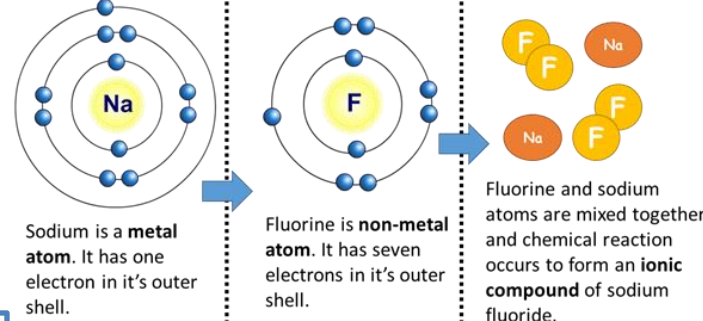


START

Why do atoms bond together?

All atoms want **full** outer shells of **electrons**. This makes them more **stable**. If they have space in their outer shell they can fill this by either giving away electrons, accepting electrons or **sharing** electrons.

Ionic and Covalent Bonding



How does an ionic bond form?

Bonding, Structure and Properties Keywords [F]

Ionic Bond – when a metal atom transfers an electron to a non-metal atom. The opposite charges attract.

Covalent Bond – when a pair of electrons are shared between two non-metal atoms.

Metallic Bond – the attraction between positive metal ions and negatively charged electrons in a metal.

Electrostatic Force of Attraction – the force of attraction between opposite charges.

Free Electrons – electrons that are able to move freely through a structure to conduct electricity.

Ion – an atom that has lost electrons to become positively charged, or gained electrons to become negatively charged.

Atom – a neutrally charged particle, there are over 100 different types, one for each element.

Melting Point – the temperature a substance turns from a solid to a liquid.

Malleable – a substance that changes shape easily rather than shattering

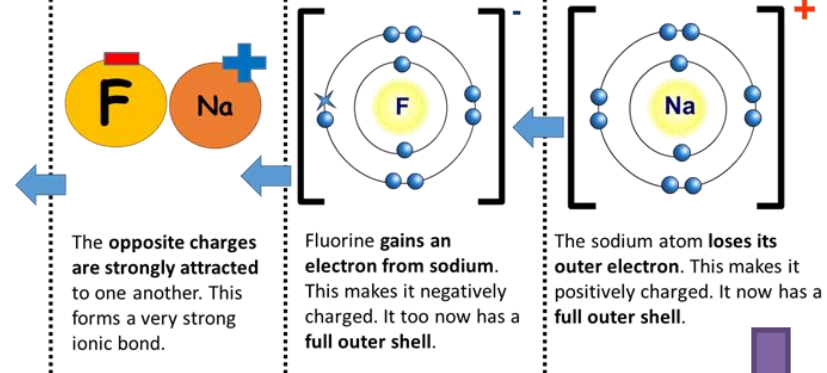
Intermolecular Force - a weak force that exists between molecules or polymer chains.

Alloy - formed when a metal is mixed with another element to improve its properties

Polymer – a very long molecule made from joining small monomers together. E.g. plastics

Lattice - a regular organised 3D structure on atoms

The End!



What is covalent bonding?

When **non-metal** atoms bond they **share** pairs of electrons – this type of bonding is called **covalent** bonding.

How does it work?

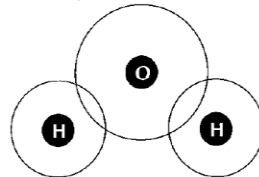
Each chlorine atom has **seven** electrons in its outer most shell. Each chlorine needs **one** more electron to gain a full outer shell and be stable.

The chlorine on the left needs to share **one** electron to the chlorine on the right and the chlorine on the right needs to share **one** electron to the chlorine on the left.

