

# UNIT 301

## ENGINEERING MATERIALS

### ASSIGNMENT 5

Evidence meets the following grading criteria (include Key Skills if relevant)

5.1	Conductive materials
5.2	Resistive and dielectric materials
5.3	Semi-conductor materials

## TASK 5.1

Create a leaflet or handout that describes semiconductor materials used in engineering companies.

The leaflet is to be given to A Level Design and Engineering students that visit Marconi this type of student. It should not focus on processes used specifically within Marconi, but give a general overview of the process in any engineering company.

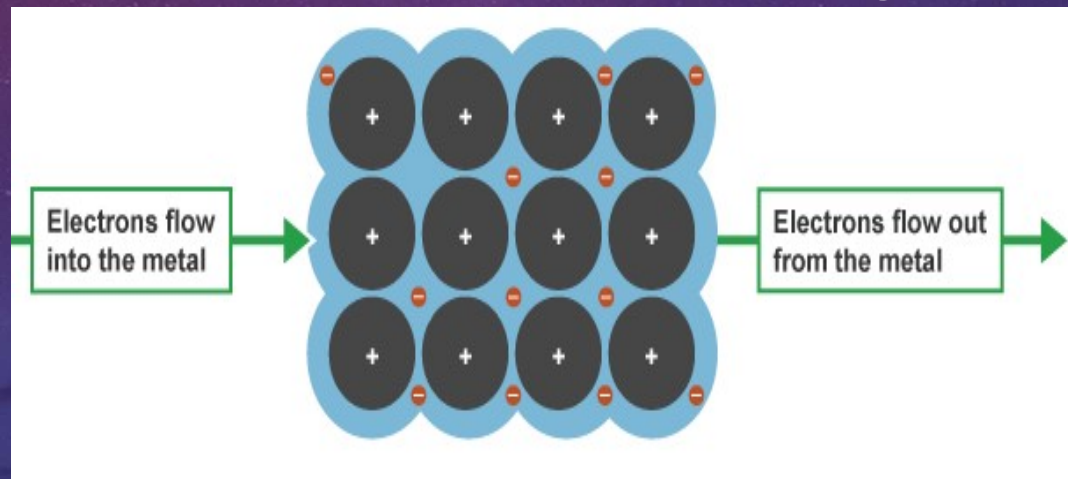
Briefly explain how the following materials conduct electricity:

- metals
- electrolytes
- superconductors
- semiconductors
- plasmas
- non-metallic conductors such as graphite and conductive polymers.

# HOW DO METALS CONDUCT ELECTRICITY?

- Every metal conducts electricity.
- This is due to the *metallic bonding* found within metal elements.
- In metallic bonding, the outer electrons are *delocalised (free to move)*.
- This produces an *electrostatic force of attraction* between the positively charged metal ions, and the negatively charged delocalised electrons.

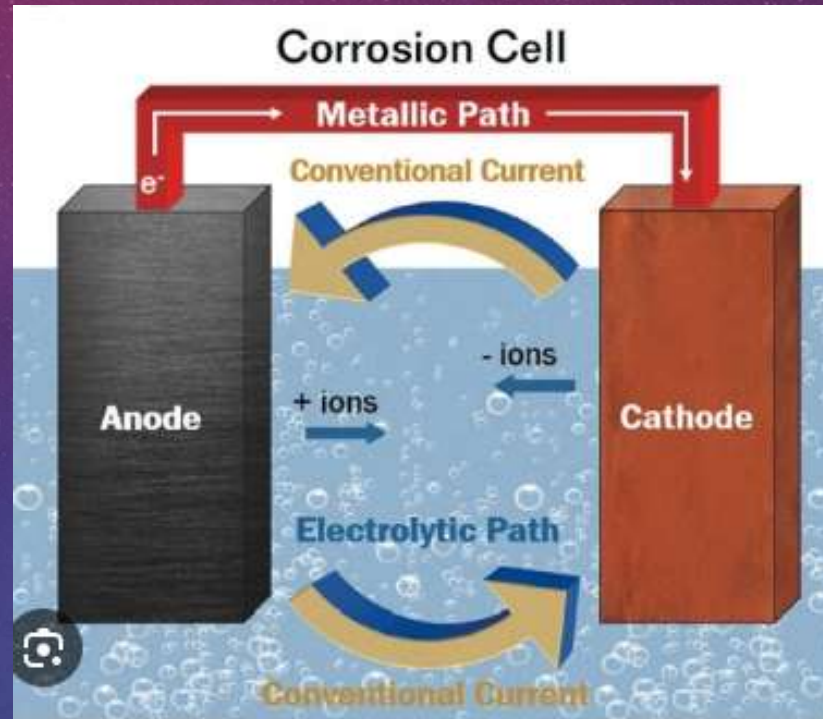
The ability of metals to conduct electricity stems from their delocalised electrons. As these are free to move, an electrical current can flow through metallic materials.



