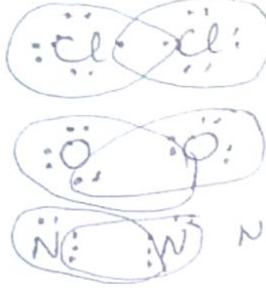
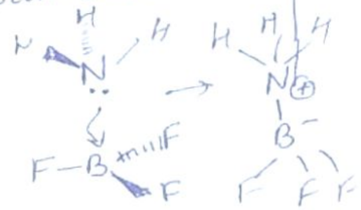
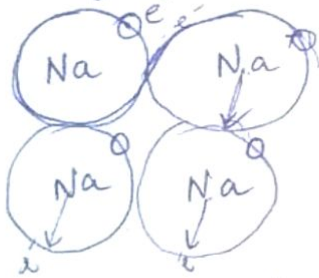
METALLIC BOND

Bonds (Chemical bond is an attractive force which keeps 2 atoms or ions together)

Ionic	Covalent	Co-ordinate (dative)	Metallic	H-bond
(Metal – Non-metal)	(Non-metal — Non metal)	– It is a 2 Centre 2 e^- covalent bond in which two electrons are derived from the same atom.	(Metal-Metal)	
$Na - 2,8,1$	 $Cl-Cl$ $O=O$ $N\equiv N$		– Solid	
$Na^+ - 2,8$			– High MP & BP.	
$Cl - 2,8,7$				
$Cl^- - 2,8,8$				
– Solid, High MP				
– Conduct electricity in Molten state				

→ A metallic bond is a type of chemical bond formed between positively charged atoms in which the free electrons are shared among a lattice of cations.

outermost e^- is weakly held by the nucleus.

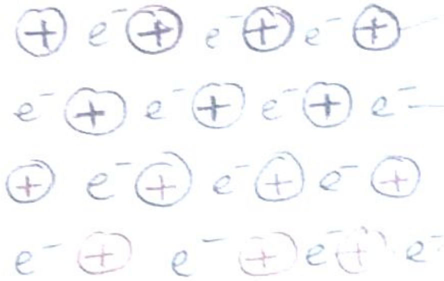


e^- while moving in its own orbit move to the orbit of other Na atom, there is attraction b/w.

– In contrast, covalent and ionic bonds are formed b/w two discrete atoms, metallic bond is the main type of chemical bond formed b/w metal atoms.

– Metallic bonds are seen in pure metals and alloys and some metalloids. For eg- graphene (an allotrope of Carbon) exhibits two dimensional metallic bonding.

" A metallic bond is the electrostatic force of attraction that the neighbour positive metallic ions have for the delocalized electrons.



The electron sea Model of Metallic bonding

(e^- embedded in the sea of +ve atoms)

Metallic bond Works

The outer energy levels of metal atoms (the S & P orbital) overlap. At least one of the valence electrons participating in a metallic bond is not shared with a neighbour atom, nor it is lost from an ion. Instead, the electrons form what may be termed as "<u>electron sea</u>" in which valence e^- move from ~~ato~~ one atom to another.

— The electron sea model is an oversimplification of metallic bonding. Metallic bonding may be seen as a consequence of a material having many more delocalised energy states than it has delocalised e^- (e^- deficiency.) . So

$N-H^{\delta +}$

repres

localised unpaired e^- may become delocalized (2)
and mobile.

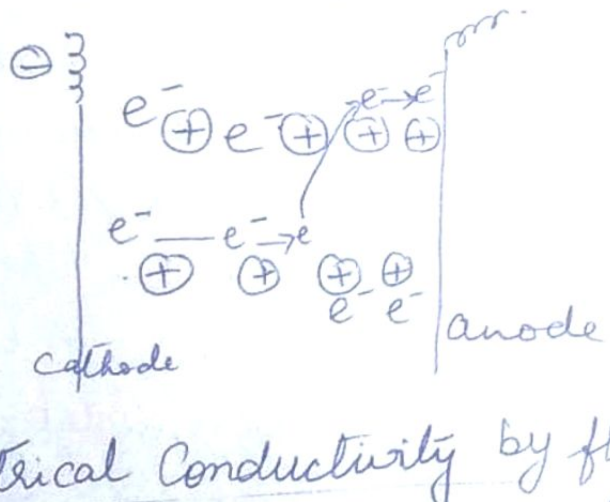
- The e^- can change energy and move throughout a lattice in any direction.

