

<i>Metals</i>	<i>Ionic substances</i>	<i>Covalent network (giant molecules)</i>	<i>Covalent molecular (small molecules)</i>
Na, Mg, Al, Fe, Cu, Ag, Hg	NaCl, MgCl <sub>2</sub> , Fe(NO <sub>3</sub> ) <sub>2</sub> , CuO	C, Si, SiO <sub>2</sub> , SiC	N <sub>2</sub> , O <sub>2</sub> , H <sub>2</sub> O, C <sub>6</sub> H <sub>12</sub> O <sub>6</sub> , C <sub>2</sub> H <sub>6</sub>
Positive ions surrounded by a sea of delocalised electrons	Positive and negative ions are arranged in a 3D lattice structure	Non metal atoms joined covalently in a giant 3D lattice structure	Non metal atoms joined covalently to form small discrete molecules
Metallic bonding is strong because the positive ions are held tightly in place by the force of attraction between the positive ions and negative electrons	Ionic bonding is strong because of the strong force of attraction between the positive (cation) ions and the negative (anion) ions	Covalent bonding is strong because the bonding (valence) electrons are shared between the atoms and hold the atoms tightly together	Covalent bonding is strong between the molecules ( <b>intramolecular</b> ) but there are weak forces ( <b>intermolecular</b> ) between the molecules
Melting and boiling point is high  All solids (except Hg)  Metallic bonding is strong. A lot of energy is needed to overcome the force of the attraction between the positive ions and the delocalised electrons, therefore the mpt. and bpt. are high	Melting and boiling point is high  All solids  Ionic bonding is strong. A lot of energy is needed to overcome the force of attraction between the cations and anions and therefore the mpt. and bpt. are high	Melting and boiling point is high  All solids  Covalent bonding is very strong. A lot of energy is needed to overcome covalent bonding and to separate the atoms and therefore the mpt. and bpt. is very high	Melting and boiling point is low  Gases, liquids and low mpt. solids  Intermolecular forces are weak. Little energy is needed to break intermolecular forces therefore the mpt. and bpt. is low
Hard and malleable  Metallic bonding is strong.  Metals are malleable because atoms can slide over each other without the force of attraction between the positive ions and the delocalised electrons break	Hard and brittle  Ionic bonding is strong.  Ionic substances are brittle because when ions of the same charge slide over each other, they repel and the crystal splits into two	Hard and brittle  Covalent bonding is very strong  Network covalent substances are brittle because the atoms cannot slide past each other	Soft  Intermolecular forces between the molecules are weak. The molecules can be pushed apart easily
Solid and liquid conduct electricity  Delocalised electrons are moving charges therefore metals can conduct electricity when solid or molten	Liquid and solution conduct electricity  Ions are moving charges in both the molten state and in aqueous solution; therefore ionic substances can conduct electricity in these cases  NB: ionic <b>solids</b> cannot conduct because there are no moving charges. The ions are fixed in position	Do not conduct electricity  There are no moving charges. There are no ions and the electrons are involved in bonding	Do not conduct electricity  There are no moving charges. There are no ions and the electrons are involved in bonding.  NB: some small polar molecules may ionise in water and be able to conduct electricity eg: HCl, HNO <sub>3</sub> , H <sub>2</sub> SO <sub>4</sub>