In solid states of matter, particles are packed tightly together. They are arranged in a regular pattern. The particles in solid vibrate in fixed positions, they have a low kinetic energy. Solids have a fixed shape and the particles are so tightly packed, that they cannot be compressed.

In liquid states of matter, particles are arranged randomly. The particles are able to move around each other, so the particles in a liquid have a greater kinetic energy than the particles in a solid. Liquids are able to flow and take the shape of the container that they are put into. The particles in liquids are still quite close together, so like solids, they cannot be compressed.

The final state of matter that we need to know of is gas. The particles in a gas are arranged randomly. They are able to move in all directions very quickly because the particles in gases are far apart from each other. Gases have the highest amount of kinetic energy of the three states of matter. Like liquids, gases are able to flow and fill the container in which they are contained in. Gases can be compressed when squashed as the gaps between particles provide space for particles to move into.

In chemical equations, we represent an element or compounds state by using state symbols. Solids are represented by a lower case s in brackets (s). Liquids are represented by a lower case l in brackets (l). Gases are represented by a lower case g in brackets (g). Aqueous solutions are those formed when a substance is dissolved in water. They are represented by the state symbol (aq).

Substances can change states of matter. For a substance a change from one state to another, and energy transfer is required.

To turn a solid to a liquid, we heat it, transferring thermal energy into the substance, causing the particles to gain energy. This results in the breaking of some attractive forces between particles. This prices is known as melting. The melting process can be reversed by the process of freezing. Freezing turns a solid into a liquid. Freezing occurs when the particles in a liquid are cooled down enough to slow down the particles and cause them to settle in a stable arrangement.

To turn a liquid to a gas, we can evaporate or boil a liquid. The process is pretty much the same as the melting process in that thermal energy is transferred to the substance in order to break the bonds between particles, but the difference is that this process requires more heat energy than melting to overcome and break the remaining chemical bonds between particles. The process can be reversed in order to turn a gas into a liquid. This process of turning a gas to a liquid is called condensation. The process is essentially the same as the freezing process in that particles in a gas are cooled down enough to slow down the particles and cause them to compact.

We can identify and categorize a substance’s state of matter by taking its temperature and comparing it with its boiling and melting points. A substance is a solid if its temperature is lower than its boiling point. A substance is a liquid if its temperature is between its melting point and boiling point. A substance is a gas if the temperature of a substance is higher than the boiling point.

Particles can be charged. A charged particle is known as an ion. An ion can be either negatively charged or positively charged. When an element gains or loses electrons, it becomes an ion. We need to know that metals will lose electrons to become positively charged and that non-metals will gain electrons to become negatively charged.

An element can gain or lose electrons through bonding with other elements. There are three main types of bonding, ionic, covalent, and metallic.

Ionic bonding occurs between metals and non-metals. Metals loose electrons which are gained by the non-metals. When this happens, the metals are left with a positive charge, and the non-metals are left with a negative charge. The opposite charges attract each other by electrostatic forces.

Ionic compounds are compounds of ions. They form structures called giant lattices. Within ionic compounds, there are strong electrostatic forces of attraction that act in all directions between the oppositely charged ions that make up the giant ionic lattice. Ionic compounds have a high melting point, which means that lots of energy is required to break them by overcoming the strong electrostatic forces of attraction. They also have a high boiling point. In their solid state, the ions are not free to move, so ionic compounds can not conduct electricity unless they are in a liquid form.

Covalent bonding is the type of bonding between non-metal elements. In covalent bonding, atoms share a pair of electrons to gain a full outer shell. Simple covalent bonds are those in Chlorine, Oxygen, Nitrogen, Water, Ammonia, Hydrogen Chloride, and Methane. We have to be able to visualise the bonds between these simple covalent bonds with a dot and cross diagram.

Covalent bonds may also take the form of giant covalent structures. A giant covalent structure is where a large number of atoms are joined by covalent bonds. A giant covalent structure involves lots of covalent bonds present between several atoms in a regular pattern forming a giant lattice. As lots of covalent bonds are present in the compound, the structure is extremely strong. Diamonds are an example of giant covalent structure. Each Carbon atom in diamond is bonded to four other carbon atoms. Because of this, diamonds are very strong, and they have a high melting and boiling point. Silicon dioxide is another example of a giant covalent bond, they have a very similar structure and properties of diamond. Graphine is one other example of a giant covalent structure. Graphite is made up of layers of Carbon arranged in hexagons. Each carbon atom is bonded to three other carbon atoms and has one free delocalized electron that is able to move around its hexagonal layers – this allows graphite to conduct electricity. The layers are held together by weak intermolecular forces. The hexagonal layers of Carbon are able to slide over each other easily because there are no strong covalent bonds between the layers. Graphite also has a high melting point. Graphene, one more example of a giant covalent structure is one layer of graphite. Due to this fact, graphene has very similar properties to graphite.

Covalent bonds are also used in nanoscience. Nanoscience refers to structures that are 1 – 100nm in size. They are made up of just a few hundred atoms. And it is important to note that nanoparticles have a high surface area to volume ratio. Fullerines, such as buckminsterfullerene are spherical molecules of Carbon, arranged in hexagons. Fullerenes can be used to deliver drugs into the body. Carbon nanotubes are tiny, but proportionately long carbon cylinders. Nanotubes can conduct electricity. Nanoparticles have many uses, including: medicines, cosmetics, sun creams, and deodorants. Nanoparticles do have risks due to their size, they can easily enter the body where they may initiate harmful reactions and they may carry toxic substances. Nanoparticles are also relatively new, so scientists do not know to a full extend, the risks associated with them.

Finally, we need to talk about the last type of bonding, metalliuc bonding. Metallic bonding, as the name suggests, is bodnign between metal elements. Metallic bonding is the arrangment of positivley charged metal ions that are surrounded by a “sea” of negatively charged delocalized electrons. Between the positiclet charged metal ions and the negatively charged electrons there are strong electrostatic forces of attraction. Because the electrons are delocalized, meaning they are free to move about, metals are great conductors of electricity.

On the topic of metals, an alloy refers to two different types of metallic elements that are bonded together.