[Conductors & Non-Conductors | Properties of Matter | Chemistry | FuseSchool \(youtube.com\)](#)

# HOW DO ELECTROLYTES CONDUCT ELECTRICITY?

There are no electrons in the electrolyte; electricity transfer through an electrolyte is due to a charge transfer of positively charged ions (cations) moving away from the anode and toward the cathode, while negatively charged ions (anions) move away from the cathode and toward the anode



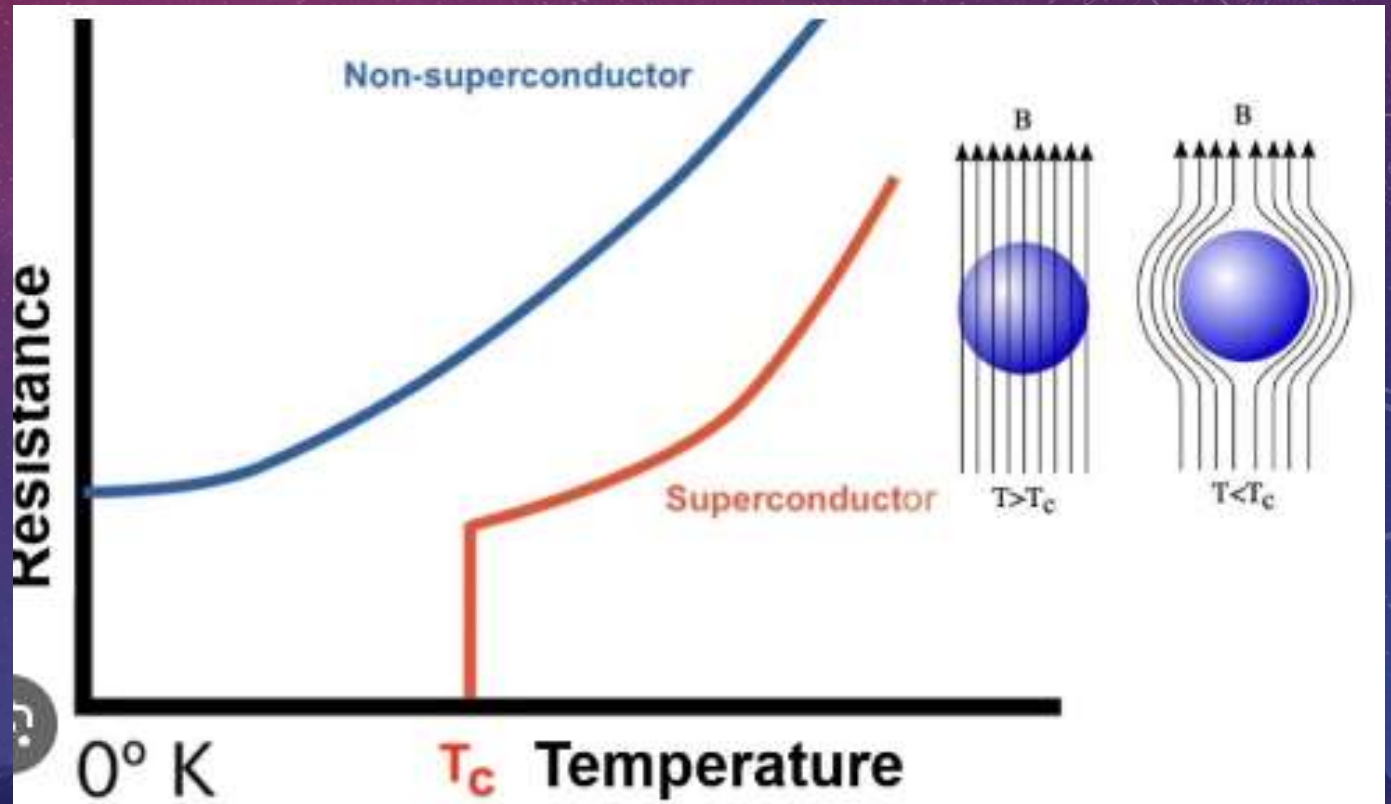
<https://www.youtube.com/watch?v=aELPrWzixeU>

# HOW DO SUPERCONDUCTORS CONDUCT ELECTRICITY?

In a superconducting material, instead of flitting around randomly, the moving electrons get passed along from atom to atom in such a way that they keep in sync with the vibrating nuclei. This coordinated movement produces no collisions and, therefore, no resistance and no heat.

