

# Magnetic properties of materials

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## Part 1. Introduction to magnetism

$$I = \oint H dl \quad (1.1)$$

$$H = \frac{I}{2\pi r} \quad (1.2)$$

$$B = \mu_0 H \quad (1.3)$$

$$U_{\text{mag}} = -m \cdot B \quad (1.4)$$

$$m_{\text{current-loop}} = IA \quad (1.5)$$

$$m = evr/2 \quad (1.6)$$

$$m = \frac{e\Pi_e}{2m_e} \quad (1.7)$$

$$m = g_e \frac{e\Pi_e}{2m_e} \quad (1.8)$$

$$m = g_e \frac{e\hbar}{2m_e} S \quad (1.9)$$

$$m = g_e \mu_B S \quad (1.10)$$

$$\mu_B = \frac{e\hbar}{2m_e} = 9.27 \cdot 10^{-24} \text{ Am}^2. \quad (1.11)$$

$$D = \epsilon_0 E + P \quad (1.12)$$

$$D = \epsilon_0 E + \chi_e \epsilon_0 E = \epsilon_0 (1 + \chi_e) E = \epsilon_0 \epsilon_r E \quad (1.13)$$

$$M = \frac{\sum_i m_i}{\text{Volume}} \quad (1.14)$$

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$$B = \mu_0(H + M) \tag{1.15}$$

$$\chi = \frac{M}{H} \tag{1.16}$$

$$B = \mu_0 H(1 + \chi) = \mu_0 \mu_r H, \tag{1.17}$$