give a reason for your answer.

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.....
.....

(2)

(Total 6 marks)

Q5. The halogens are in Group 7 of the periodic table.

(a) Why, in terms of electrons, are the halogens in Group 7?

.....
.....

(1)

(b) Sea water contains bromide ions (Br⁻).

The bromide ions can be changed to bromine by bubbling chlorine gas into sea water. Chlorine is able to displace bromine from sea water because chlorine is more reactive than bromine.



Explain, in terms of electrons, why chlorine is more reactive than bromine.

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(3)
(Total 4 marks)

Q6. This question is about carbon and gases in the air.

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

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

Name of particle	Relative mass
proton	1
neutron	
electron	

(2)

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

Tick (✓) **one** box.

The atomic number

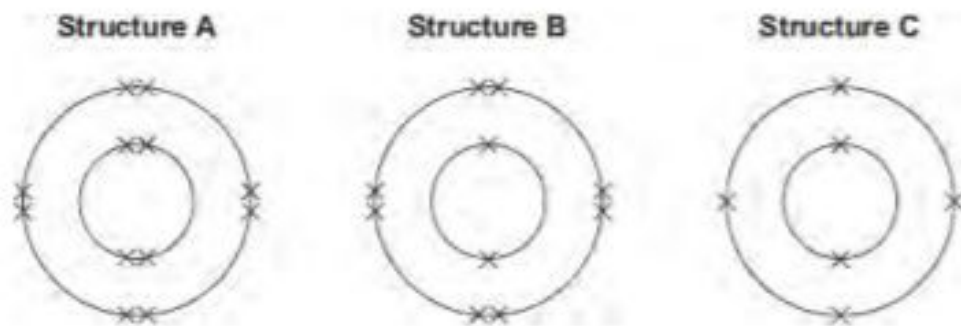
The mass number

One mole of the atom

(1)

- (c) An atom of carbon has six electrons.

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



The carbon atom is structure

(1)

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

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

.....

(1)

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

.....

(1)

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

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

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

.....

.....

M_r of carbon monoxide =

(1)

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

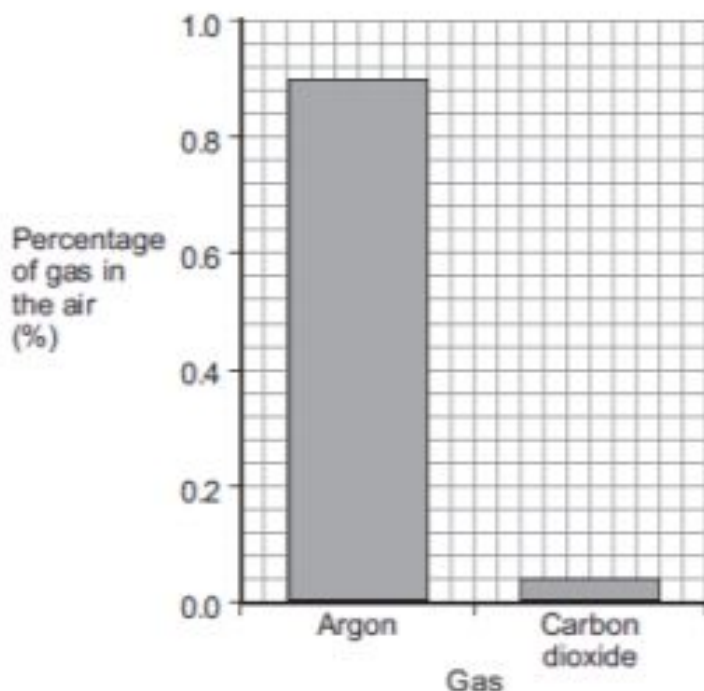
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Percentage by mass of carbon in carbon monoxide =%

(1)

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

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



What is the percentage of argon in the air?

Percentage of argon =%

(1)

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

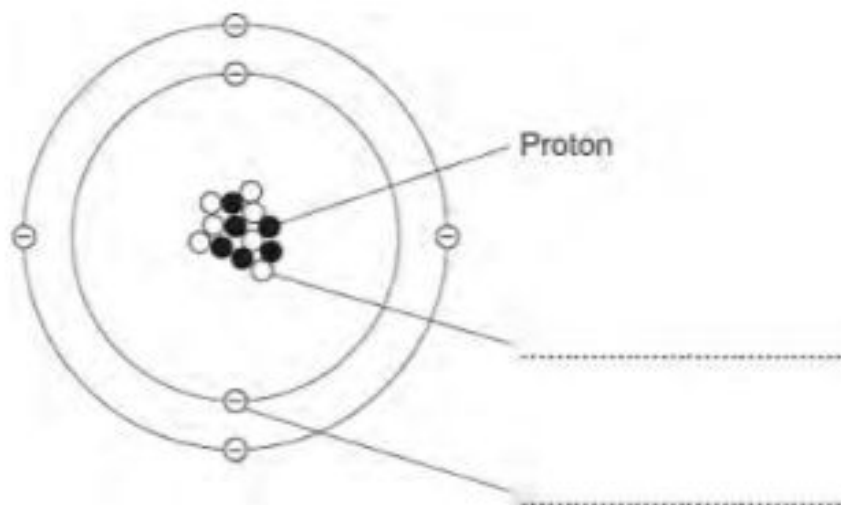
Give **one** reason for using an instrumental method.

