

Grade 11 Chemistry



**Knowledge Area:
Matter and
Materials**

Atomic bonds

1.1 Chemical bonds

A **chemical bond** occurs when atoms bond together to form a new substance with new properties. In doing so it has a noble gas electron structure and a lower potential energy.

Definition



Quick facts

Chemical bonds occur to increase the stability of a substance, by decreasing the potential energy and increasing the entropy.



Atomic bonds

1.2 Bonding models

- Bond between non-metals
- Electrons in half-filled orbitals overlap and are shared.
- Smallest particle is a molecule.
- Atoms must have half-filled orbitals.
- The half-filled orbitals overlap to form a new filled orbital.
- The atom's electronegativity must be the same or the difference must be less than 1,9.



Atomic bonds

- Polar or non-polar bonds form.

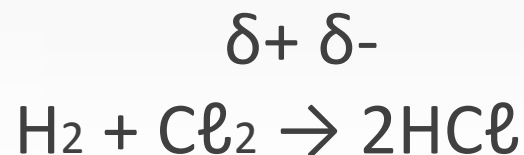
Non-polar bonds: atoms attract the shared pair of electrons equally.

Example:



Polar bond: one atom has a greater pull on the shared pair than the other.

Example:



Atomic bonds

A covalent bond is where two non-metal atoms in a molecule share an electron pair during the overlapping of orbitals.

A non-polar covalent bond is where the shared electron pair is distributed evenly between the two atoms in the region where the orbitals overlap.

A polar covalent bond is where the shared electron pair is distributed unevenly between the two atoms in the region where the orbitals overlap.

Definition



Atomic bonds

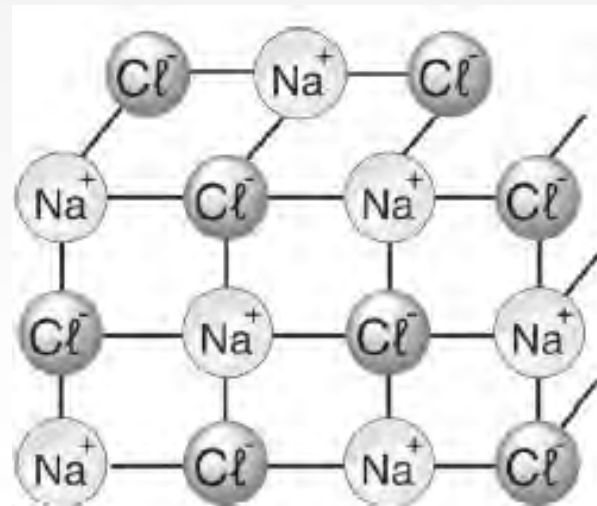
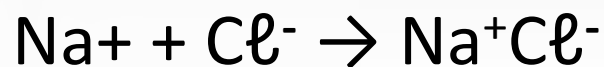
Ionic bond

- Bond between metals and non-metals
- Electron transfer occurs.
- Positive ions (cations) and negative ions (anions) attract each other with strong electrostatic or Coulombic forces.
- Atoms' electronegativity must differ by more than 2,1.
- One atom must have a low ionisation energy so that it gives electrons away easily.



Atomic bonds

- Metals tend to donate electrons and become positive ions (cations).
- One of the atoms must have a high electron affinity to accept electrons.
- Smallest particle is an ion.
- Examples of ionic bonds:



Atomic bonds

Ionic bonds take place between metal atoms and non-metal atoms when electrons of a metal atom are transferred to the non-metal atom. The ions that form are attracted to each other with strong electrostatic forces.

Definition

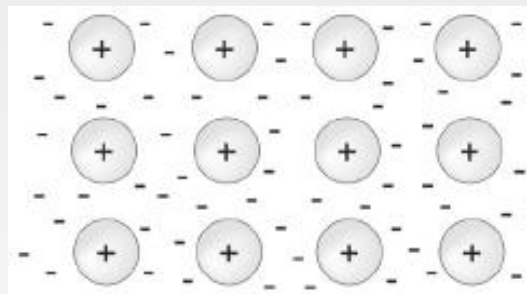


Metallic bond

- Bond within metals
- Crystal lattice of positive atomic core with a sea of delocalized electrons.
- Closely-packed crystal lattice.
- Smallest particle is a positive core ion.

Atomic bonds

- For a metallic bond to form:
 - Low ionisation energy
 - Atoms must have empty valence orbitals



Metallic bonds are when metal atoms of a metal bind through the attraction force between delocalised electrons and the crystal lattice of a positively charged atomic core.

Definition



Atomic bonds

1.3 Valence electrons

Electrons found in the outermost energy level.

Corresponds to the group number.

Valence electrons of some elements

| Element | Group | Period | Valence electrons | Number of valence electrons |
|---------|----------|--------|-------------------|-----------------------------|
| Na | 1 (I) | 3 | $3s^1$ | 1 |
| Mg | 2 (II) | 3 | $3s^2$ | 2 |
| N | 15(V) | 2 | $2s^2 2p^3$ | 5 |
| O | 16 (VI) | 2 | $2s^2 2p^4$ | 6 |
| Cl | 17 (VII) | 3 | $3s^2 sp^5$ | 7 |

Atomic bonds

1.4 Valency

Number of electrons that an atom will donate, accept or share.

1.5 Lewis structure

| Group 1 (I) | Group 2 (II) | Group 13 (III) | Group 14 (IV) | Group 15 (V) | Group 16 (VI) | Group 17 (VII) | Group 18 (VIII) |
|----------------|-----------------|-------------------|------------------|-----------------|-----------------------|-----------------------|-------------------------|
| Li • | Be •• | B •• • | C •• •• | N •• •• • | O •• •• •• • | F •• •• •• • | Ne •• •• •• •• |

Atomic bonds

Covalent bonds

Example:

