TRANSITION TO SIXTH FORM TASK

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TRANSITION TASK

Complete the booklet on atomic structure and bonding in preparation for the A-level course. This will consolidate learning from GCSE and will be built on in the first A-level topics.

KEY PRE-KNOWLEDGE TOPICS

GCSE AQA Chemistry

4.1. Atomic structure and the periodic table.
4.2. Bonding, structure and the properties.

KEY TERMS TO LEARN

Ionic, covalent, metallic, macromolecular, intermolecular, atomic number, mass number, ion, molecule, isotope, co-ordinate bond, electrostatic

RECOMMENDED WEBSITES

www.a-levelchemistry.co.uk

www.knockhardy.org.uk

www.physicsandmathstutor.com

www.chemrevise.org/revision-guides/

PLACES TO VISIT

NECESSARY READING

The recommended text for Year 12 is:
A-Level Year 1 & AS Chemistry
AQA published by CGP
ISBN 978 1 78294 321 1

BEYOND THE CLASSROOM

ChemNet from the Royal Society of Chemistry - help and support for those studying chemistry ages 14-18 (www.chemnet.rsc.org/home)

The Mole - the Royal Society of Chemistry magazine for students (www.rsc.org/eic/mole)

Lymm High School

KS5 Chemistry

Transition Work Booklet

Atomic Structure and Bonding

Name: _____

In this booklet, you will re-cap your previous knowledge from GCSE Chemistry on bonding. This will then be expanded upon with some appropriate Y12 content.

By the end of this, you can expect to be able to:

	Happy	Kind of	Help me
Atomic Structure			
Describe the subatomic particles in an atom			
Define mass number, atomic number and isotope			
Explain isotopes in terms of subatomic particles			
Ionic Bonding			
Describe the structure of ionic compounds			
Explain the properties of ionic compounds using an understanding of ionic bonding			
Predict the formula of simple ions based on their position in the Periodic Table			
Write the formula of common compound ions			
Write the formula of ionic compounds			
Covalent Bonding			
Describe the nature of covalent bonds			
Represent molecules by diagrams where lines represent each covalent bond			
Describe the structure of molecular substances			
Explain the properties of molecular substances			
Describe Co-ordinate covalent bonds and their importance			
Explain the giant covalent structures of diamond and graphite using knowledge of their structure and properties			
Metallic Bonding			
Describe the nature of metallic bonding			
Describe the structure of metals using specialist terminology			
Explain the properties of metals using knowledge of their structure			
Determine the type of structure you have based on given data or that gained from experimentation			

All work in this booklet is to be completed. This forms part of your course, just as attending lessons and completing outside study.

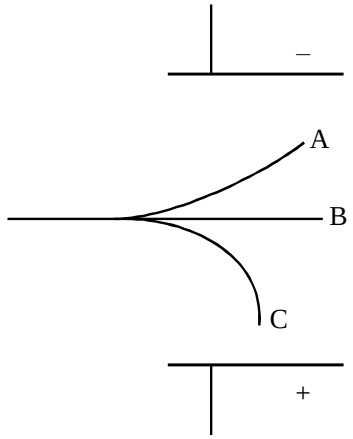
Atomic Structure

As at GCSE it is often useful to use relative values for these particles. Record the relative values in the table below:

	Relative Mass	Relative Charge
Proton		
Neutron		
Electron		

3.1.1.2 Protons, neutrons and electrons.

The figure below shows the behavior of three subatomic particles when traveling through an electric field.



Identify the fundamental particles labelled A, B and C.

_____

Mass number and isotopes

Definitions:

Mass number =

_____

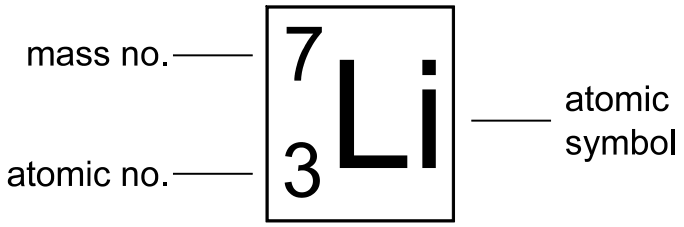
Atomic number =

_____

Isotopes

_____

The mass and atomic numbers are written at the left hand side of each symbol as follows.



