Edexcel GCSE Chemistry

Your notes

Covalent Bonding

Contents

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Covalent Bonding

- Non-metal atoms can share electrons with other non-metal atoms to obtain a **full outer shell** of electrons
- When atoms share pairs of electrons, they form covalent bonds
- Covalent bonds between atoms are very **strong**
- When two or more atoms are chemically bonded together, they form 'molecules'
- Covalently bonded substances may consist of small molecules or giant molecules
- Weak **intermolecular forces** exist between individual molecules
  - E.g. Each liquid water molecule consists of two hydrogen atoms covalently bonded to an oxygen atom, and in between two individual water molecules there are weak intermolecular forces
- Shared electrons are called **bonding electrons** and occur in **pairs**
- Electrons on the outer shell which are not involved in the covalent bond(s) are called **non-bonding** electrons
- Simple covalent molecules do not conduct electricity as they do not contain free electrons

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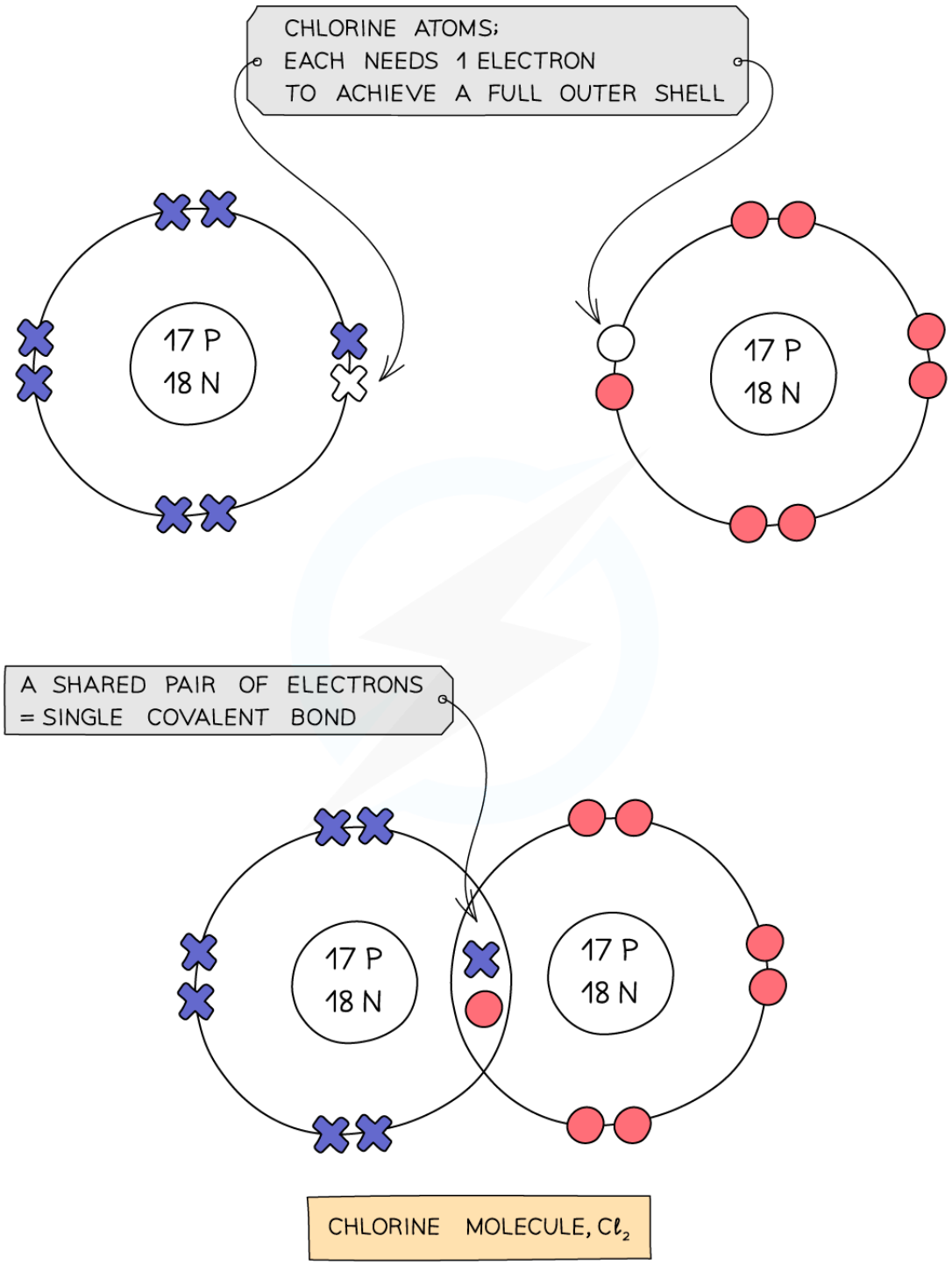

Diagram showing covalent bonding in a molecule of chlorine (Cl_2)

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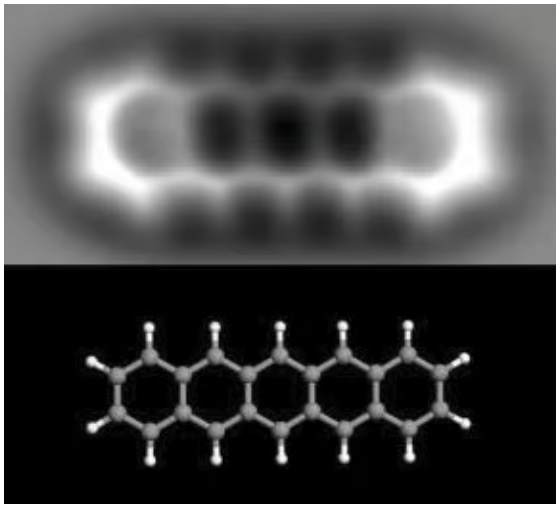
The Size of Molecules

- Simple molecular substances consist of molecules which contain atoms that are bound tightly together by strong covalent bonds
- An atom is typically about 0.1 nanometres in size, which is 0.0000000001 m or 10^{-10} m
- Simple molecules contain only a few atoms, so the sizes of atoms and simple molecules have similar ranges
- The smallest molecule is hydrogen, H_2, which is just 0.074 nm long or 7.4×10^{-11} m
- Even though individual atoms and molecules are extremely small, developments in electron microscopy can produce images of atoms and simple molecules



Pentacene ($C_{22}H_{14}$) was first imaged in 2009 by the IBM Research team in Zurich using a technique called atomic force microscopy

Examiner Tips and Tricks

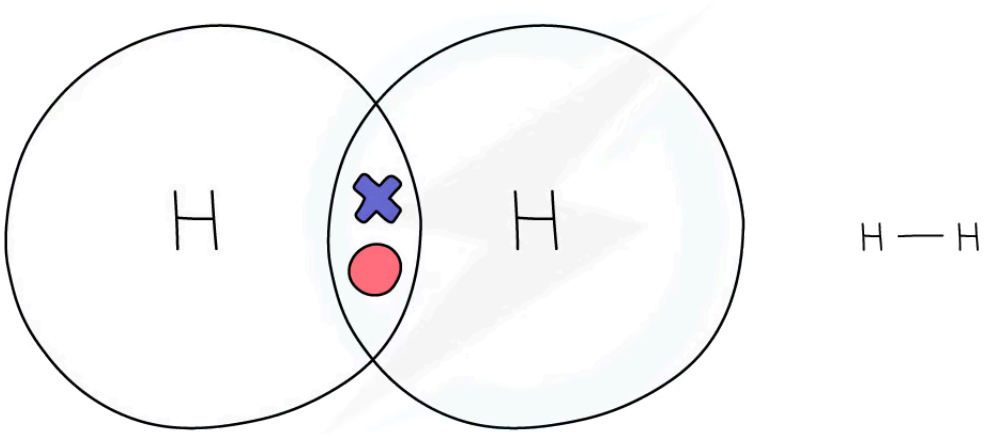
A key difference between covalent bonds and ionic bonds is that in covalent bonds the electrons are shared between the atoms, they are not transferred (donated or gained) and no ions are formed.

