Chapter 17 Current and Resistance

§17.1 Electric Current

The current is the rate at which charge flows through this surface. If ΔQ is the amount of charge that passes through this area in a time interval of Δt, the current I is equal to the ratio of the charge to the time interval:

$$I \equiv \frac{\Delta Q}{\Delta t}$$

The SI unit of current is the ampere (A):

$$1\,A = 1\,C/s$$

Example 17.1

$\Delta Q = (nA v_d \Delta t) q$

v_d : the drift speed

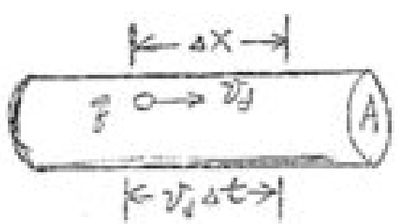
$$I = \frac{\Delta Q}{\Delta t} = nqv_d A$$

Example 17.2

§17.3 Current and Voltage Measurements in Circuits

Fig 17.5 (b)

17.2 A microscopic View: Current and Drift Speed



ΔQ = number of carriers × charge per carrier

$= (nA\Delta x) q$

n : the number of mobile charge carriers per unit volume.

$A\Delta x$: the volume element.

q : the charge on each carrier

§17.4 Resistance and Ohm's Law 電阻 歐姆定律

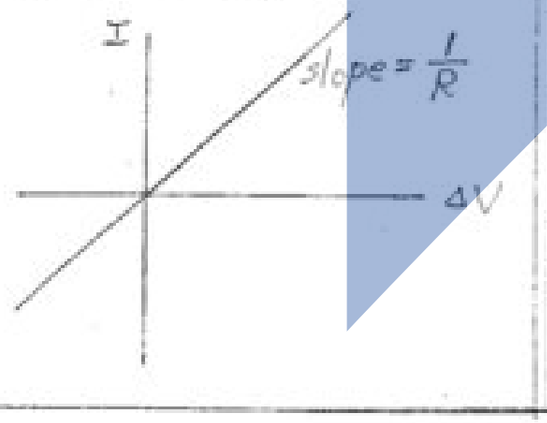
定義：

Resistance 電阻 $R \equiv \frac{\text{電壓(電位差)}\ \Delta V}{\text{電流}\ I}$

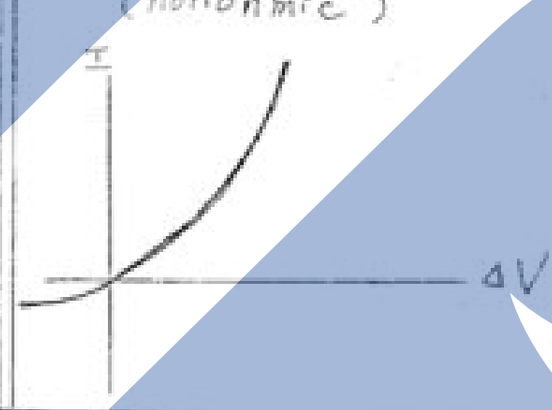
R的單位在SI制為 ohms (歐姆)(Ω).

Ohm's Law : $\Delta V = IR$

ohmic material :



semiconducting diode : (nonohmic)



§17.5 Resistivity 電阻係數

$$(\text{電阻})\ R = \rho \frac{l}{A}$$

ρ: resistivity 電阻係數
l: 長度
A: 截面積

§17.6 Temperature Variation of Resistance

For most metals:

$$\rho = \rho_0 [1 + \alpha (T - T_0)]$$

ρ：在溫度T時的電阻係數
ρ_0：在溫度T_0時 ——
α：電阻係數的溫度係數

$$\Rightarrow R = R_0 [1 + \alpha (T + T_0)]$$

Example 17.4

12.7 Superconductors 超導體

There is a class of metals and compounds whose resistances fall virtually to zero below a certain temperature T_c called the critical temperature. These materials are known as superconductors.

Fig. 12.8

12.8 Electrical Energy and Power

功率 $P = I\Delta V = I^2R = \frac{(\Delta V)^2}{R}$

Example 12.5