Relating Metallic Bonds to Metallic Properties

Because e^- are delocalised around positively charged nuclei, metallic bonding explains many properties of metals.

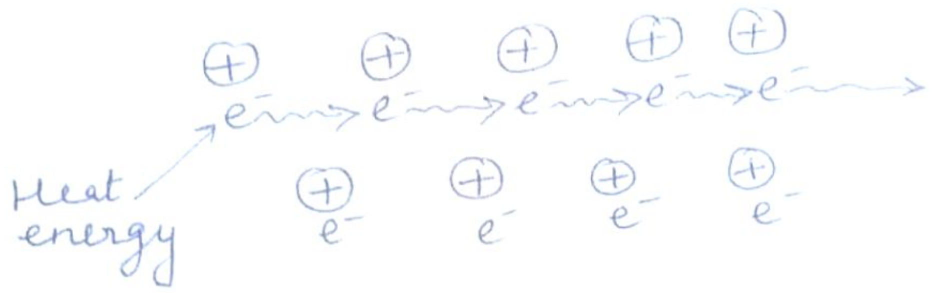
1) Electric Conductivity The metal is a good conductor of electricity.

Acc. to the 'electron Sea Model', the mobile e^- are free to move through the vacant space b/w ~~ions~~ metal ions. When electric voltage is applied at the two ends of metal wire, it causes the e^-'s to be displaced in a given direction. The best conductors are the metals which attract their outer e^-'s the least (low ionisation energy) and thus allow them the greatest freedom of movement



Electrical Conductivity by flow of electrons based on e^- sea model

2> Heat Conductivity - If a metal is heated at one end, the heat is carried to the other end. The mobile electrons in the 'electron sea' around one end of the metal easily absorb heat energy and increase their vibrational motion. They collide with adjacent electrons and transfer the added energy to them. Thus the mobility of the electrons allows heat transfer to the other end.

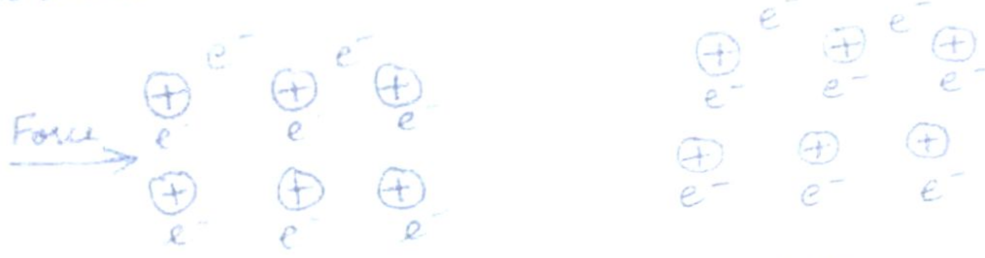


Heat Conduction through the metal

3> Ductility and Malleability - The ductility and malleability can also be explained by the electron sea Model. In Metals the positive ions are surrounded by the sea of e^-'s that 'flows' around them. If one layer of metal ions is forced across another, say by hammering, the internal structure remains essentially unchanged. The sea of electrons adjust positions rapidly and the crystal lattice is restored. This allows metal to be malleable and ductile.

gen
N,O
δ-
N

However, in ionic crystals of salts eg - NaCl, displacement of one layer of ions with respect to another brings like-charged ions near to each other. The strong repulsive forces set up between them can cause the ionic crystal to cleave or shatter. Thus, ionic crystals are brittle.



Before After

4> Luster or Reflectivity — The delocalized mobile electrons of the 'electron sea' account for this property. Light energy is absorbed by these electrons which jump into higher energy levels and return immediately to the ground level. In doing so, the electrons emit electromagnetic radiation (light) of the same frequency. Since the radiated energy is of same frequency as the incident light, we see it as a reflection of original light.