Chemistry A Level

Why choose chemistry?

A level chemistry is **useful** for entry into

- Forensic science
- Physics
- Earth sciences
- Biology
- and many more….

It is **essential** for entry to

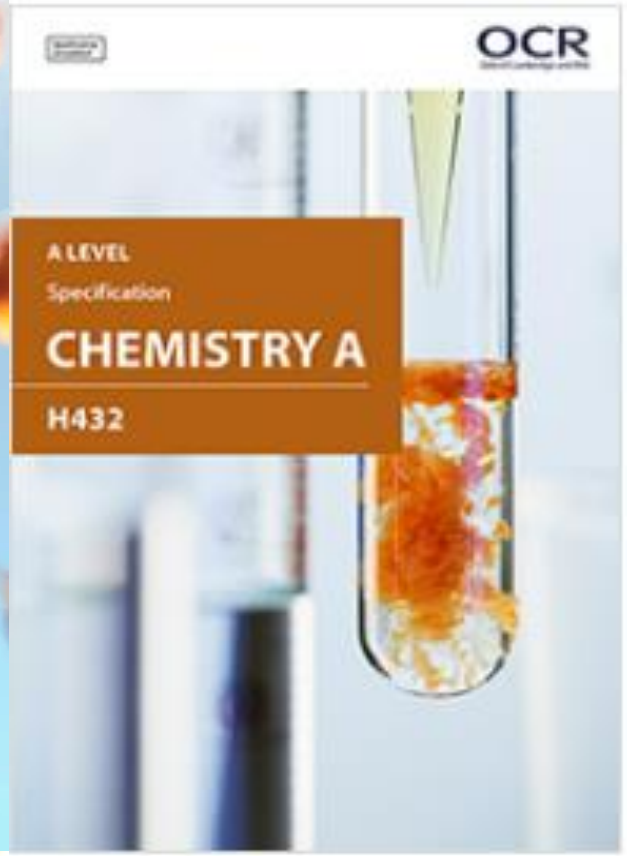
- Medicine
- Veterinary Science
- Pharmacology
- Dentistry

and many more …

Course Details

Course Name:
A Level Chemistry

Exam Board: OCR



OCR Chemistry A

- 2015 - Developed with the Royal Society of Chemistry, GlaxoSmithKline, teachers and centres.
- There is an increased emphasis on understanding and application rather than recall.
- 'How Science Works' IS integrated within the learning outcomes/opportunities.
- Updated in response to developments in chemistry and also the impact on society and resources.

A wide range of activities

- Laboratory experiments
- Finding and using a range of resources
- Independent learning
- Computer-linked work
  - modelling
  - word-processing
  - spreadsheets
  - data-logging
- Preparing and giving a presentation
- Discussion in groups
- Data handling and analysis
- Model making
- Study skills

Section 5.3: Covalent Bonding

Big Question: Why do atoms react together and bond?

Small Questions:

What is a covalent bond?

How can we represent them using dot and cross diagrams?

What is average bond enthalpy?

Revisiting:

1 Ionic Compounds have low melting points	T	F
2 Ionic Compounds are mostly insoluble	T	F
3 Ionic compounds are made up of metals and non-metals	T	F
4 Metals always gain electrons	T	F
5 An ion is any atom that has gained or lost electrons	T	F
6 Non-metals form negative ions	T	F
7 Ionic compounds do not conduct electricity when solid	T	F
8 Ionic compounds form giant lattices	T	F
9 Ionic compounds have weak electrostatic forces holding ions together	T	F
10 Magnesium Fluoride has the formula MgF	T	F

Knowledge:

Molecules

Molecules are formed when two or more atoms bond together — it doesn't matter if the atoms are the same or different. Chlorine gas (Cl_2), carbon monoxide (CO), water (H_2O) and ethanol (C_2H_5OH) are all molecules. Molecules are held together by strong **covalent bonds**. A covalent bond is the strong electrostatic attraction between a shared pair of electrons and the nuclei of the bonded atoms. Usually each of the atoms in a molecule ends up with eight electrons in its outer shell. This is good for the atoms — it's a very stable arrangement.

Single bonds

In a single covalent bond, the atoms share one pair of electrons. In general, each atom donates one electron to the bonding pair.

Examples

Two chlorine atoms (Cl) bond covalently to form a molecule of chlorine (Cl_2) — see Figure 1. (These diagrams don't show all the electrons — just the ones in the outer shells.)