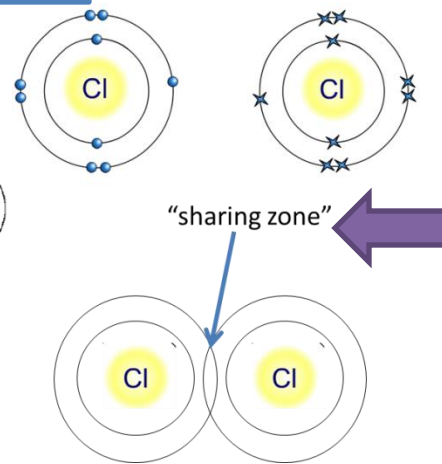
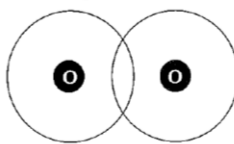
That means **two** electrons (a pair) need to go in the sharing zone. Each chlorine has six other electrons in its outer shell, these can be added on outside the sharing zone.

Try these...

c) Water (H_2O)



b) Oxygen (O_2)



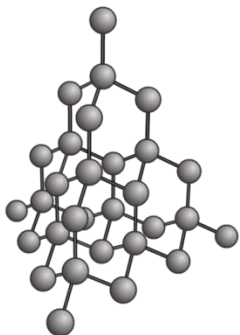
Comparing Ionic and Covalent Bonding

Covalent	Ionic
Pair(s) of electrons are shared	Involves ions of opposite charges
Does not involve ions	Bonding between a metal and a non metal
Bonding between non-metals	Does not form molecules
Forms molecules (groups of atoms bonded together)	Electrons are transferred from the metal atom to the non metal atom.

Structure and Properties

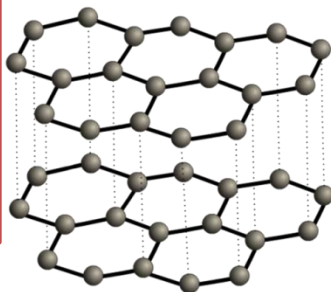
Diamond

Very hard strong high melting point each carbon has four strong covalent bonds to other carbon atoms. To break these a large amount of energy is needed. Does not conduct electricity because all the electrons are used to form covalent bonds with other carbon atoms. Without free electrons diamond cannot conduct electricity.

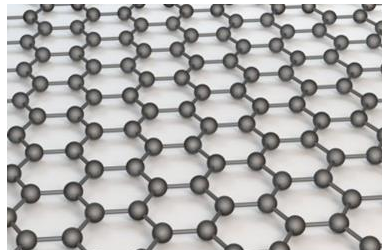


Graphite	Graphene
Layers	No Layers
Weak forces between layers	No layers
Each carbon atom covalently bonded to 3 others	
Free electrons	
Slippery	Not Slippery
Conducts electricity	
High melting point	
Used in pencils	Used in foldable screens

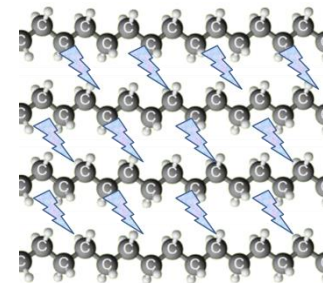
Graphite



Graphene



Polymers



Intermolecular forces exist **between** polymer chains

Because polymer chains are so large these forces are much stronger

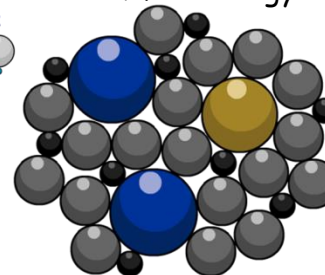
This makes polymers **very strong** and gives them **higher melting** and boiling points than simple molecules.