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.....

(1)

(Total 10 marks)

Q7. The diagram shows a carbon atom.



(a) (i) A proton is labelled.

Use the correct answer from the box to label each of the other sub-atomic particles.

electron	ion	molecule	neutron
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(2)

(ii) The atom of carbon is represented as:



What is the mass number of this carbon atom?

Draw a ring around the correct answer.

6 13 19

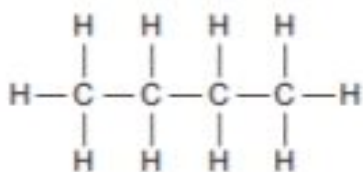
(1)

(iii) Complete the sentence.

Atoms of carbon have no overall electrical charge because the number of protons is the same as the number of

(1)

(b) Butane is represented as:



(i) Use the correct answer from the box to complete each sentence.

bond	compound	helium	hydrogen	mixture	oxygen
------	----------	--------	----------	---------	--------

Butane is a

Butane contains atoms of carbon and

Each line between the atoms in butane represents a chemical

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(3)

(ii) Which is the correct formula for butane?

Tick (✓) **one** box.

C_4H_4

C_4H_6

C_4H_{10}

(1)
(Total 8 marks)

GCSE Chemistry Question Part 2

Q1. An atom of aluminium has the symbol ${}_{13}^{27}\text{Al}$

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

Number of protons

Number of neutrons

Number of electrons

(3)

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

.....

.....

(1)

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

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

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

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

.....

.....

(6)
(Total 10 marks)

Q2. Rock salt is a mixture of sand and salt.

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

Some students separated rock salt.

This is the method used.

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

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

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.....

(1)

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

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

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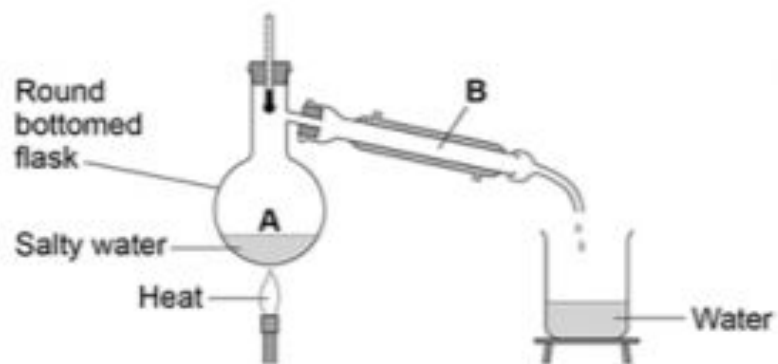
(1)

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

.....
.....

(1)

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



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

.....

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.....

(2)

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

..... °C

(1)
(Total 6 marks)

Q3. This question is about halogens and their compounds.

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

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

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

Tick **one** box.

Iodine is ionic and chlorine is covalent

Iodine is less reactive than chlorine

The covalent bonds between iodine atoms are stronger

The forces between iodine molecules are stronger

(1)

(b) Predict the boiling point of bromine.

.....

(1)

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

The equation for this reaction is:



Look at table above.

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

Tick **one** box.

Brown

Orange

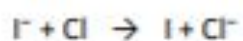
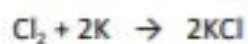
Pale green

Colourless

(1)

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

Tick **one** box.



(1)

(e) Why does potassium iodide solution conduct electricity?

Tick **one** box.

It contains a metal

It contains electrons which can move

It contains ions which can move

It contains water

(1)

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

Tick **one** box.

Product at cathode

Product at anode

hydrogen

iodine

hydrogen

oxygen

potassium

iodine

potassium

oxygen

(1)

(Total 6 marks)

Q4.Water from a lake in the UK is used to produce drinking water.

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

Give a reason for each step.

Step 1

Reason

Step 2

Reason

(2)

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

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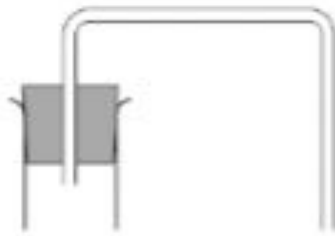
(3)

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

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

Label the following:

- pure water
- salt solution



(3)

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

Give the expected result of the test for pure water.

