Retrieval Practice

1. **What are the differences between an ionic and a covalent bond?**

IONIC : Metal and non-metal, electrons are transferred

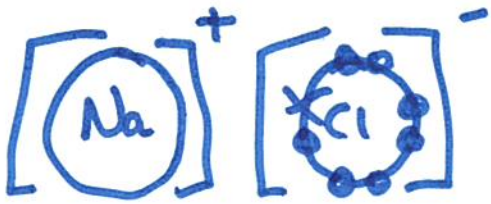
COVALENT : Two non-metal atoms, electrons are shared

2. **What type of bond would NaCl have? How do you know?**

Na = metal

Cl = non-metal

3. Bonding must be ionic!



Lesson 4: Metals, Alloys and Metallic Bonding **Date: ___ / ___ / ___**

What are the general properties of a metal you learnt in KS2?

How many can you list?

The key properties are:

Hard, Strong
Heat conductor, electrical conductor
Malleable
High melting point
Sonorous
Ductile.

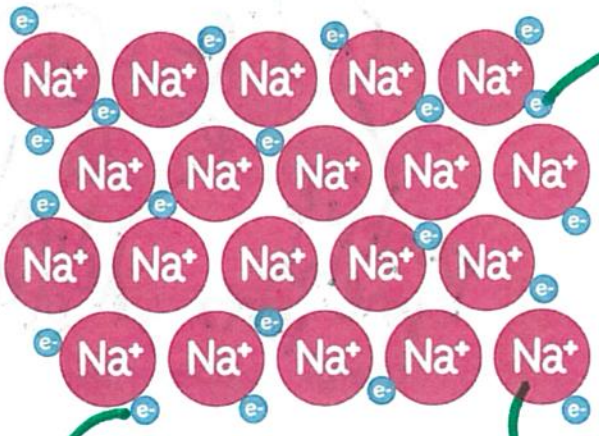
Description		Property
Can transfer electrical energy easily	*	Electrical conductor
Can be shaped without breaking	*	Malleable
Can take a large force without damage.		Strong
Can be drawn into wires	*	Ductile
Makes a ringing sound when struck		Sonorous
Can transfer heat energy easily	*	Heat conductor
Changes state from solid to liquid at a high temperature	*	High melting point
Solid and rigid		Hard.

- The arrangement of the atoms in a metal's structure can explain **ALL** of the properties.
- Metals exist as a **GIANT METALLIC LATTICE**.

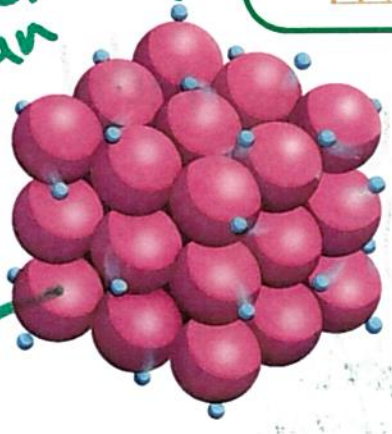
GIANT — Large! A giant lattice can be a single structure made of billions of particles

METALLIC — Made from metals

LATTICE — A regular, repeated arrangement – predictable!



2D structure



3D structure

electrons that can move

Strong electrostatic attractions

positive metal ions

Key Learning

The Giant Metallic Lattice

A giant metallic lattice is a structure made up of metal atoms arranged in a regular pattern. The structure is held together by strong electrostatic attractions. The outer electrons of the metal ions are free to move throughout the structure. This is called a "sea of delocalised electrons," and it allows metals to conduct electricity and heat well.

free to move

The strong electrostatic attractions between the metal ions and the delocalised electrons make the structure difficult to melt. This is because it takes a lot of energy to break the strong electrostatic attractions between the metal ions and the delocalised electrons. Metallic lattices are also strong, malleable (can be shaped without breaking), and ductile (can be drawn into wires).

A metallic lattice is malleable because the layers of metal atoms can slide over each other without breaking the strong electrostatic attractions. This is due to the "sea of delocalised electrons," which allows the structure to stay intact even when the shape is changed. When a force is applied, the layers slide over each other, but the strong electrostatic attractions keep the metal together. This is why metals can be hammered into different shapes or rolled into thin sheets without shattering.

The outer electrons of the metal ions in a giant metallic lattice are free to move throughout the structure, forming a sea of delocalised electrons. When a voltage is applied, these delocalised electrons flow, allowing the metal to conduct electricity. The delocalised electrons also help transfer thermal energy (heat). When a metal is heated, the energy is transferred to the electrons, which then move faster and spread the heat energy throughout the structure. Vibrations of the metal ions also contribute to heat transfer, but the moving electrons make metals particularly good heat conductors.

Fill in the blanks to describe metallic bonding.

Then, draw a labelled diagram using the description to help you.

Metallic bonding is sometimes described as 'positive metal ions in a sea of electrons.

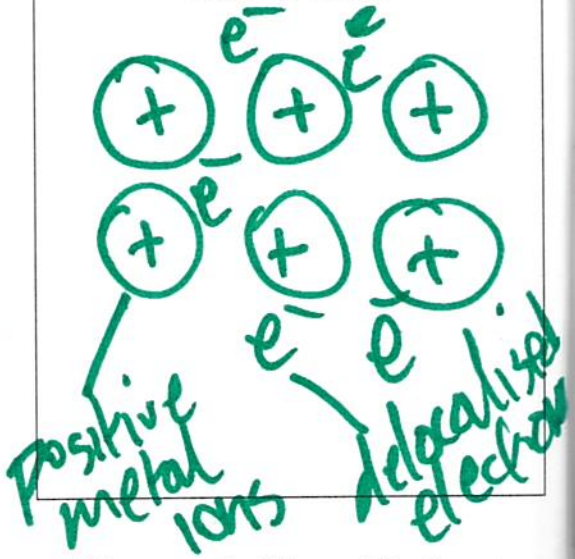
A solid metal is a lattice of positive metal ions.