Simple Molecules

- **low boiling/melting point**
- Small groups of atoms
- Covalent bonds between atoms within molecules
- Intermolecular forces between molecules are weak
- Little energy needed to melt/boil

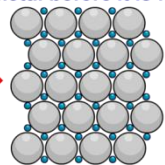
Polymers

- **Higher boiling/melting point**
- Many monomers joined in long chains
- Covalent bonds between atoms within polymer chains
- Intermolecular forces between polymer chains are strong
- More energy needed to melt/boil

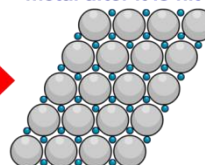


Alloys are harder than pure metals

metal before it is hit



metal after it is hit



force →

force →

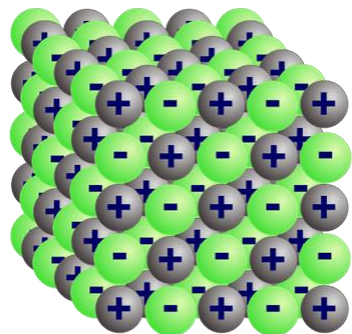
- In pure metals the atoms are all the same size.
- They form organised layers.
- These layers can easily slide so the metal changes shape more easily.

- In alloys, metals are mixed with other elements.
- The atoms are different sizes so there are no longer nice neat layers.
- The layers cannot easily slide making the alloy harder.

It is much softer than diamond because the carbon atoms are only bonded to 3 others by strong covalent bonds in layers. The layers are held together by weak forces which are easily broken. This allows the layers to slide over one another. Because each carbon atom only forms 3 covalent bonds with others there are free electrons. These electrons can flow through the structure allowing graphite to conduct electricity.

Tips – when describing substances you should

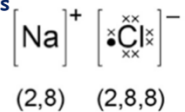
- Name the type of bonding (ionic/covalent/metallic/weak forces)
- Describe the number of bonds each atom forms
- Describe the strength of the bond
- Give any charges of any ions (positive or negative)



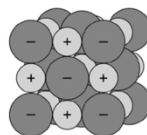
This is what the structure of an ionic substance could look like. Many oppositely charged ions attracting to each other in a giant 3D lattice.

Models of Ionic Bonding and Ionic Lattices

Dot and cross

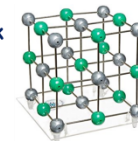


- Shows clearly what happens in terms of electrons
- Does not show what the arrangement in the structure might be like.



- Shows clearly the regular structure of a giant ionic lattice.
- You can only see the outside of the structure and not what's going on inside.

Ball and Stick

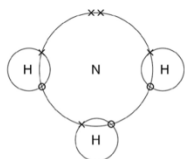


- Shows clearly the regular structure of a giant ionic lattice.
- You can only see external and internal structure.
- Ions are all the same size.
- Shows gaps between the ions.

Models of Covalent Bonding

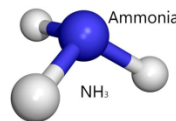
Dot and cross

For ammonia (NH₃)



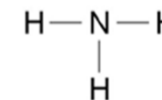
- Shows clearly that electrons are shared when outer shells overlap.
- Shows which atoms the electrons come from.
- Relative size of atoms not always correct.
- Arrangement of atoms (e.g. angle) not always correct.

Displayed Formula



- Shows how atoms are connected but in large molecules it would be too complex.
- Does not show which atoms the electrons come from.
- Shows what the molecule would look like in 3D.

Displayed Formula

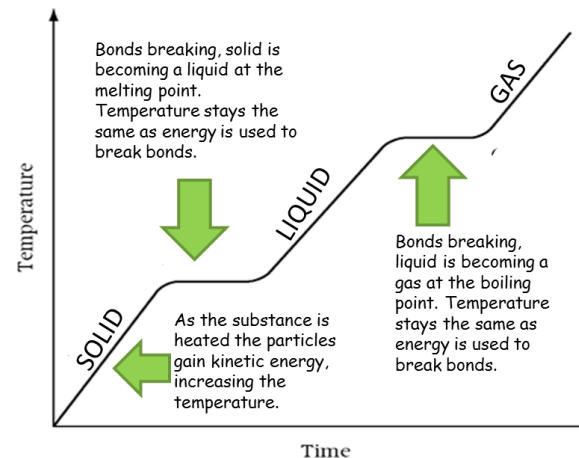


- Shows how atoms are connected in large molecules where dot and cross would be too complex.
- Does not show which atoms the electrons come from.
- Doesn't show what the molecule would look like in 3D.