From the above symbol we can conclude

- The number of protons is 3 (This is the bottom number)
- The number of electrons is 3, as all atoms are neutral and so the number of negative electrons must be the same as the number of positive protons.
- The number of neutrons and protons is 7 and since 3 of these are protons there must be 4 neutrons in the nucleus.

To find the number of each type of sub atomic particle in an atom:

- The protons are given by the bottom left hand number.
- The electrons are the same as the protons (this is only the case in neutral atoms not in ions)
- The neutrons are the difference between the top and bottom numbers.

Question: Find the number of each type of sub atomic particle in the following atoms.

	$^{27}_{13}Al$	$^{108}_{47}Ag$	$^{56}_{26}Fe$	$^{28}_{14}Si$
p	_____	_____	_____	_____
e	_____	_____	_____	_____
n	_____	_____	_____	_____

Isotopes

Thompson observed that some elements could have atoms with different masses these are referred to as isotopes. We have met many examples of isotopes before at GCSE, but the following is included to remind you.

The element chlorine has two common isotopes, 75% of all chlorine atoms are Cl^{35} and 25% of chlorine atoms are Cl^{37}. These atoms have the same number of protons (_____) and the same number of electrons (_____), but they differ in the number of neutrons in the nucleus. One isotope has _____ neutrons in the nucleus whereas the other has _____ neutrons in the nucleus.

The chemical properties of isotopes of an element will be the same. Explain why.

_____

_____

_____

The physical properties of isotopes of an element will be different. Give some examples of physical properties.

_____

_____

Explain why the physical properties of isotopes differ.

_____

_____

_____

Bonding

There are three types of strong chemical bonds, which were met at GCSE:

1. _____
2. _____
3. _____

Why do atoms form bonds with other atoms?

_____

Why are the noble gases very unreactive?

_____

Note: We will be using energy levels instead of shells when describing electronic configuration at A-level.

Ionic Bonding

Ionic bonds form between metals and non-metal. Metals will lose electrons to attain noble gas configuration. Non-metals will gain electrons to attain noble gas configuration

An example of an ionic compound is Potassium chloride, KCl. Describe how the ions in potassium chloride are formed and draw a dot-cross diagram.

_____

_____

_____

Describe the nature of the bonding and structure of potassium chloride.

_____

_____

_____

Properties of Ionic Compounds

Ionic compounds are always solid at room temperature. Draw a 3D diagram to show the arrangement of the ions.

Ionic compounds have very high melting point. Explain this property in terms of their structures.

_____

_____

_____

_____

Ionic compounds conduct electricity in the molten state and when dissolved in water, but not when they are solid. Explain this property with diagrams.

_____

_____

_____

_____

Ionic compounds are brittle; they shatter when given a sharp blow. Explain this property with diagrams.

_____

_____

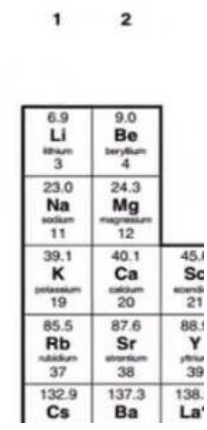
_____

Formulae of Ions

In A-Level Chemistry, you need to be able to determine the name and formula of many common ions.

For simple, monoatomic ions:

The group number of the atom will tell you how many electrons are in the outer energy level. All you need to do is work out how to make it full, e.g.



If we focus on Lithium (Li), we can see it is in group 1. This means it has one electron in its outer energy level. To make it full, you need to fill up the energy level with electrons. We can either add 7 electrons or remove 1 – removing one electron is going to be much easier!

Removing a **negatively charged** electron will result in an overall positive charge, giving us a lithium ion, or Li^+.

As a rule of thumb:

Group 1 ions are 1+, **Group 2** ions are 2+, **Group 3** ions are 3+

Group 5 ions are 3-, **Group 6** ions are 2-, **Group 7** ions are 1-

Group 0/8 elements don't form ions.

Determine the formula for these common ions:

Na ____ H____ Mg____ K____ N____

For polyatomic compound ions:

Look up the following compound ions and their formulae

CO_3____ OH____ NO_3____ CN____ HCO_3____

SO_4____ NH_4____ HSO_4____ PO_4____ MnO_4____

Covalent bonding

Non-metals need to gain electrons and will share some of their outer electrons with each other to attain noble gas configuration. The number of electrons to share is the number of electrons the atom needs to attain the stable configuration.