Normally the positive metal ions would repel because they have the same charge.

The positive metal ions are held together by a strong electrostatic attraction to the electrons.

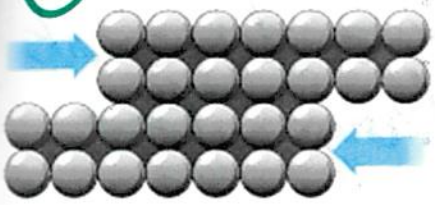
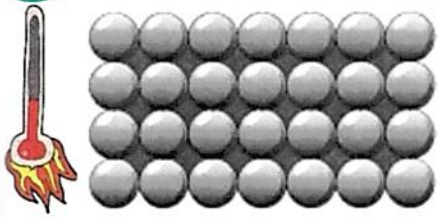
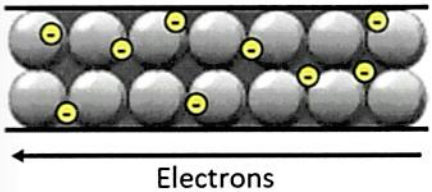
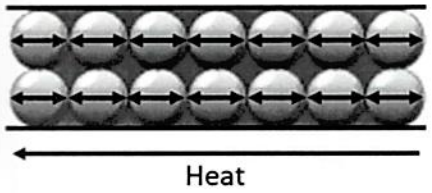
The electrons are free to move in a metallic lattice.

Labelled diagram of a giant metallic lattice



Charge Lattice Electrons (x2) Ions Repel Metal Electrostatic Positive

Explaining the properties of metals

Diagram	Property	Explanation
3 	Malleable	- The layers of metal ions can slide over each other easily without breaking. (Use these words: lattice, easily, electrons, move)
2 	High Melting Point	It takes a lot of energy to break the strong electrostatic attraction between the metal ions and the electrons. (Use these words: melting, high, electrostatic, energy)
4 	Conduct electricity	The electrons can move and carry a charge. (Use these words: electrons, move, charge)
4 	Conduct heat	The electrons can move and carry heat through the metal. (Use these words: strong, electrostatic, electrons, move, easily)

Alloys are mixtures of a metal and another element.

Because the other element is a different size to the metal ions, it changes the giant metallic lattice.

Alloys have different properties to pure metals because of this.

See the key learning box!

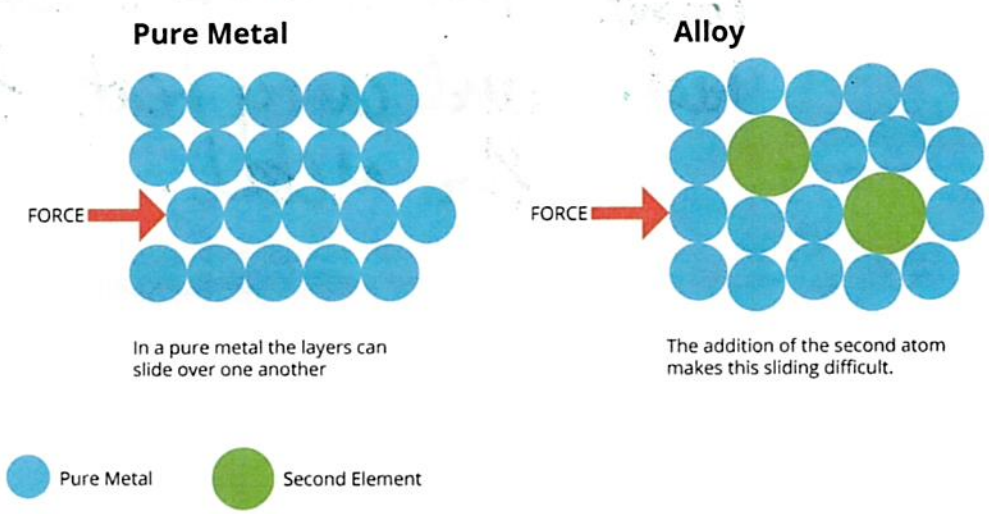
Alloys are **mixtures** of a **metal and another element**.

Some common alloys are:

- Steel – Iron and carbon
- Bronze – Copper and tin
- Brass – Copper and zinc

Alloys still conduct electricity and heat in the same way as a pure metal.

However, alloys are usually harder than a pure metal.



Key Learning

Questions!

1. What is an alloy?

A mixture of a metal and another element.

2. Explain why an alloy is likely to be harder than a pure metal.

(HINT: Use the key learning box to help you!)

The two elements have differently sized ions. This disrupts the giant metallic lattice and makes it more difficult for the layers to slide over each other. This makes the alloy harder.

3. Using the data in the table, answer the questions below.

	Al	Ti	Pb	Cu	Fe
Density (g/cm^3)	2.7	4.5	11.3	8.9	7.9
Electrical Conductivity (siemens/m)	0.382	0.024	0.046	0.593	0.100
Tensile Strength (MPa) (How easily a metal can stretch… lower numbers = more stretch!)	50 - 110	230	15	220 - 430	210

✓ strong?

a. Which would be the better material for overhead electricity cables – aluminium or titanium? Give reasons for your choice.

↑ conduct electricity?

An overhead cable should be light, conduct electricity and not stretch…

b. Explain why lead is not used for overhead electricity cables.

High density = heavy!

low tensile strength = stretchy!

c. Use the data to suggest why aluminium and titanium are used to make aeroplanes.