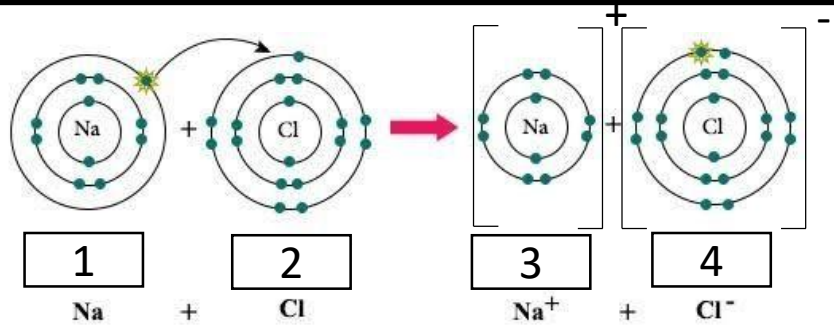
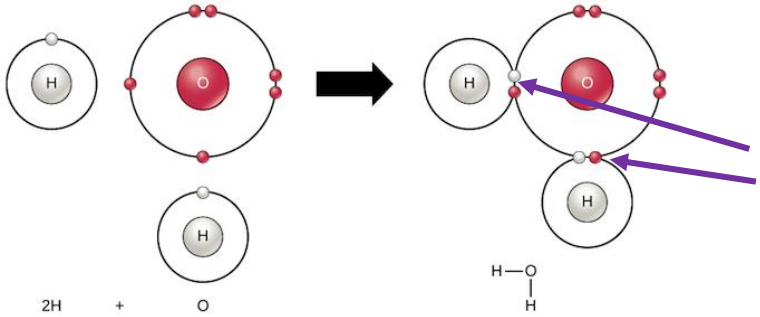
# Chemistry Topic 2: Bonding, Structure, and the properties of matter

| 1. Keywords | |
|---|---|
| Ionic bond | When a metal donates electrons to a non-metal forming opposite charged ions that are attracted to each other |
| Covalent bond | A shared pair of electrons between two non-metals |
| Metallic bond | Positive metal ions in a 'sea' of delocalised electrons |
| Ions | Charged atoms which have either gained or lost electrons |
| Electrons | Negative particles found in the shells of atoms |
| Group 0 | The unreactive 'noble gases' all elements get to group 0 electron configuration when they react |
| Dot and cross diagrams | The simplest way we show the bonding in atoms |
| Polymer | A long chain molecule made up of repeating monomers |
| Monomer | The small molecules that join together to make polymers |
| Delocalised | Electrons which are free to move anywhere |
| Alloy | A mixture of a metal and another element to change its properties |

## 2. The process of ionic bonding




| No | Name | Electron movement | Charge | Electron configuration | Does it have a full outer shell? |
|---|---|---|---|---|---|
| 1 | Sodium atom | 0 | 0 | 2,8,1 | No |
| 2 | Chlorine atom | 0 | 0 | 2,8,7 | No |
| 3 | Sodium ion | Lost 1 | +1 | 2,8 | Yes |
| 4 | Chloride ion | Gained 1 | -1 | 2,8,8 | Yes |



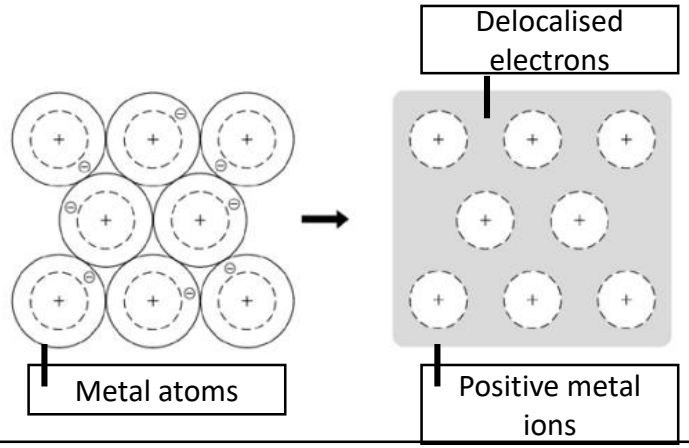

Make sure both electrons are in the overlap of the outer shells

## 3. The process of covalent bonding

| | |
|---|---|
| 1 | Non metals share their outer unpaired electrons |
| 2 | Now all outer shell spaces appear full |
| 3 | There is no change in charge. They remain uncharged |