Simple Molecules

Your notes

Dot & Cross Diagrams for Molecules

- Covalent substances tend to have small molecular structures, such as H_2, H_2O or CO_2
- These small molecules are known as **simple molecules**
- Small covalent molecules can be represented by dot and cross diagrams
- You need to be able to describe and draw the structures of the following molecules using dot-and-cross diagrams: hydrogen (H_2), hydrogen chloride (HCl), water (H_2O), methane (CH_4), oxygen (O_2) and carbon dioxide (CO_2)
- The correct dot and cross diagrams for these molecules are shown below:



Dot & cross representation of a molecule of hydrogen

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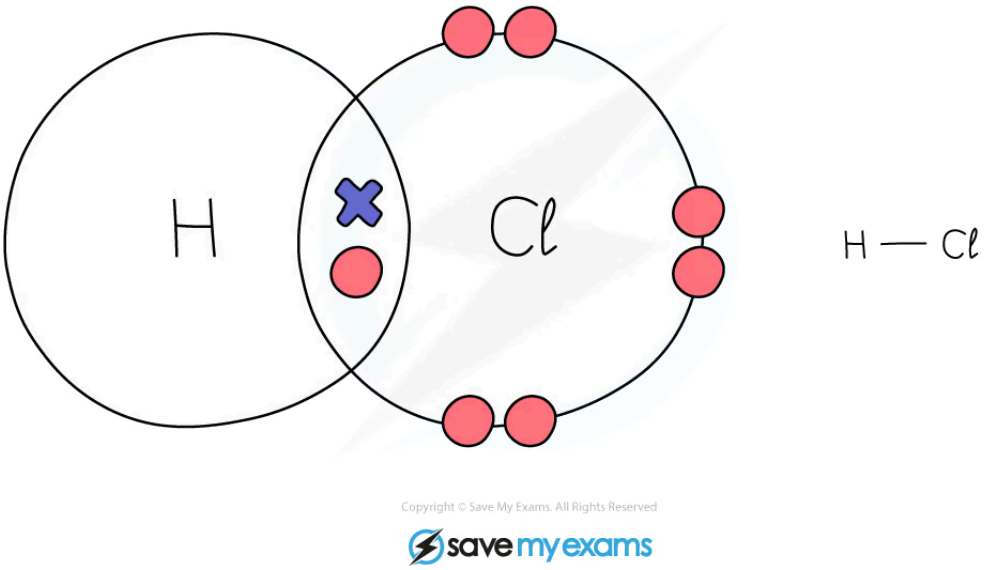
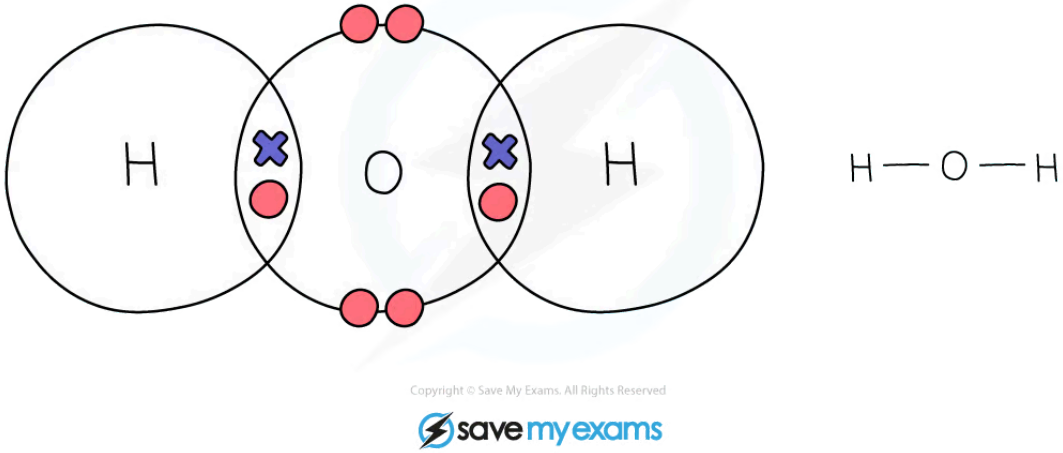


