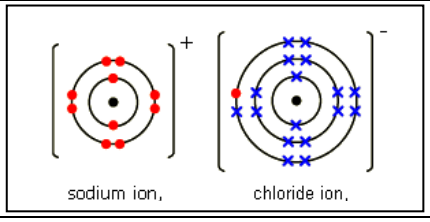
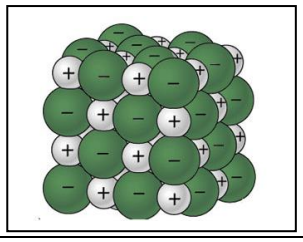
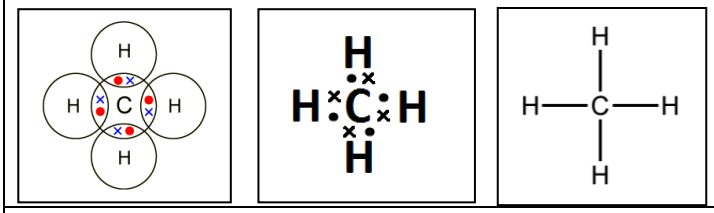
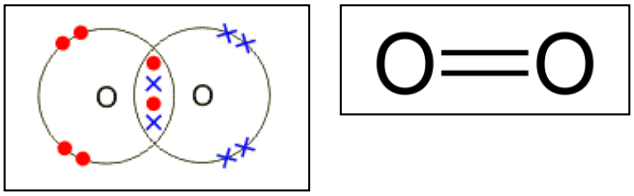
AQA Trilogy-Chemistry key terms – Bonding, structure and the properties of matter

General	
Compounds have two or more elements chemically combined. Chemical bonding involves either transferring or sharing electrons in the outer energy levels of atoms to achieve the electronic structure of a noble gas.	A metal with a non-metal forms ionic bonds. A non-metal with a non-metal forms covalent bonds. A metal with a metal forms a metallic bond.
Ionic Compounds	
Ions form when atoms gain or lose electrons to get the electronic structure of a noble gas (Group 0).	Atoms that lose electrons become positively charged ions. Atoms that gain electrons become negatively charged ions.
The elements in Group 1, the alkali metals, all react with non-metal elements to form ionic compounds in which the metal ion has a single positive charge.	The elements in Group 7, the halogens, all react with the alkali metals to form ionic compounds in which the halide ions have a single negative charge.
The charge on a simple ion depends on the group number of the element in the periodic table. Group 1 ions have a +1 charge. E.g. Na^+ Group 2 ions have a +2 charge. E.g. Mg^{2+} Group 7 ions have a -1 charge. E.g. Cl^- Group 6 ions have a -2 charge. E.g. O^{2-}	Electronic structures Na^+ =[2,8] $^+$ Cl^- =[2,8,8] $^-$ 
An ionic compound is a regular, giant structure of ions called a <u>giant ionic lattice</u>. E.g sodium chloride. 	Ionic compounds are held together by <u>strong electrostatic forces</u> of attraction between oppositely charged ions. These forces act in <u>all directions</u> in the lattice and this is called <u>ionic bonding</u>.
Ionic compounds have <u>high melting points and high boiling points</u> because of the large amounts of energy needed to break the strong ionic bonds. They are solid at room temperature.	<u>Solid</u> ionic compounds <u>do not conduct electricity</u> as the ions cannot move. When <u>melted</u> or <u>dissolved</u> in water, ionic compounds <u>do conduct electricity</u> because the ions are free to move and carry the current.
Work out formulae for ionic compounds by balancing out the charges. E.g. Magnesium chloride is made of Mg^{2+} and Cl^- ions. Formula = $MgCl_2$	Sometimes we need brackets, if the ions have more than one atom. E.g. Magnesium hydroxide is made of Mg^{2+} and OH^- ions. Formula = $Mg(OH)_2$
Covalent Structures and Molecules	
<u>Covalent bonds</u> form when atoms <u>share pairs of electrons</u>. These bonds between atoms are very strong.	Some covalently bonded substances consist of <u>simple molecules</u> such as H_2, Cl_2, O_2, HCl, H_2O, NH_3 and CH_4.
Show covalent bonds in molecules in these forms: 	O_2 has a double bond 
Substances made of simple molecules have low melting points and boiling points. They are gases, liquids or solids that are easy to melt.	Forces between molecules are weak. It is these weak *intermolecular* forces that are broken when the substance melts or boils, not the strong covalent bonds.
Substances that consist of simple molecules do not conduct electricity because the molecules do not have an overall electrical charge.	
<u>Giant covalent structures</u> are formed when huge numbers of atoms are held together by a network of covalent bonds.	Diamond and silicon dioxide are giant covalent structures. All the atoms are linked by strong covalent bond so they have very high melting points.

