**Summary of covalent, ionic and metallic substances**

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| **Substance** | **Type of bonding** | **Properties** |
| **Covalent giant lattice or macro molecular**  E.g. diamond | **Covalent**- a pair of electrons is shared in every covalent bond. **All** bonds between the non-metal atoms in a giant lattice are covalent. | * Not common * Very high MP and BP as all bonds are strong covalent bonds * http://www.bbc.co.uk/staticarchive/9c5bbfcd9c71639f801e67024b8124e8293cf72d.jpgDiamond is an example (centre bellow) - each carbon is covalently bonded to its neighbouring carbon atom giving a tetrahedral shape. * **Variable conductivity** - Diamond does not conduct electricity. Graphite (above left) contains free electrons and conducts electricity. (silicon dioxide shown above right) Silicon is semi-conductive - that is, midway between non-conductive and conductive. |
| **Covalent molecular**  In many covalent compounds, each atom is joined to other atoms in small groups or clusters of atoms called [molecules](http://www.bbc.co.uk/bitesize/standard/chemistry/propertiesofsubstances/ionic/revision/3/)  E.g. water, carbon dioxide, methane | Within the molecule there are covalent bonds. A pair of electrons is shared in each single covalent bond between the **non-metal atoms.** Between molecules usually weaker intermolecular forces exist. Dispersion forces (if the molecules are non- polar) and dipole-dipole interaction if the molecules are polar such as HF or HCl | * Low MP and BP –usually gases or liquids at room temperature- the bonds between the molecules are weak * Do not conduct electricity. This is because they do not have any free electrons or an overall electric charge. * Water molecule with 2 hydrogens attached to oxygen, ammonia has 3 hydrogens attached to nitrogen, carbon dioxide has 2 oxygens attached to carbon, and methane has 4 hydrogens attached to carbonO=C=O carbon dioxide has double covalent bonds. Triple covalent bonds also exist.   Diagram of carbon dioxide molecule. One atom of carbon shares four electrons with two atoms of oxygen |
| **Ionic** | All bonds are Ionic bonds- electrostatic attraction between a metal cation (+) and a non- metal anion (-) or a polyatomic ion eg SO42-. A crystal lattice is formed | * High MP and BP due to strong electrostatic attraction between ions. Most have melting points above 500⁰C * Form crystal lattice structures * Conduct electricity when dissolved in water or if melted because the ions are freed * Do not conduct electricity when solid * Brittle because if the lattice is shifted so that like charges align – repulsion will occur and shatter the crystal |
| **Metallic** | All bonds are metallic bonds - cations in a sea of delocalised electrons  CC6_malleability part 1_V2 | * High MP and BP due to strong metallic bond in 3d lattice. There is strong attraction between positive cations and negative delocalised electrons. * Form metal lattice with grain boundaries * Conduct heat and electricity when solid or molten due to delocalised electrons * Lustre due electrons reflecting light * Bendy, malleable, ductile- metallic bonds can break and reform easily within the 3d lattice. * Dense- cations tightly packed |

**Types of bonding**

1. Explain why metals conduct electricity? Link your answer to metallic bonding. Use a diagram to support your answer

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1. Explain the difference between an ionic and covalent bond. Illustrate your answer with examples.

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1. i. Give two examples of a **covalent molecular** substance

a.

b

ii. Give an example of a **covalent giant lattice** (macro molecular) …………………………………………………………………………………………………

1. Why do covalent giant lattice structures have higher melting and boiling points than covalent molecular substances?

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1. If organic substances contain C, O and H, which type of bonding exists within organic compounds?

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1. Show 2 ways of representing a covalent bond ……………………………………………………………..………………………………………………………………………
2. What is a lone pair? …………………………………………………………………………………………………………….…………………………………………………………………………..………
3. What is a polar covalent bond and what causes them to occur? ……………………………………………………………………………………………

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