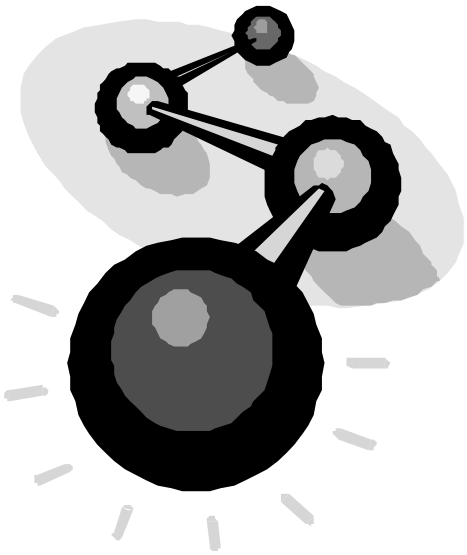
Intermediate 1

Int 1 Chemistry



Section 3

Bonding

3LO Section 3: Learning Outcomes

Intermediate 1 Chemistry Unit 1: Chemistry In Action

Section 3: Bonding

LO	Lesson	Text Book	Learning Outcome	Int1
1	3.1	p30	Every element is made up of very small particles called atoms .	Int1
2	3.1	p30	Atoms of different elements are different.	Int1
3	3.2	p31	Some substances are made up of molecules.	Int1
4	3.2	p31	Molecules are made up of two or more atoms held together by strong bonds.	Int1
5	3.2 3.9 3.9	p34 p35 p39	Bonds between molecules are weak. a) substances made of molecules have low melting and boiling points b) substances made of molecules do not conduct electricity	Int1
6	3.8	p37	Some substances are made up of ions.	Int1
7	3.8	p38	Ions can be positively or negatively charged.	Int1
8	3.8	p38	Ionic compounds are made up of oppositely charged ions.	Int1
9	3.8 3.9 3.11	p37 p37 p37	Bonds between ions are strong. a) substances made of ions have high melting and boiling points b) substances made of ions conduct electricity when dissolved in water or molten	Int1
10	3.5	p31	Formulae are written from models or pictorial representations.	Int1
11	3.7	p33	Formulae are written using prefixes, eg 'mono- ', 'di- ', 'tri- ', 'tetra- '.	Int1

NB: There are no Access 3 level Learning Outcomes in Section 3

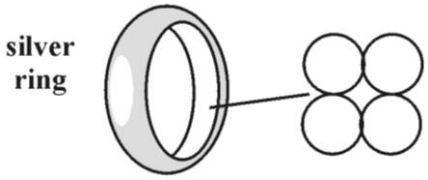
3.1 Atoms

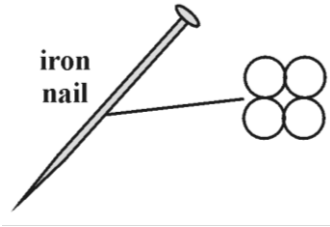
a) **Copy** the following into your jotter.

Atoms are the simplest building block of all substances.

There are approximately 100 different types of atoms. These are called elements and are found on the Periodic Table

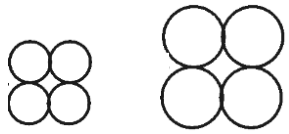
A **silver** ring contains millions of silver atoms. Each silver atom is the same.





Every atom in an **iron** nail is an atom of iron, and all atoms of iron are the same.

But iron atoms are smaller and lighter than silver atoms.



b) **Copy** and **complete** the following table into your jotter for the first **ten** elements of the Periodic Table and **ten** elements of your own choice.

