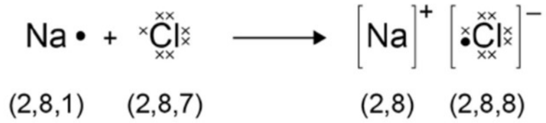
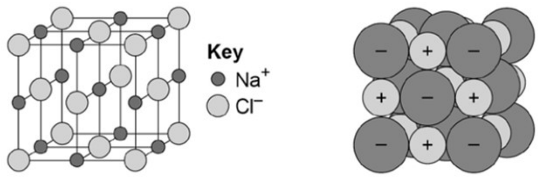
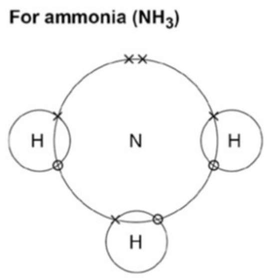
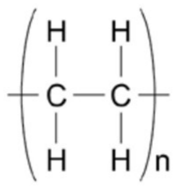
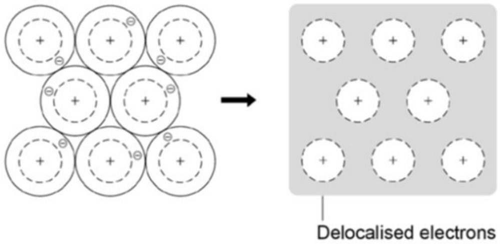
Chemistry Knowledge Organiser
Bonding, structure & the properties of matter

1	Ion formation	When a metal atom reacts with a non-metal atom electrons in the outer shell of the metal atom are transferred. Metal atoms lose electrons to become positively charged ions. Non-metal atoms gain electrons to become negatively charged ions. 
2	Ionic compounds & bonding	An ionic compound is a giant structure of ions. Ionic compounds are held together by strong electrostatic forces of attraction between oppositely charged ions. These forces act in all directions in the lattice and this is called ionic bonding. 
3	Covalent bonding	 When atoms share pairs of electrons, they form covalent bonds. These bonds between atoms are strong. Covalently bonded substances may consist of small molecules.
4	Polymers	 poly(ethene) When polymers form, monomers join together by forming covalent bonds between the monomers. For this to happen, the double covalent bond within the monomer needs to break to form a new single covalent bond.
5	Metallic bonding	 Metals consist of giant structures of atoms arranged in a regular pattern. The electrons in the outer shell of metal atoms are delocalised and so are free to move through the whole structure. The sharing of delocalised electrons gives rise to strong metallic bonds

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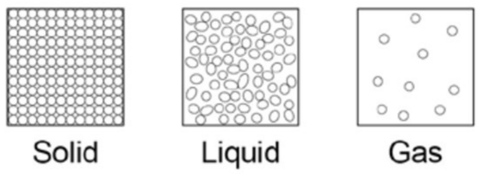
6	The 3 states of matter	 The three states of matter can be represented by a simple model. In this model, particles are represented by small solid spheres. Particle theory can help to explain melting, boiling, freezing and condensing.
7	Changing state	The amount of energy needed to change state from 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.
8	Limitations	Limitations of the simple model above include that in the model there are no forces, that all particles are represented as spheres and that the spheres are solid.
9	Properties of ionic compounds	Ionic compounds have regular structures (giant ionic lattices) in which there are strong electrostatic forces of attraction in all directions between oppositely charged ions. These compounds have high melting points and high boiling points because of the large amounts of energy needed to break the many strong bonds. When melted or dissolved in water, ionic compounds conduct electricity because the ions are free to move and so charge can flow.
10	Properties of small molecules	Substances that consist of small molecules are usually gases or liquids that have relatively low melting points and boiling points. These substances have only weak forces between the molecules (intermolecular forces). It is these intermolecular forces that are overcome, not the covalent bonds, when the substance melts or boils. The intermolecular forces increase with the size of the molecules, so larger molecules have higher melting and boiling points.
11	Giant covalent structures	Substances that consist of giant covalent structures are solids with very high melting points. All of the atoms in these structures are linked to other atoms by strong covalent bonds. These bonds must be overcome to melt or boil these substances. Diamond and graphite (forms of carbon) and silicon dioxide (silica) are examples of giant covalent structures.

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12	Alloys	In pure metals, atoms are arranged in layers, which allows metals to be bent and shaped. Pure metals are too soft for many uses and so are mixed with other metals to make alloys which are harder.
13	Metals as conductors	Metals are good conductors of electricity because the delocalised electrons in the metal carry electrical charge through the metal. Metals are good conductors of thermal energy because energy is transferred by the delocalised electrons.
14	Diamond	In diamond, each carbon atom forms four covalent bonds with other carbon atoms in a giant covalent structure, so diamond is very hard, has a very high melting point and does not conduct electricity.
15	Graphite	In graphite, each carbon atom forms three covalent bonds with three other carbon atoms, forming layers of hexagonal rings which have no covalent bonds between the layers. In graphite, one electron from each carbon atom is delocalised.
16	Graphene	Graphene is a single layer of graphite and has properties that make it useful in electronics and composites.
17	Fullerenes	Fullerenes are molecules of carbon atoms with hollow shapes. The structure of fullerenes is based on hexagonal rings of carbon atoms but they may also contain rings with five or seven carbon atoms. The first fullerene to be discovered was Buckminsterfullerene (C_{60}) which has a spherical shape.
18	Nanotubes	Carbon nanotubes are cylindrical fullerenes with very high length to diameter ratios. Their properties make them useful for nanotechnology, electronics and materials.