

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:

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

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

$$1 \text{ A} = 1 \text{ C/s}$$

Example 17.1

$$\Delta Q = (n A v_d \Delta t) q$$

v_d : the drift speed

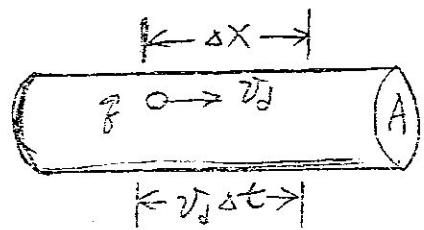
$$I = \frac{\Delta Q}{\Delta t} = n q v_d A$$

Example 17.2

§ 17.3 Current and Voltage Measurements in Circuits

Fig 17.5 (b)

§ 17.2 A microscopic view: Current and Drift Speed



$$\Delta Q = \text{number of carriers} \times \text{charge per carrier}$$

$$= (n A \Delta x) q$$

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

$A \Delta x$: the volume element.

q : the charge on each carrier

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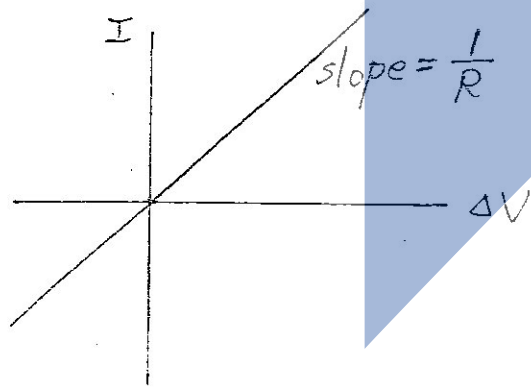
§ 17.4 Resistance and Ohm's Law
电阻 欧姆定律

定義: Resistance 电阻 $R = \frac{\text{电压 (电压差) } \Delta V}{\text{电流 } I}$

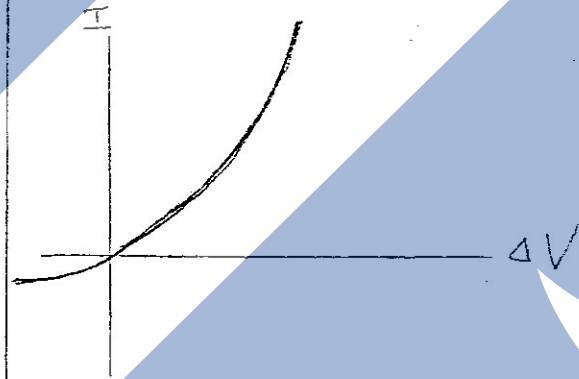
R 的單位在 SI 制為 ohms (欧姆) (Ω).

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

ohmic material:



semiconducting diode:
(nonohmic)



§ 17.5 Resistivity 电阻係数

(电阻) $R = \rho \frac{l}{A}$

ρ : resistivity 电阻係数
 l : 长度
 A : 截面积

§ 17.6 Temperature Variation of Resistance

For most metals:

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

ρ : 在温度 T 时的电阻係数

ρ_0 : 在温度 T_0 时

α : 电阻係数的温度係数

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

Example 17.4

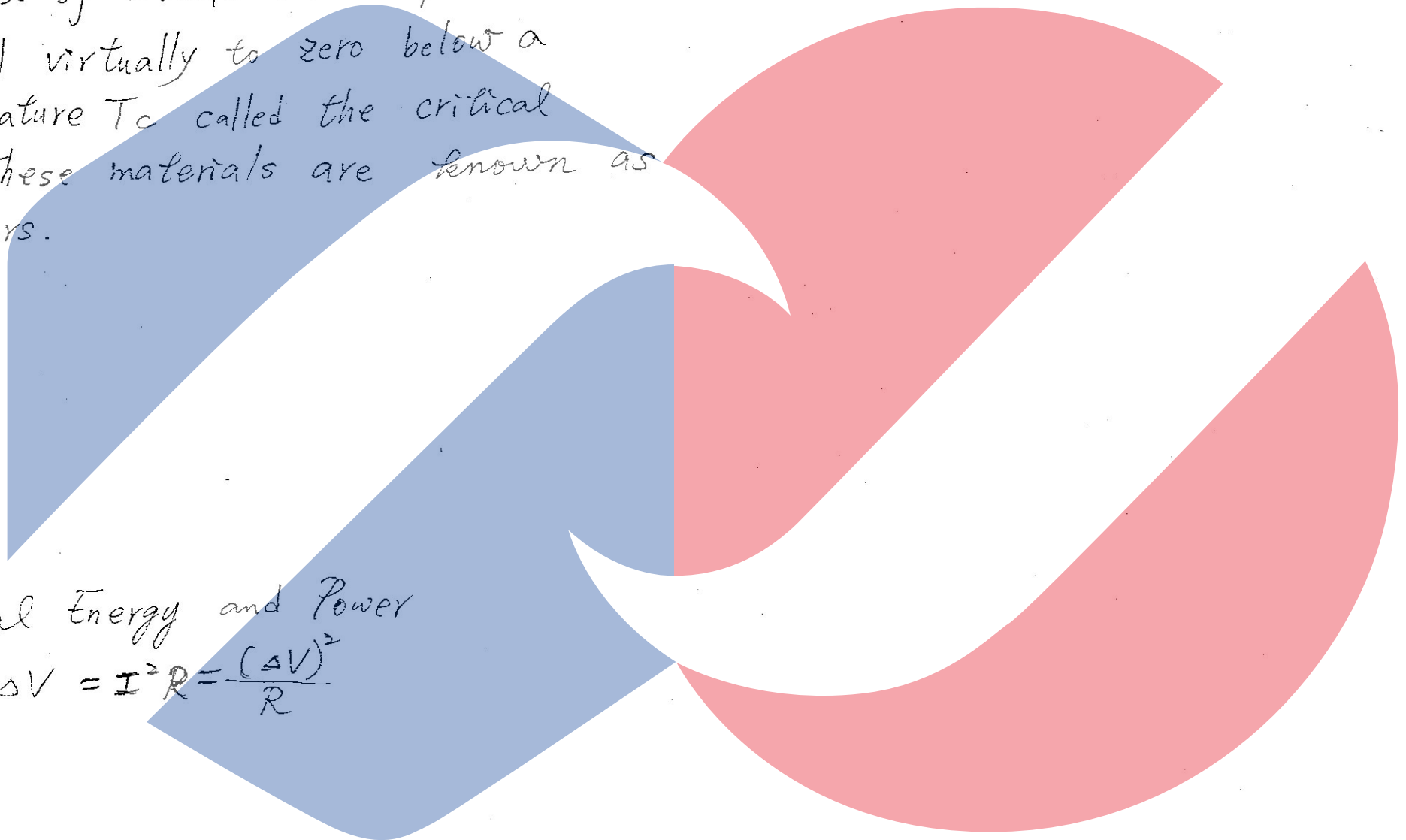
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12.7 Superconductors 超導體

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

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

Example 12.5

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