A pair of electrons = a single covalent bond. A double bond will consists of _____ electrons.

Covalently bonded substances fall into two categories:

a) Simple molecules
b) Giant covalent structures (macromolecules)

Simple molecules

A molecule is a small group of atoms that are joined by covalent bonds.

Use dot-cross diagrams to show the bonding in:

i. Hydrogen chloride

ii. Ammonia

iii. Oxygen

iv. Carbon dioxide

Co-ordinate (dative covalent) bonds

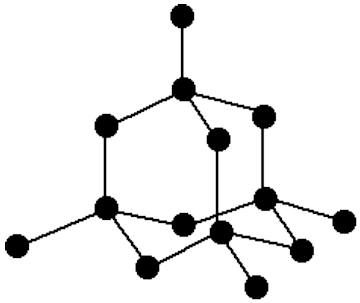
As we know, a covalent bond is a pair of electrons shared between two atoms. Usually each atom contributes one electron to the bond, but in some covalent bonds, both electrons are provided by one atom. This is called a co-ordinate (or dative) bond. Once the bond is formed it is identical to any other covalent bond. Discover how to draw the particles in the following equations:

E.g. ammonia + hydrogen ion → ammonium ion

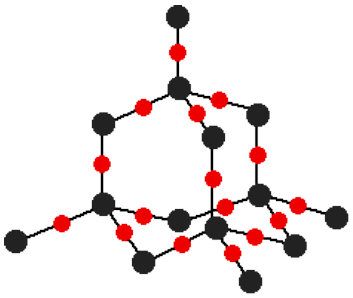
E.g. $BCl_3 + NH_3 \rightarrow NH_3BCl_3$

Giant covalent structures (macromolecules)

A macromolecule is one in which a large number of atoms are bonded together by covalent bonds. the covalent bonds extent throughout a giant structure. Typical examples are diamond and silicon dioxide. Label the atoms in the diagrams



Diamond



Silicon dioxide

Properties of macromolecules

Macromolecules have extremely high melting points. Explain why.

_____

_____

_____

Macromolecules are usually poor conductors of electricity. Explain this property.

_____

_____

_____

Metallic bonding

Metals lose up to three electrons to attain a noble gas configuration, forming positively charged metal ions. The outermost electrons become delocalised; this means that they are no longer part of any particular atom.

Describe the nature of the structure and bonding in metals. Draw a picture to illustrate your ideas.

_____

_____

_____

_____

Properties of metals

Metals are good conductors of heat and electricity. Explain this property.

_____

_____

_____

Metals are malleable and ductile. Explain these properties with diagrams.

_____

_____

Metallic bonds tend to be strong. Their strength depends on two things:

i. The charge on the metal ion

_____

_____

ii. The size of the ion

_____

_____

We often consider the charge-to-size ratio of the metal ion. If the charge : size ratio is large (i.e. highly-charged and small size), then the metallic bond is said to be _____.

Metals generally have high melting points. Explain this property.

_____

_____

_____

State and explain which of the metals Na, Mg and Al have the highest melting point.

_____

_____

_____

Exam Questions

1. (a) Complete the following table.

	Relative mass	Relative charge
Proton		
Electron		

(2)

(b) An atom of element **Q** contains the same number of neutrons as are found in an atom of ^{27}Al. An atom of **Q** also contains 14 protons.

(i) Give the number of protons in an atom of ^{27}A1.

.....

(ii) Deduce the symbol, including mass number and atomic number, for this atom of element **Q**.

.....

(3)

(c) Define the term *relative atomic mass* of an element.

.....

.....

(2)

2. State the relative charge and relative mass of a proton, of a neutron and of an electron. In terms of particles, explain the relationship between two isotopes of the same element. Explain why these isotopes have identical chemical properties. **(Add answer on separate sheet)**

(7)

3. Silver reacts with fluorine to form silver fluoride (AgF).

Silver fluoride has a high melting point and has a structure similar to that of sodium chloride.

State the type of bonding involved in silver fluoride.

Draw a diagram to show how the particles are arranged in a silver fluoride lattice and show the charges on the particles.

Explain why the melting point of silver fluoride is high.
(Add answer on separate sheet)

(5)