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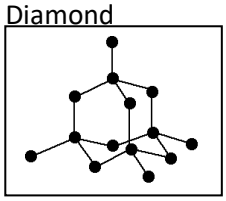
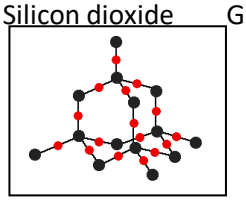
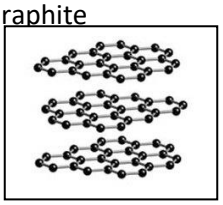
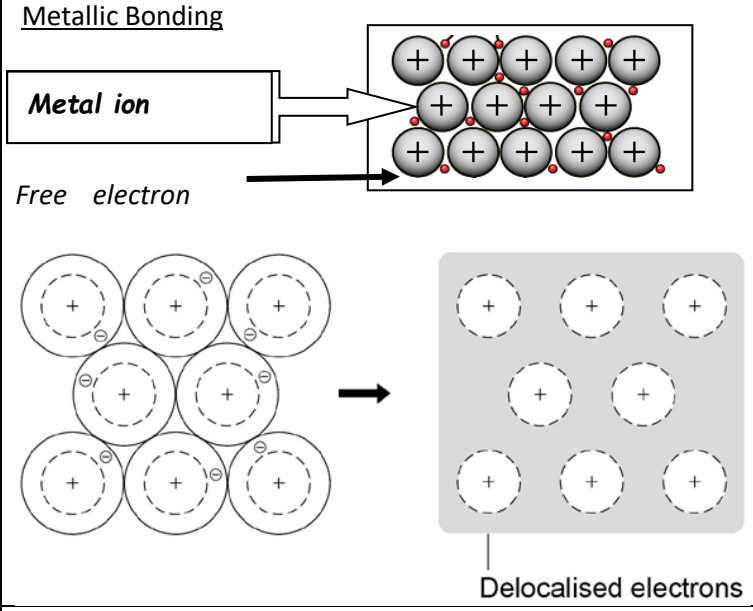
In diamond, each carbon atom forms four covalent bonds with other carbon atoms in a giant covalent structure, so diamond is very hard.	Most giant covalent structures do not conduct electricity as they do not have any charged particles that can move.
Graphite is another giant covalent structure of carbon but it is very unusual in that it conducts electricity and is quite soft.	In graphite, each carbon atom bonds to three others, forming layers. The layers can slide over each other because there are no covalent bonds between the layers, so graphite is soft and slippery.
Diamond  Silicon dioxide  Graphite 	In graphite the forces *between* the layers are weak *intermolecular* forces. In graphite, one electron from each carbon atom is delocalised. These delocalised electrons allow graphite to conduct heat and electricity (in a similar way to in metals).
Carbon can also form fullerenes with different numbers of carbon atoms. These are made of hexagonal rings of carbon atoms.	Fullerenes can be used for drug delivery into the body, in lubricants, as catalysts, and in nanotubes for reinforcing materials, eg in tennis rackets.
Metallic Bonding	
Metals consist of many atoms arranged in a regular, closely packed pattern.	The layers of atoms in metals are able to slide over each other and so metals can be bent and shaped.
Alloys are usually made from two or more different metals. The different sized atoms of the metals distort the layers in the structure, making it more difficult for them to slide over each other, and so make alloys harder than pure metals.	Shape memory alloys can return to their original shape after being deformed, eg Nitinol used in dental braces.
Metallic bonding is positively charged metal ions held together by strong electrostatic attractions to the electrons from the outer shell of each metal atom.	Metallic Bonding 
Metals conduct heat and electricity because the outer electrons in their structures are free to move throughout the giant metallic lattice.	
States of Matter	

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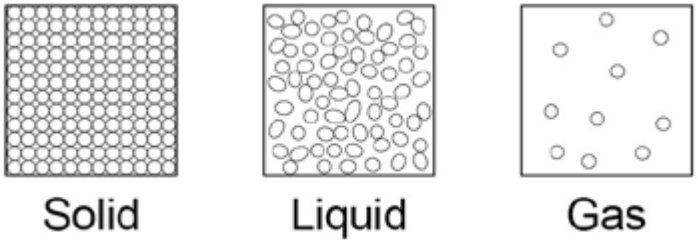
The three states of matter are solid, liquid and gas. Melting and freezing take place at the melting point, boiling and condensing take place at the boiling point. The three states of matter can be represented by a simple model. In this model, particles are represented by small solid spheres. Particle theory can help to explain melting, boiling, freezing and condensing.  	The amount of energy needed to change state from solid to liquid and from liquid to gas depends on the strength of the forces between the particles of the substance. The nature of the particles involved depends on the type of bonding and the structure of the substance. **The stronger the forces between the particles the higher the melting point and boiling point of the substance.** (HT only) Limitations of the simple model above include that in them model there are no forces, that all particles are represented as spheres and that the spheres are solid.
In chemical equations, the three states of matter are shown as (s), (l) and (g), with (aq) for aqueous solutions.	
Polymers	
The properties of polymers depend on what monomers they are made from and the conditions under which they are made.	For example, low density (LD) and high density (HD) poly(ethene) are produced using different catalysts and reaction conditions.
Thermosoftening polymers will soften or melt when heated. They can be heated and remoulded. They are made of a tangle of separate polymer chains.	Thermosoftening polymers are easy to melt because the forces between polymer chains (intermolecular forces) are very weak, so are easily broken.
Thermosetting polymers will not soften when heated so are more heat resistant. This makes them suitable for making electric kettles. If they are strongly heated they char.	Thermosetting polymers have many (covalent) crosslink between the polymer chains. This prevents polymer chains sliding past each other so they are rigid and heat resistant.