Element	Atomic Number
	1
	2
	3
	4
	5
	6
	7
	8
	9
	10

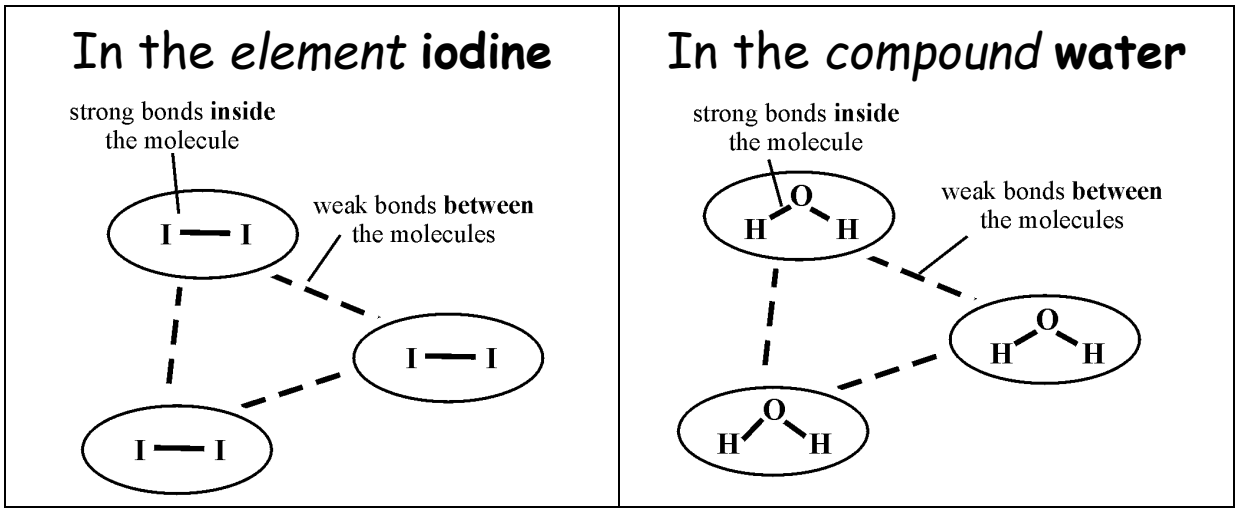
Element	Atomic number

3.2 Molecules and Bonds

a) **Copy** the following into your jotter.

- Atoms are pure substances.
- Mixtures are when different substances are "mixed" together without chemically joining together.
- A **molecule** is when 2 or more atoms are joined together.
- The "joins" between molecules are called **bonds**.
    - Bonds **inside** molecules are **strong** to hold molecules together.
    - Bonds **between** molecules are **weak**.

b) **Copy** the following diagrams into your jotter.



c) **Copy** and **complete** the following passage in your jotter using the word bank.

wordbank

large	**strong**	**less**	**weak**	**further**

1. The bonds holding atoms together <u>inside</u> a molecule are ……..
2. This is why breaking up molecules requires a ……amount of energy.
3. The bonds between different molecules are ……
4. Melting and boiling makes molecules move …… apart.
5. This is why melting a substance requires …… energy than breaking up molecules.

3.3 Chemical Formula I

a) **Copy** the following into your jotter.

Every substances has a chemical name and a chemical formula.

As well as having its own chemical name, each substance can be represented by a **chemical formula**.

- The chemical formula tells us the number of atoms of each element in a molecule.
- The number of atoms of each element in the molecule is indicated by a number after the symbol for the element,

Examples:

1. Chemical formula is O_2 → **two** oxygen atoms in the molecule.
2. Chemical formula is PH_3 → **one** phosphorus and **three** hydrogens

b) **Copy** and **complete** the following table in your jotter.
(use page 6 of data booklet to identify elements from their symbol)

Formula	Number of Atoms
CO_2	1 carbon + 2 oxygen
CH_4	
H_2O	
Al_2O_3	
$CaCO_3$	
H_2SO_4	
NH_3	
N_2O	
HCl	

If there is only one atom of an element in the molecule, then the number '1' is not written in, e.g. the chemical formula CO_2 shows that there is **one** carbon atoms and **two** oxygen atoms in the molecule.

3.4 Chemical Formula II – Molecular Models

a) **Collect** a set of molecular models (molymods)

b) **Read** the following instructions on the use of molymods

Each colour of molymod represent a type of atom.