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(2)

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

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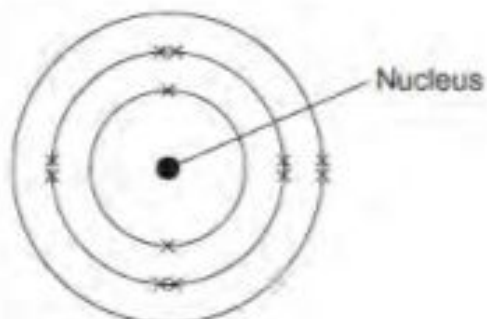
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(1)

(Total 11 marks)

Q5. This question is about magnesium.

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



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

electrons	neutrons	protons	shells
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The nucleus contains protons and

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

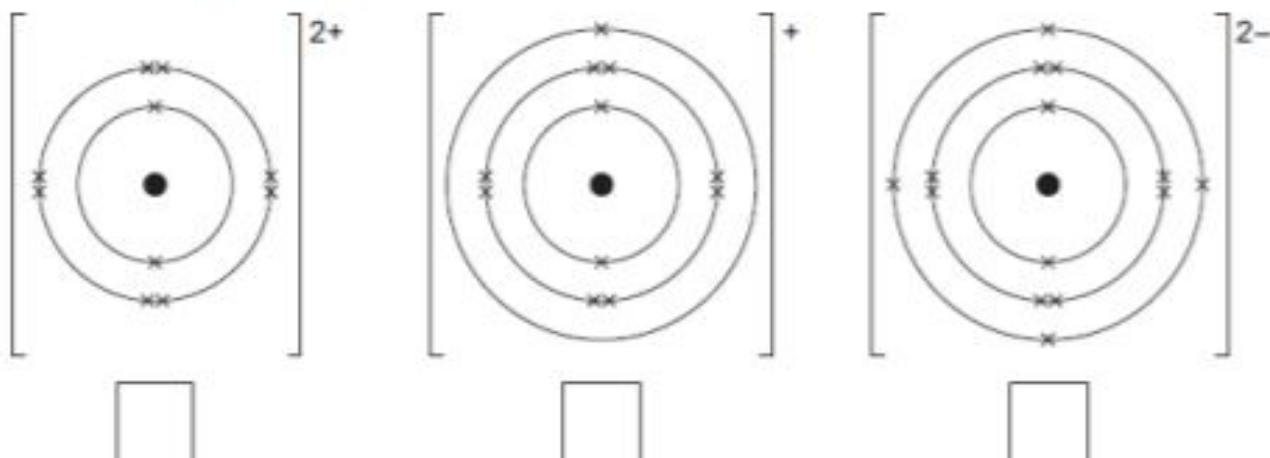
Atoms of magnesium are neutral because they contain the same number of electrons and

(3)

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

Which diagram shows a magnesium ion?

Tick (✓) one box.



(1)

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



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

1

.....

2

.....

(2)

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

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

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

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

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(6)
(Total 12 marks)

Q6.This question is about atomic structure and elements.

(a) Complete the sentences.

(i) The atomic number of an atom is the number of

(1)

(ii) The mass number of an atom is the number of

.....

(1)

(b) Explain why an atom has no overall charge.

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

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(2)

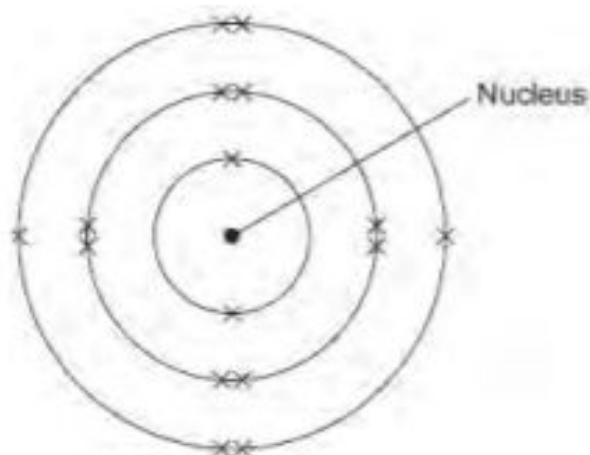
(c) Explain why fluorine and chlorine are in the same group of the periodic table.

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

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.....

(2)

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



What is the chemical symbol of this non-metal?

Tick (✓) **one** box.

Ar

O

S

Si

(1)

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

Complete the sentences.

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

(1)

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

(1)

(Total 9 marks)