## Resistivity or Specific Resistance (ρ).

(1) Definition: From $R = \rho \frac{l}{A}$; If l = 1m, A = 1 m2 then $\boldsymbol{R = \rho}$ i.e. resistivity is numerically equal to the resistance of a substance having unit area of cross-section and unit length.

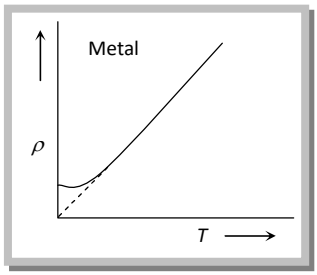
(2) Unit and dimension:its S.I. unit is ohm × m and dimension is $[ML^3T^{-3}A^{-2}]$

(3) Itsformula: $\rho = \frac{m}{ne^2\tau}$

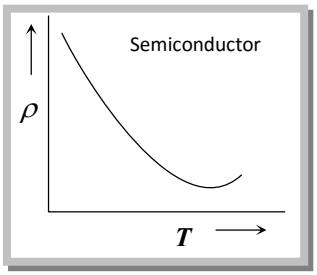
(4) Itsdependence: Resistivity is the intrinsic property of the substance. It is independent of shape and size of the body (i.e. l and A). It depends on the followings:

(i) Nature of the body: For different substances their resistivity also different e.g. ρsilver = minimum = 1.6 × 10–8 Ω-m and ρfused quartz = maximum ≈ 1016 Ω-m

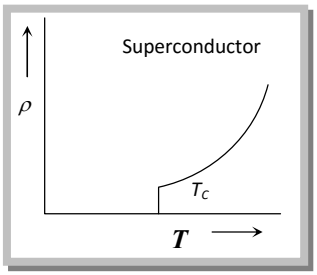
(ii) Temperature: Resistivity depends on the temperature. For metals ρt = ρ0 (1 + αΔt) i.e.




ρ increases with temperature




ρ decreases with temperature




ρ decreases with temperature and becomes zero at a certain temperature

resistivity increases with temperature.

(iii) Impurity and mechanical stress: Resistivity increases with impurity and mechanical stress.

(iv) Effect of magnetic field: Magnetic field increases the resistivity of all metals except iron, cobalt and nickel.

(v) Effect of light: Resistivity of certain substances like selenium, cadmium, sulphides is inversely proportional to intensity of light falling upon them.

(5) Resistivity of some electrical material:

$$\underset{\text{(Maximum for fused quartz)}}{\rho_{\text{insulator}}} > \rho_{\text{alloy}} > \rho_{\text{semi-conductor}} > \underset{\text{(Minimum for silver)}}{\rho_{\text{conductor}}}$$

Note: Reciprocal of resistivity is called conductivity (σ) i.e. $\sigma = \frac{1}{\rho}$ with unit mho/m and dimensions $[M^{-1}L^{-3}T^{3}A^{2}]$.