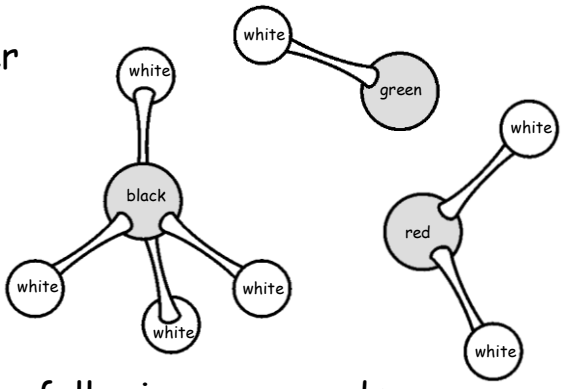
- BLACK: a carbon atom
- BLUE: a nitrogen atom
- RED: an oxygen atom
- GREEN a chlorine atom
- WHITE: a hydrogen atom

c) **Join** the following combinations together

i. Hydrogen and chlorine atoms

ii. Hydrogen and oxygen atoms

iii. Hydrogen and carbon atoms



d) Use the molymods to **make** models of the following compounds

i. hydrogen oxide

ii. nitrogen hydride

iii. carbon chloride

iv. carbon dioxide

v. hydrogen H_2

vi. Chlorine Cl_2

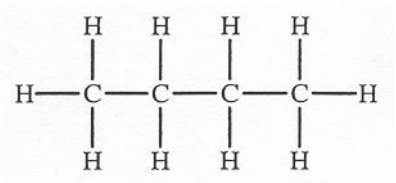
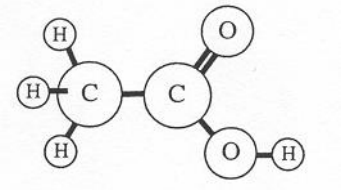
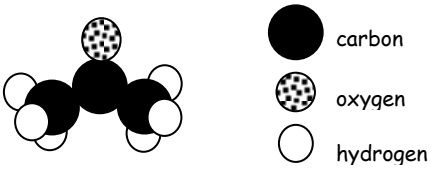
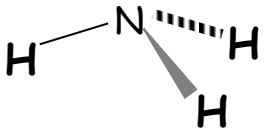
vii. nitrogen N_2

viii. Oxygen O_2

3.5 Chemical Formula III - Diagrams

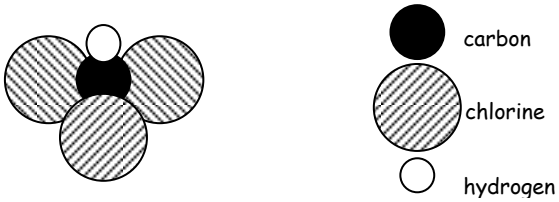
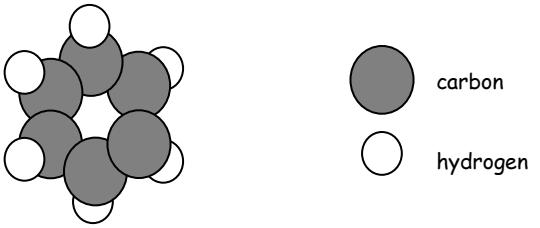
a) **Collect** the question sheet and **stick** it into your jotter.

b) **Work out** the chemical formula of the substances shown and **write** down the chemical formula in the last column of the table.

Chemical	Diagram	Chemical Formula
butane (camping gas)		C_4H_{10}
ethanoic acid (vinegar)		$C_2H_4O_2$
acetone (nail varnish remover)		
Ammonia (found in some hair dyes)		
Ethylene glycol (anti-freeze)		

3.6 Diagrams II

a) **Work out** the chemical formula as you did in the previous lesson

Chemical	Diagram	Chemical Formula
Trichloromethane (chloroform)		
Benzene (carcinogen & causes cancer)		
Aspirin (pain-killer drug)		
Caffeine (found in coffee and red bull)		

3.7 Chemical Formula IV: Prefixes

a) **Copy** the following passage into your jotter.

Some chemicals have names which give information about the chemical formula. They use prefixes to indicate the number of atoms in the formula.

b) **Copy** the following table into your jotter.

Prefix	Meaning	Example	Formula
Mono-	1	carbon **mono**xide	$C_1O_1 \rightarrow CO$
Di-	2	sulphur **di**oxide	$S_1O_2 \rightarrow SO_2$
Tri-	3	phosphorus **tri**hydride	$P_1H_3 \rightarrow PH_3$
Tetra-	4	carbon **tetra**chloride	$C_1H_4 \rightarrow CH_4$

c) **Copy** and **complete** the following table in your jotter.

