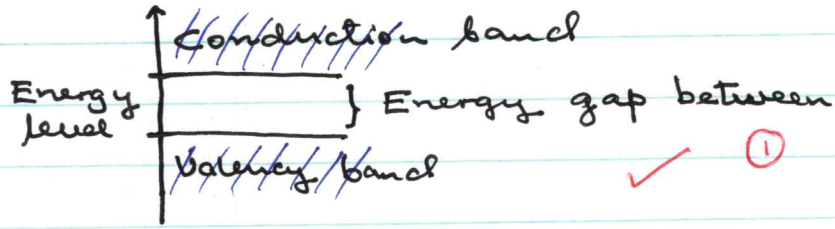
CAT 1

Atomic Structure and Bonding

1. According to energy-band theory, when atoms move close together, their energy levels overlap to form bands. ✓ ①



✓ ①

If electrons occupy conduction band, the metal is a good conductor even at absolute zero temperature ✓ ①

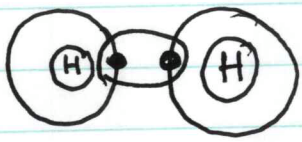
Addational Notes

For insulators, the valency band is completely filled and no electron occupy the conduction band.

For semi-conductors, at absolute zero temperature, no electron is in the conduction band. But when electrons are provided with enough energy to close over the energy gap, they occupy the conduction band and hence conduct electricity in high temperature state.

2. Covalent bonds — formed through sharing of electrons between atoms. ✓ $\frac{1}{2}$ (Stating)

e.g Bonding of two hydrogen atoms



H — H ✓ $\frac{1}{2}$ (Explaining and example)

- They are mainly molecules.
- And do not conduct electricity

– cont –

2. Ionic bonds – formed by exchange of electrons, hence formed between ~~elements~~ ions. or

e.g $Cl^- + Na^+ \longrightarrow NaCl$ (Table salt)

$\boxed{Na \rightarrow Na^+ + e^-}$ and $\boxed{Cl + e^-} \rightarrow \boxed{Cl^-}$ ion

– They are mainly solids.

– They are poor conductors of electricity in their solid form but good conductors when molten or in solution form.

Metallic bonds – atoms held together by sharing a stream of delocalised electrons.

e.g any metal.

They are good conductors of heat and electricity because of the free shared electrons.

Electrostatic force of attraction is between the positive nuclei of metals and the delocalised valence electrons in the metallic structure.

3. In diamond, each carbon atom has a covalent bond with four other carbons, The outer electron layer for all the atoms are filled with 8 electrons; hence no free electrons to move or conduct electricity. Hence insulator

In graphite, a carbon atom is bonded to three other carbon atoms implying three valency electrons are shared. The outer valency has a deficit of one electron which can be moved to conduct electricity.

4 Aluminium has more delocalized electrons compared to magnesium hence higher electrical conductivity. 1

Conductivity (electrical) increases with the number of free electrons.