Particle Theory

	Solid (s)	Liquid (l)	Gas (g)
Properties	Fixed shape, fixed volume, high density, doesn't flow	No fixed shape, fixed volume, lower density, flows	No fixed shape, no fixed volume, very low density, flows
Particle Arrangement	Tightly packed, lattice structure (rows)	Loosely packed, but close together	Far apart
Particle Motion (amount of kinetic energy)	Vibrate only, very low kinetic energy	Constant random motion, high kinetic energy, slow movement	Constant random motion, very high kinetic energy, very fast
Bonding	Strong forces	Weak forces	Very weak forces
Diagram			

Changes in State



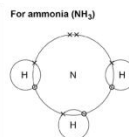
	Type of Bonding	Description of Structure	Properties of Structure	Examples of Substances
Simple Covalent Molecules	Covalent Bonding	Small groups of atoms bonded together with strong covalent bonds. Weak intermolecular forces between molecules. Always made up of two non-metal atoms.	Often liquids or gases, but sometimes solids. Very low melting and boiling points. Cannot conduct electricity.	Oxygen Carbon Dioxide Ammonia
Giant Covalent Structure	Covalent Bonding	Many non metal atoms held together by strong covalent bonds. It is a giant structure so many atoms joined together in a large 3D lattice.	Solids at room temperature. Very high melting and boiling points. Do not conduct electricity (except graphite) Very hard/strong materials	Diamond Graphite Silicon Dioxide
Giant Ionic Structures	Ionic Bonding	Made up of both metal and non-metal atoms held together by the attraction between oppositely charged ions. It is a giant structure so many atoms joined together in a large 3D lattice.	Solids at room temperature. Very high melting and boiling points. Do not conduct electricity when solid but do when melted (molten) or dissolved in water. Brittle if hit.	Sodium Chloride Magnesium Chloride
Metallic Structure	Metallic Bonding	Made up of metal and atoms held together by the attraction between metal ions and delocalised electrons. It is a giant structure so many atoms joined together in a large 3D lattice.	Solids at room temperature. Very high melting and boiling points. Do conduct electricity when solid and melted (molten). Malleable	Iron Steel (alloy) Copper Bronze (alloy)

1. What type of bonding occurs between two metal atoms?
2. What type of bonding occurs between two non metal atoms?
3. What type of bonding occurs between a metal and a non-metal atom?
4. What is a covalent bond?
5. What is an ionic bond?
6. What is a metallic bond?
7. Describe how an ionic bond forms between an atom of Lithium and an atom of fluorine. Use diagrams to help you.
8. Try the examples of covalent bonding on the first page of the learn sheet.
9. What is a molecule?
10. What is a giant structure?
11. Describe the structure and bonding in metals.

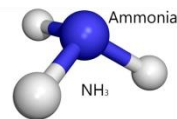
16. Explain why alloys are harder than pure metals.
17. Describe the structure and bonding in ionic substances e.g. sodium chloride.
18. Describe the structure and bonding in diamond.
19. Describe the structure and bonding in graphite.
20. Use particle theory to explain why:
 - a) Solids are not fluid but liquids and gases are.
 - b) Liquids are able to take the shape of the container whereas solids do not.
 - c) Gases expand to fill the space whereas liquids do not.
 - d) Solids and liquids have a definite volume whereas gases do not.
 - e) Diffusion in gases is faster than in liquids.
 - f) Diffusion cannot happen in solids.

substance	melting point (°C)	boiling point (°C)	state at -100°C	state at 20°C	state at 200°C
A	56	120			
B	32	87			
C	-35	16			
D	375	508			
E	-210	-196			
F	-78	-45			
G	-27	34			
H	203	365			
I	57	187			
J	-133	-84			
K	-27	12			
L	354	489			

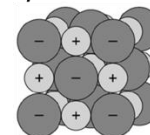
Why would you chose to use this model?



Instead of this model...



Why would you chose to use this model?



Instead of this model...