Substance	Formula
carbon dioxide	
sulphur trioxide	
nitrogen dioxide	
nitrogen monoxide	
dinitrogen oxide	
dinitrogen tetroxide	
dihydrogen oxide (water)	
phosphorus pentachloride	

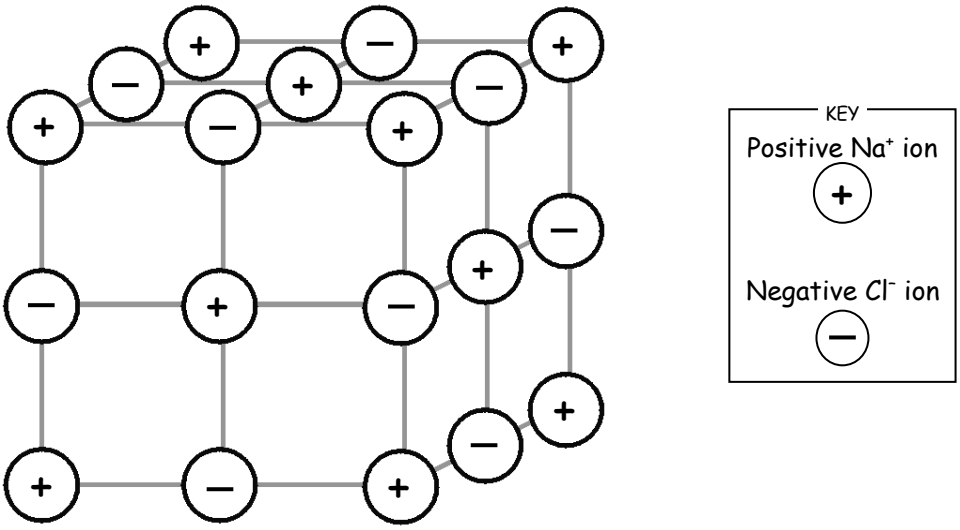
3.8 Ions

a) **Copy** the following passage into your jotter.

Some substances are made of ions.

- Ions are charged particles
- There are two different oppositely-charged ions in every substances made of ions.
  - Positive ions (+ve)
  - Negative ions (–ve)
- The bonds between ions are strong

b) **Collect** the diagram of the ionic compound sodium chloride Na^+Cl^-, **stick** it into your jotter and **complete** the diagram by colouring the two different types of ions.



sodium chloride

c) **Copy** and **complete** the following passage using the word bank.

wordbank		
attract	strong	repel

1. The bonds between ions are ……
2. A positive and a negative ion …… each other
3. Two positive ions …… each other
4. Two negative ions …… each other

3.9 Bonding Type I: Melting & Boiling Points

a) **Copy** the following passage into your jotter.

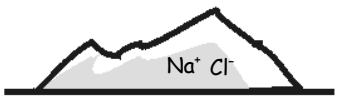
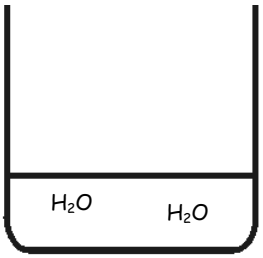
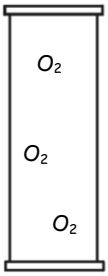
The bonds between molecules in substances are <u>weak</u>.

- Weak bonds between molecules are easy to break
- Less heat energy required to break up molecules
- Low melting and boiling point as less energy is required
- <u>Substances made of molecules tend to be gases and liquids</u> at room temperature

The bonds between ions in substances are <u>strong</u>.

- Strong bonds between ions are hard to break
- More heat energy required to break up ions
- High melting point and boiling point as more energy is required
- <u>Substances made of ions are solids</u> at room temperature.

b) **Copy** the following table into your jotter

Salt (sodium chloride NaCl)	Water (H_2O)	Oxygen (O_2)
		
Melting Point: 801°C Boiling Point: 1465°C	Melting Point: 0°C Boiling Point: 100°C	Melting Point: -218°C Boiling Point: -183°C
Solid at 25°C	**Liquid** at 25°C	**Gas** at 25°C
Substance made of: **Ions**	Substance made of: **Molecules**	Substance made of: **Molecules**

3.10 Bonding Type II

a) **Read** the following two statements to help you complete the rest of this lesson:

- Substances made of molecules *tend* to be gases and liquids at room temperature
- Substances made of ions are solids at room temperature.

b) **Copy** and **complete** the following table in your jotter.