Dot & cross representation of a molecule of hydrogen chloride



Dot & cross representation of a molecule of water

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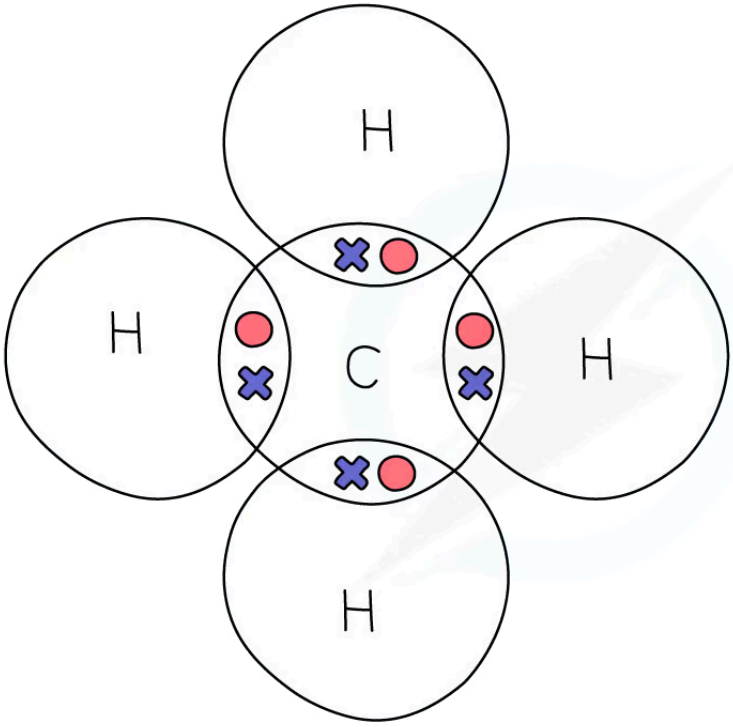

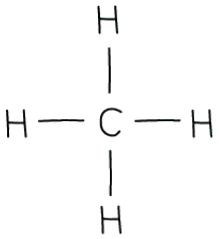

Dot & cross representation of a molecule of methane

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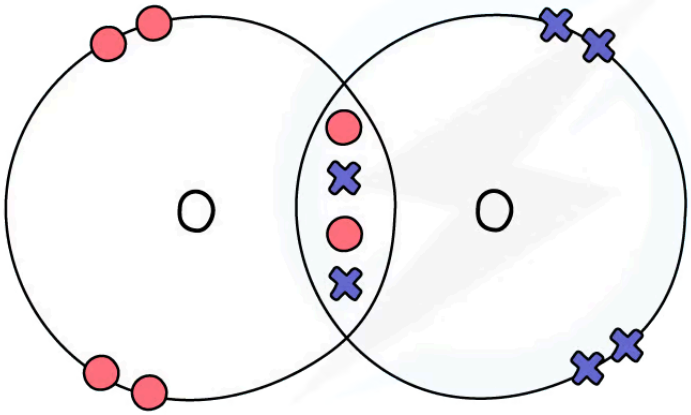
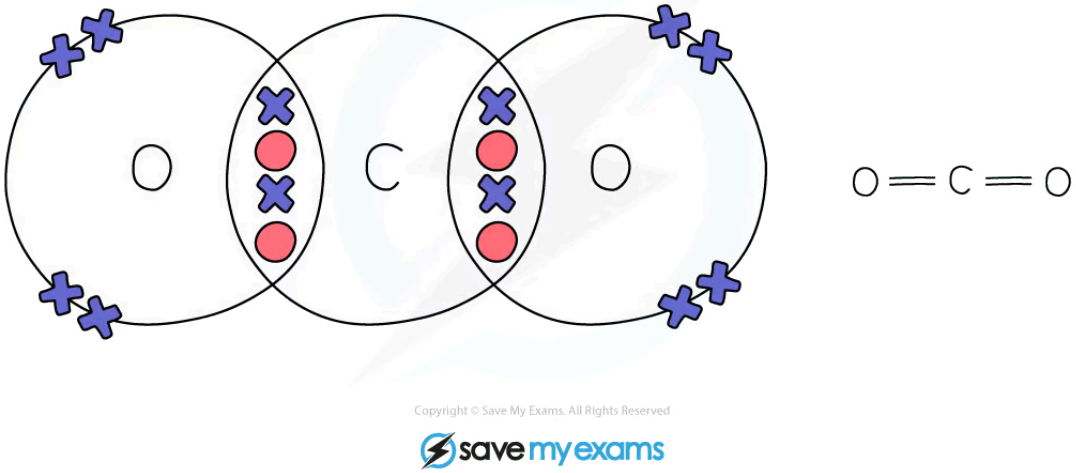


Dot & cross representation of a molecule of oxygen



Dot & cross representation of a molecule of carbon dioxide

Examiner Tips and Tricks

Simple covalent molecules are small and can be separated into individual molecular units without breaking any chemical bonds (although there will still be strong covalent bonds holding the atoms in each individual molecule together). Giant ionic and covalent structures form huge continuous networks of atoms that are bonded together and cannot be separated into individual units without breaking bonds.

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