## 4. Metallic bonding

| | |
|---|---|
| 1 | Metal atoms |
| 2 | Positive metal ions |
| 3 | 'Sea' of delocalised electrons |

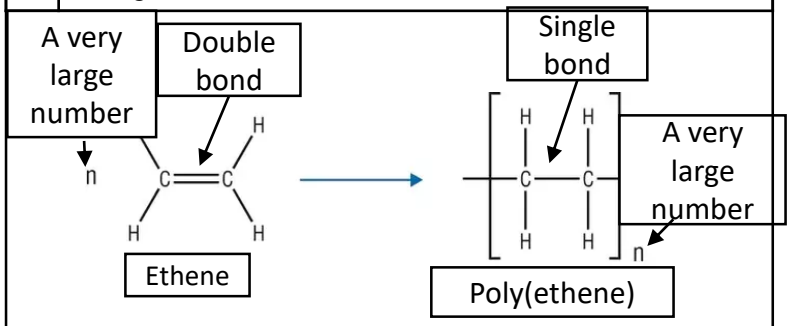



## 5. State symbols

| Symbol | Meaning | Example |
|---|---|---|
| (s) | Solid | Gold |
| (l) | Liquid | Water |
| (g) | Gas | Hydrogen |
| (aq) | Aqueous (dissolved in water) | Salt solution |

## 6. Polymers

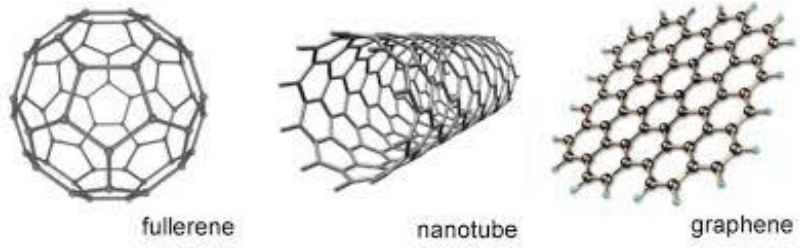
| | |
|---|---|
| 1 | Ethene |
| 2 | Poly(ethene) "polythene" |
| 3 | A very large number |
| 4 | A double bond |
| 5 | A single bond |




## 7. General properties of different substances

| Property | Ionic compounds | Small covalent molecules | Giant covalent structures | Metals and alloys |
|---|---|---|---|---|
| Density | High | Low | High | High |
| Melting and boiling point | High | Low | High | High |
| Conduct electricity | Only melted or dissolved in water | No | No (apart from graphite) | Yes |
| Conduct heat | No | No | No (apart from diamond) | Yes |
| Brittle or malleable | Brittle | N/A | Brittle | Malleable |
| Examples | • Salt (sodium chloride)<br>• Magnesium Sulfate | • Chlorine<br>• Oxygen | • Diamond<br>• Graphite<br>• Sand | • Iron<br>• Steel |

| 9. The structure and bonding of carbon | | | |
|---|---|---|---|
| Name of structure | Diamond | Graphite | Graphene + Fullerene |
| Number of bonds | 4 | 3 | 3 |
| Any delocalised electrons? | no | yes | Yes |
| Hardness | Very hard | soft | Flexible and strong |
| Conduct electricity | No | yes | Yes |
| Melting point | Very high | High | High |
| Uses | • Gems<br>• Drill bits | • Electrodes<br>• Pencils<br>• Lubricants | • Electronics<br>• Nanotubes |




| 10. Bulk and surface properties of nanoparticles (TRIPLE ONLY) | | |
|---|---|---|
| Name | Size in nanometres (nm) | Size in standard form (m) |
| Nanoparticles | 1-100 | $1x10^{-9}$ m to $1x10^{-7}$ |
| Fine particles | 100-2500 | $1 \times 10^{-7}$ m to $2.5 \times 10^{-6}$ |
| Coarse particles ("dust") | 2500nm – 10000 | $2.5 \times 10^{-6}$ m to $1 \times 10^{-5}$ |
| Uses of nanoparticles | Example | |
| 1. Medicine<br>2. Electronics<br>3. Cosmetics<br>4. Sunscreen<br>5. Deodorants<br>6. Catalysts | 1. Delivering drugs directly to cells<br>2. Wearable electronics<br>3. Anti-aging creams<br>4. Sunscreen without white marks<br>5. Antibacterial action<br>6. Fullerene | |