Substance	Solid, Liquid or Gas	Molecular or Ionic
Salt		
Water		
Oxygen		
Fertiliser	Solid	
Petrol		
Methane		
Epsom salts		
Baking Soda		

However, some molecular substances can be solids e.g. sugar.

c) **Copy** the following table into your jotter and use you data booklet (page 4) to **complete** the table.

Substance	Melting Point (°C)	Molecular or Ionic
phenol		
calcium oxide		
naphthalene		
sodium bromide		

3.11 Bonding & Conductivity

a) **Copy** the following passage into your jotter.

The type of bonding in a substance decides whether a substance conducts electricity or not:

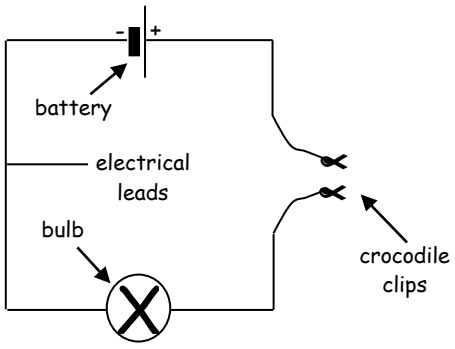
- Substances made of molecules do <u>not</u> conduct electricity
- Substances made of ions sometimes conduct depending on which state they are in
  - Solid ionic compounds do <u>not</u> conduct
  - Liquid (i.e. molten) ionic compound conduct electricity
  - Ionic substances in solution conduct electricity

b) **Copy** the following table into your jotter.

Substance	State	Molecular or Ionic	Conductor or Non-conductor
oxygen	gas	Molecular	
paraffin	liquid	Molecular	
sodium chloride	solid	Ionic	
sodium chloride	solution	Ionic	
Sodium chloride	liquid	Ionic	conductor

c) **Carry out** the following experiment.

1. Set up the following electrical circuit.
2. Use the crocodile clips to connect up the different materials provided into the electrical circuit.
3. If the bulb lights up, record the material as an electrical conductor in your results table.
4. If the bulb fails to light up, record the material as an electrical insulator in your results table.



d) **Copy** and **complete** the following summary.

- Make sure you only leave the *correct* words in the table

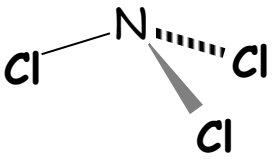
Type of Bonding	Bonds Between molecules/ions	Usual State(s)	Melting/Boiling Point	Conductivity (✓ or ×)		
				Solid	Liquid	solution
Molecular	strong/weak	solid/liquid/gas	high/low	✓ or ×	✓ or ×	✓ or ×
Ionic	strong/weak	solid/liquid/gas	high/low	✓ or ×	✓ or ×	✓ or ×

Revision 3.12

Intermediate 1 Level Revision Questions

1. An ionic compound will conduct electricity as a **solid** / **solution**.
2. In ionic compounds the ions have **the same** / **opposite** charge.
3. Molecules are made up of atoms held together by **weak** / **strong** bonds.
4. Substances made up of molecules have a low melting point because the bonds between the molecules are **weak** / **strong**.
5. The forces between the ions in an ionic compound are **weak** / **strong**.

6. Which of these substances is made up of ions?
   A. Water.
   B. Carbon dioxide.
   C. copper.
   D. salt.

7. the compound represented by 

is called
   A. Nitrogen monochloride.
   B. Nitrogen dichloride.
   C. Nitrogen trichloride.
   D. Nitrogen tetrachloride.

8. Copy and complete the table.

Substance	**Molecular or ionic**	**Electrical conduction**	
		Solid	**liquid**
Sodium bromide	Ionic		Yes
Hexane	Molecular	No	
Calcium chloride			yes

9. Look at the information in the table below.

Substance	Boiling point (°C)
CH_4	-164
C_2H_6	-89
A	-42
C_4H_{10}	-1

a) Predict the formula for compound "A".
b) Suggest a pattern for how the boiling point changes with the number of carbons.
c) Suggest a value for the boiling point of the compound C_5H_{12}.