AQA Chemistry Unit 1

Atomic Structure

Crompton House Chemistry

I am able to:

		Learn it	Revise it
1	**I can fully describe the structure of the atom and give the charges of protons, electrons, and neutrons**		
2	I can explain the difference between elements and compounds		
3	I can write word equations and symbol equations for chemical reactions, including using appropriate state symbols		
4	I can name and describe the physical processes used to separate mixtures and suggest suitable separation techniques.		
5	I can describe how the atomic model has changed over time due to new experimental evidence, including the discovery of the atom and Rutherford and Marsden's scattering experiments		
6	**I can describe how electrons fill energy levels in atoms, and I can represent the electron structure of elements using diagrams and numbers**		

DODDLE QUIZZES

AQA Atoms, Elements and Compounds _____%

AQA Mixtures _____%

AQA Atomic Model _____%

AQA Atoms and subatomic particles _____%

AQA Atomic mass and electronic structure _____%

Kerboodle Extension Quizzes

Positive Points/postcards for completion

C1 Homework: Atomic Structure 1 _____%

C1 Homework: Atomic Structure 2 _____%

C1 Progress Quiz: Atomic Structure 1 _____%

C1 Progress Quiz: Atomic Structure 2 _____%

C1 Checkpoint quiz: Atomic Structure _____%

Self Reflection

WWW:

EBI:

Checked by Teacher:

Date:

Chapter 1: Atomic structure

Knowledge organiser

Development of the model of the atom

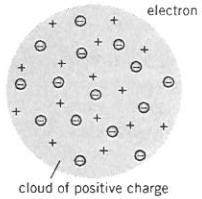
Dalton's model

John Dalton thought of the **atom** as a solid sphere that could not be divided into smaller parts. His model did not include **protons**, **neutrons**, or **electrons**.

The plum pudding model

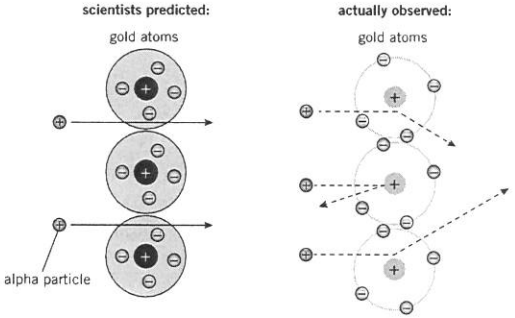
Scientists' experiments resulted in the discovery of sub-atomic charged particles. The first to be discovered were electrons – tiny, negatively charged particles.

The discovery of electrons led to the plum pudding model of the atom – a cloud of positive charge, with negative electrons embedded in it. Protons and neutrons had not yet been discovered.



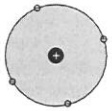
Alpha scattering experiment

1. Scientists fired small, positively charged particles (called alpha particles) at a piece of gold foil only a few atoms thick.
2. They expected the alpha particles to travel straight through the gold.
3. They were surprised that some of the alpha particles bounced back and many were deflected (alpha scattering).
4. To explain why the alpha particles were repelled the scientists suggested that the positive charge and mass of an atom must be concentrated in a small space at its centre. They called this space the **nucleus**.



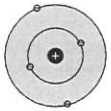
Nuclear model

Scientists replaced the plum pudding model with the nuclear model and suggested that the electrons **orbit** the nucleus, but not at set distances.



Electron shell (Bohr) model

Niels Bohr calculated that electrons must orbit the nucleus at fixed distances. These orbits are called **shells** or **energy levels**.



The proton

Further experiments provided evidence that the nucleus contained smaller particles called protons. A proton has an opposite charge to an electron.

The neutron

James Chadwick carried out experiments that gave evidence for a particle with no charge. Scientists called this the neutron and concluded that the protons and neutrons are in the nucleus, and the electrons orbit the nucleus in shells.

Relative mass

One property of protons, neutrons, and electrons is **relative mass** – their masses compared to each other. Protons and neutrons have the same mass, so are given a relative mass of 1. It takes almost 2000 electrons to equal the mass of a single proton – their relative mass is so small that we can consider it as 0.

Size

The atom has a radius of 1×10^{-10} m. Nuclei (plural of nucleus) are around 10 000 times smaller than atoms and have a radius of around 1×10^{-14} m.

Elements and compounds

Elements are substances made of one type of atom. Each atom of an element will have the same number of protons.

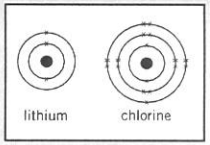
Compounds are made of different types of atoms chemically bonded together. The atoms in a compound have different numbers of protons.

Drawing atoms

Electrons in an atom are placed in fixed shells. You can put

- up to two electrons in the first shell
- eight electrons each in the second and third shells.

You must fill up a shell before moving on to the next one.



Mixtures

- A mixture consists of two or more elements or compounds that are not chemically combined together.
- The substances in a mixture can be separated using physical processes.
- These processes do not use chemical reactions.

Separating mixtures

- filtration – insoluble solids and a liquid
- crystallisation – soluble solid from a solution
- simple distillation – solvent from a solution
- fractional distillation – two liquids with similar boiling points
- paper chromatography – identify substances from a mixture in solution

Atoms and particles

	Relative charge	Relative mass	
Proton	+1	1	= atomic number
Neutron	0	1	= mass number – atomic number
Electron	−1	0 (very small)	= same as the number of protons

All atoms have equal numbers of protons and electrons, meaning they have no overall charge:

total negative charge from electrons = total positive charge from protons

Isotopes

Atoms of the same element can have a different number of neutrons, giving them a different overall mass number. Atoms of the same element with different numbers of neutrons are called **isotopes**.

The **relative atomic mass** is the average mass of all the atoms of an element:

$$\text{relative atomic mass} = \frac{(\text{abundance of isotope 1} \times \text{mass of isotope 1}) + (\text{abundance of isotope 2} \times \text{mass of isotope 2}) \ldots}{100}$$

Key terms

Make sure you can write a definition for these key terms.

abundance, atom, atomic number, aqueous, compound, electron, element, energy level, isotope, neutron, nucleus, orbit, product, proton, reactant, relative atomic mass, relative charge, relative mass, shell

Balancing Equations

Put your final answers here although you may wish to do your working on a separate sheet of paper

1) $Ca + O_2 \rightarrow CaO$

2) $Na_2O + H_2O \rightarrow NaOH$

3) $Al + O_2 \rightarrow Al_2O_3$

4) $Na + Cl_2 \rightarrow NaCl$

5) $Na_2CO_3 \rightarrow Na_2O + CO_2$

RELATIVE ATOMIC MASS

Element	Isotopes	Abundance	Relative atomic mass (A_r) (to 3sf)
Chlorine	$^{35}_{17}Cl$	75.8%	$A_r = \frac{[(35 \times 75.8) + (37 \times 24.2)]}{75.8 + 24.2} = \frac{3548.4}{100} = 35.5$ (3sf)
	$^{37}_{17}Cl$	24.2%	
Lithium	$^{6}_{3}Li$	7.6%	
	$^{7}_{3}Li$	92.4%	
Bromine	$^{79}_{35}Br$	50.7%	
	$^{81}_{35}Br$	49.3%	
Copper	$^{63}_{29}Cu$	69.2%	
	$^{65}_{29}Cu$	30.8%	
Fluorine	$^{19}_{9}F$	100.0%	

Q1. There are millions of different substances that make up our world. All these substances are made from chemical elements.

(a) What is an element?

_____

_____

_____

(1)

(b) Many substances are compounds. What is a compound?

_____

_____

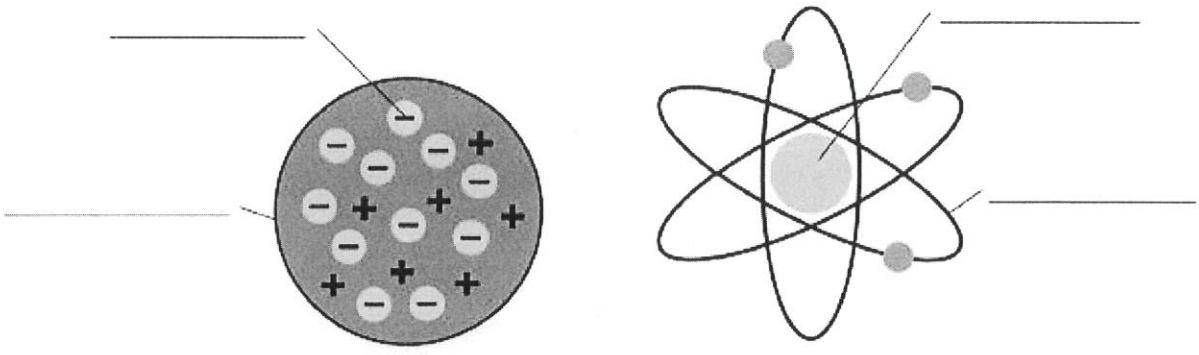
_____

(2)

(Total 3 marks)

Q2. **Figure 1** shows two models of the atom.