<https://www.youtube.com/watch?v=2nDcoARyAVs>

<https://www.youtube.com/watch?v=xgC5zgr6Hdc>



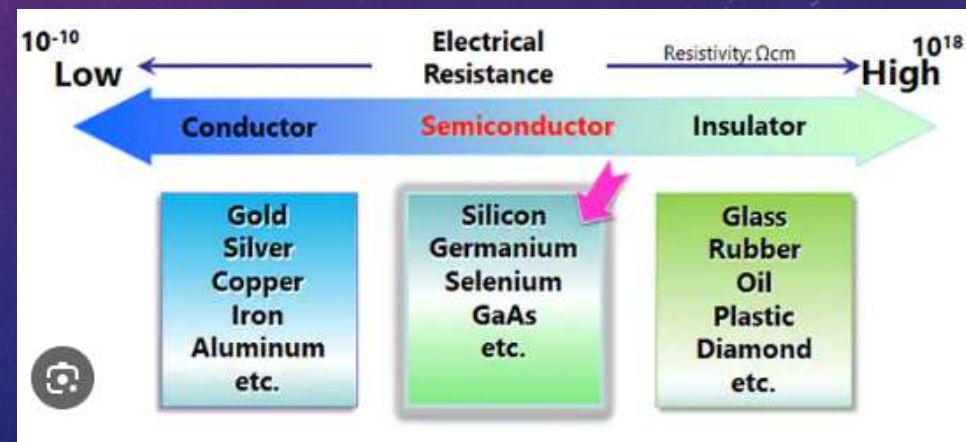
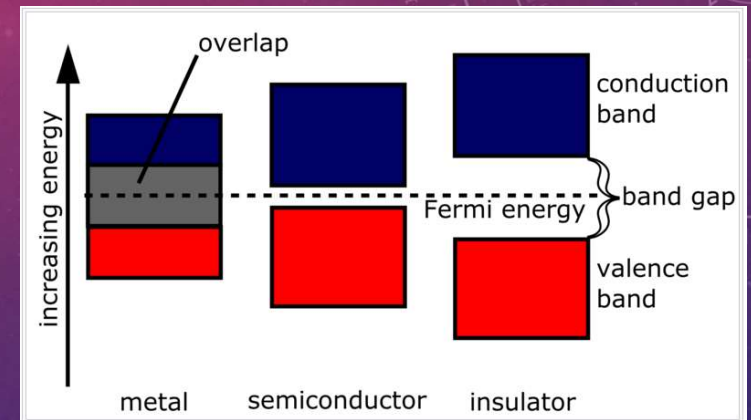
# HOW DO SEMICONDUCTORS CONDUCT ELECTRICITY?

They are mostly made of atoms that don't conduct electricity, but they have a handful of atoms with loose electrons. Under certain circumstances -- by changing things like temperature or how much energy is injected -- these loose electrons will start a flowing current.

At room temperature, a semiconductor has enough free electrons to allow it to conduct current. At or close to absolute zero a semiconductor behaves like an insulator.

A semiconductor is an element or compound that conducts electricity under some conditions but not others. This property of being neither a good insulator nor a good conductor makes semiconductors useful for controlling electric current.

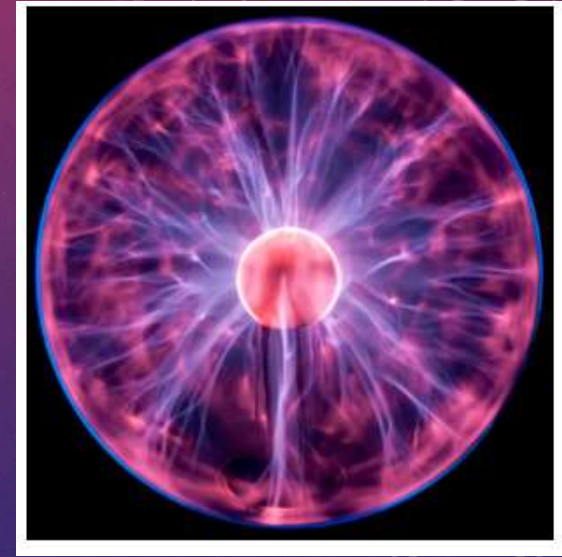
[How semiconductors conduct electricity \(youtube.com\)](https://www.youtube.com/watch?v=...)



## HOW DO PLASMAS CONDUCT ELECTRICITY?

In a typical plasma, some or all of the electrons in an atom gain enough energy to overcome nucleus potential barrier and an ionized gas is formed. So, plasma contains free electron-ions and is able to conduct electricity

Plasma is a state of matter that resembles a gas but has certain properties that gases do not have. Like a gas, plasma consists of particles of matter than can pull apart and spread out, so it lacks a fixed volume and a fixed shape. Unlike a gas, plasma can conduct electricity and respond to a magnetic field. That's because plasma consists of electrically charged particles called ions, instead of uncharged particles such as atoms or molecules. This gives plasma other interesting properties as well. For example, plasma glows with colored light when electricity passes through it.



[What's In A Candle Flame? \(youtube.com\)](https://www.youtube.com/watch?v=...)

## HOW DO NON-METALLIC CONDUCTERS CONDUCT ELECTRICITY?

Graphite is a good conductor of both electricity and heat. This is due to its molecular structure, which allows electrons to move freely through it.

Graphite has a layered structure that contains free electrons, and the free electron is responsible for electrical conduction.

Its unusual stacked 'plate-upon-plate' structure means graphite is the only common non-metal that conducts electricity so effectively.

Conducting polymers are a unique class of organic materials characterized by conjugated single and double carbon bonds along the polymer backbone. This conjugation allows electrons to delocalize across the backbone, creating a conducting path that can transport charges efficiently.