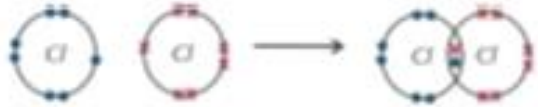


Figure 1: Formation of a molecule of chlorine.

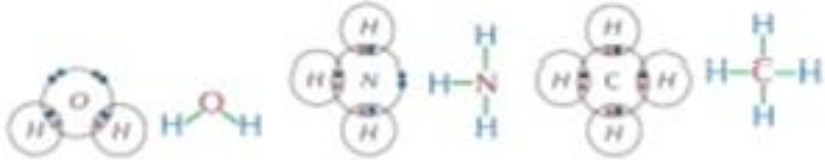
A chlorine molecule can also be drawn as:

Cl–Cl

Figure 2: Use of lines to represent covalent bonds.

The diagrams below show other examples of covalent molecules.

Hydrogen chloride — Hydrogen



Water — Ammonia — Methane

Figure 3: Examples of covalent molecules.

Consolidation

1. What is a molecule?
2. What is a covalent bond?
3. What is a single covalent bond?

Double and triple bonds

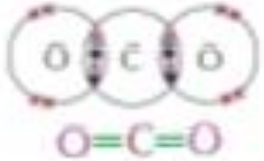
Atoms in covalent molecules don't just form single bonds — double or even triple covalent bonds can form too. In double bonds, the atoms share two pairs of electrons, and in triple bonds the atoms share three pairs of electrons.

Examples

Double bonds

The oxygen atoms in O_2 are connected via a double bond. It forms because each oxygen atom has six electrons in its outer shell, so needs another two to get a full outer shell of electrons. This happens if each oxygen atom shares two electrons, forming a double bond.

Carbon dioxide contains two C=O double bonds. Carbon has 4 electrons in its outer shell, so it needs another 4 to have a full outer shell. This means each oxygen atom must share two electrons.



Triple bonds

Nitrogen has 5 electrons in its outer shell, so it needs another 3 to have a full outer shell. The only way of doing this in N_2 is if each nitrogen atom shares three electrons, resulting in a triple bond.

Consolidation

1. What is a double covalent bond?
2. What is a triple covalent bond?

Special cases

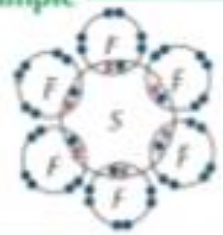
There are always a few pesky exceptions to make life that bit trickier. For example, a few compounds contain atoms with fewer than 8 electrons in their outer shell.

Example

In boron trifluoride, boron only has 6 electrons in its outer shell.

And a few compounds can use d-orbitals to 'expand the octet'. This means they contain atoms with more than 8 electrons in their outer shell.

Example



In sulfur hexafluoride, sulfur has 12 electrons in its outer shell.

Covalent bond strength

Not all covalent bonds are the same strength — they differ depending on how much the outer atomic orbitals of the bonded atoms overlap, and how strongly the atomic nuclei are attracted to the shared electrons.

You can find out the strength of a covalent bond by looking at its **average bond enthalpy**. Average bond enthalpy measures the energy required to break a covalent bond. The stronger a bond is, the more energy is required to break it, and so the greater the value of the average bond enthalpy.

Consolidation

1. What is a dative covalent bond?
2. What is a dative covalent bond also known as?
3. Which molecules contain atoms where there are more or less than 8 outer electrons?
4. What does a large bond enthalpy tell you?

Consolidation

Practice Questions — Fact Recall

Q1 What is a covalent bond?

Q2 Draw a 'dot-and-cross' diagram to show the formation of a chlorine molecule.

Q3 Explain what a triple covalent bond is.

Q4 Describe the difference between a normal single covalent bond and a dative covalent bond.

Q5 Draw a 'dot-and-cross' diagram to show the bonding in BF_3.

Q6 What does the average bond enthalpy tell you about a covalent bond?

Application Phase:

Practice Questions — Application

Q1 Draw a dot-and-cross diagram to show the bonding in the molecule chloromethane, CH_3Cl, given that the carbon atom forms four single covalent bonds. You should only show the outer electron shells.

Q2 Carbon monoxide, CO, contains a triple bond between carbon and oxygen. One of the bonds is a dative covalent bond from oxygen. Construct a dot-and-cross diagram to show the bonding in carbon monoxide. You only need to show the outer electron shells.

Testing Phase:

1. Solid boron tribromide has a simple molecular lattice structure. The atoms are held together by covalent bonds.

i. What is meant by the term *covalent bond*?