Figure 1



Plum pudding model

Nuclear model

(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.

Determine the speed of the alpha particles.

Speed of light = 300 000 000 m/s

_____

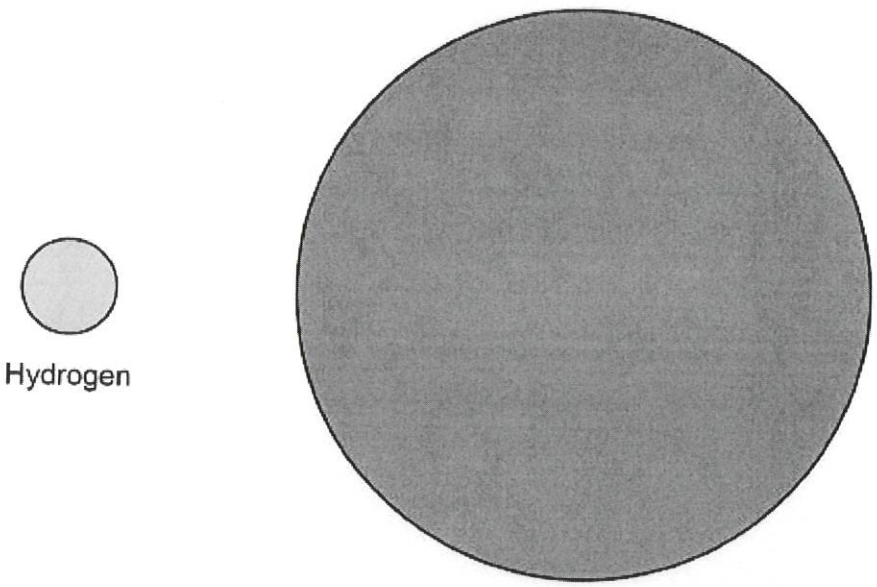
_____

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

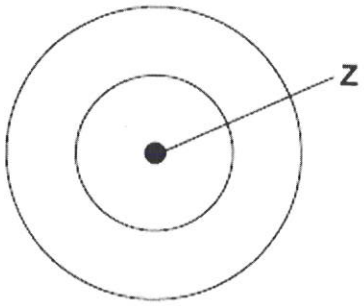
(2)

(Total 10 marks)

Q3. There are eight elements in the second row (lithium to neon) of the periodic table.

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

Figure 1



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

(1)

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

_____

(1)

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

Give the relative charges of these sub-atomic particles.

_____

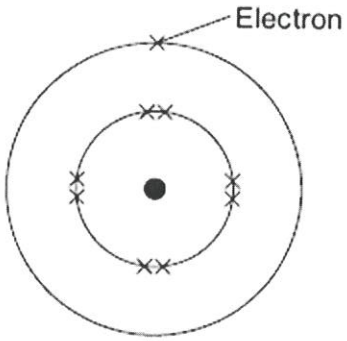
_____

_____

(3)

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

Figure 2

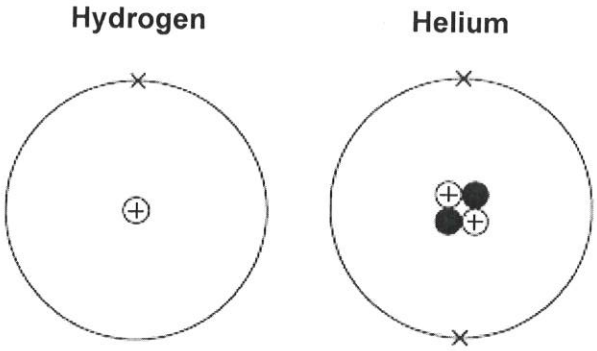


Explain what is wrong with the electronic structure shown in **Figure 2**.

(3)

(Total 8 marks)

Q4. The Sun produces helium atoms from hydrogen atoms by nuclear fusion reactions.



(a) Describe the differences in the atomic structures of a hydrogen atom and a helium atom.

_____

_____

_____

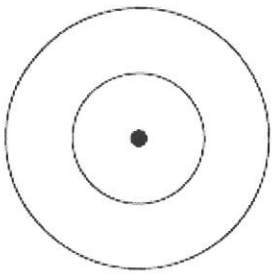
_____

(3)

(b) The Sun consists of 73% hydrogen and 25% helium.
The rest is other elements.
One of the other elements in the Sun is neon.

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

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



(1)

(ii) Why is neon in the same group of the periodic table as helium?

_____

_____

_____

(1)

(Total 5 marks)