[1]

ii. Draw a '*dot-and-cross*' diagram to show the bonding in a boron tribromide molecule.

Show outer electrons only.

[1]

2. Carbon monoxide contains a triple bond, and includes a dative covalent bond.

Construct a '*dot-and-cross*' diagram to show the outer electron pairs in a molecule of carbon monoxide.

[2]

END OF QUESTION PAPER

Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1		i	A shared pair of electrons.	1	**Examiner's Comments** The quality of answers to this question were very high. Only the weakest of candidates failed to state that it is a pair (or two) of electrons which are shared.
		i		1	**Examiner's Comments** As with the previous '*dot-and-cross*' diagram this was well answered. Only a very few attempted to show the molecule's bonding as ionic. Some candidates did lose the mark by adding a lone pair to the boron atom.
			Total	2	
2			 three shared electron pairs plus a lone pair on C and O (1) one of the shared pairs shown as dative – i.e. both with the same type of dot / cross as the other electrons around the O (1)	2	mark can be awarded if either lone pair is missing, but there must be three shared pairs
			Total	2	

Self-Assessment

Small Question	Mastered	Secure	Approaching	Developing	Additional Help
What is a covalent bond? How can we represent them using dot and cross diagrams? What is average bond enthalpy?					

M1: Development of Practical Skills in Chemistry

M2: Foundations of Chemistry

M3: Periodic table and energy

M4: Core organic chemistry

M5: Physical Chemistry and Transition Elements

M6: Organic Chemistry and Analysis

Component 01 assesses content from modules 1, 2, 3 and 5.

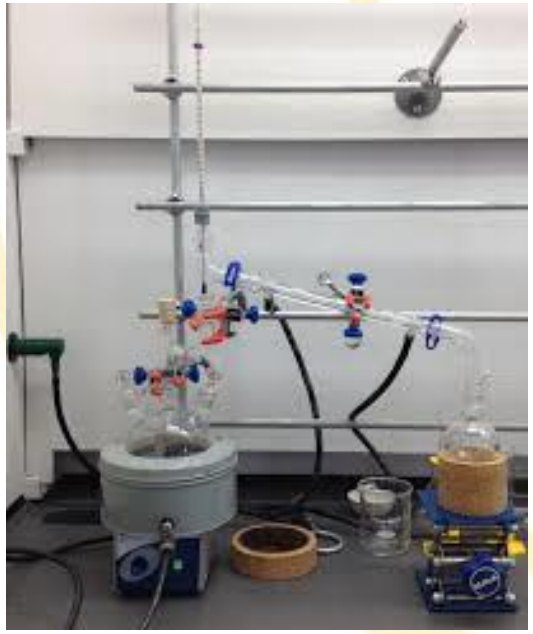
Component 02 assesses content from modules 1, 2, 4 and 6.

Component 03 assesses content from all modules (1 to 6).

Assessment Overview	
Periodic table, elements and physical chemistry (01) 100 marks 2 hours 15 minutes written paper	**37%** of total A level
Synthesis and analytical techniques (02) 100 marks 2 hours 15 minutes written paper	**37%** of total A level
Unified chemistry (03) 70 marks 1 hour 30 minutes written paper	**26%** of total A level
Practical Endorsement in chemistry (04) (non exam assessment)	Reported separately (see Section 5)

Practical endorsement for A Level

- No exam!
- Awarded as an endorsement to your grade – it is a pass or fail
- Teacher assessed
- Demonstrate you have practical competence in at least twelve practical's



First Year Practicals

- Moles Determination
- Acid Base titration
- Enthalpy Determination
- Qualitative analysis of ions
- Synthesis of an organic liquid

Second Year Practicals

- Qualitative analysis of organic functional groups
- Synthesis of an organic solid
- Electrochemical cells
- Rates of Reaction

Unscaffolded And Investigative

- Rates of Reaction – Initial rates
- pH Measurement
- Research Skills

Entry Requirements

7, 6 in Combined Science
Or
7 in Chemistry.

Must also have at least a grade 6 in Mathematics.

Note
To study two A level Sciences, you will need a grade 7,7 on combined sciences.
To study three A level Sciences, you will need a grade of 8,7 on combined sciences.

Results

2024	100%	A*-E	43% A*-C
2023	100%	A*-E	75% A*-C
2022	90%	A*-E	60% A*-C
2021	100%	A*-E	65% A*-C
2020	100%	A*-E	78% A*-C
2019	100%	A*-E	78% A*-C

dneves@stfrancis.cc