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BOHR IRON

If each electron contributes 1 Bohr magneton to the magnetization of iron, how many electrons per atom, on average, contribute to the saturation field of 2 Tesla?

1 Bohr magneton = $\frac{e\hbar}{m_e c} = 10^{-23}$ amp m$^2 = m$

2 Tesla $= B = \mu_o M = \mu_o m N$

where N = density of electrons per m^3

$$N_{\text{electrons}} = \frac{M}{\mu_o m} = \frac{2 \text{ Tesla}}{4\pi \times 10^{-7} \times 10^{-23} \text{ amp m}^2/\text{electron}}$$

$$= 1.6 \times 10^{29} \text{ electrons/m}^3$$

density of iron $\approx$ 8 gm/cm^3 , atomic weight $\approx$ 56

$$N_{\text{atoms}} \approx 8 \text{ gm/cm}^3 \times 10^6 \text{ cm}^3/\text{m}^3 \times \frac{6\times 10^{23} \text{ atoms}}{56 \text{ grams}}$$

$$N_{\text{atoms}} \approx 8 \times 10^{28} \text{ atoms/m}^3$$

$\Rightarrow N_{\text{electrons}} \approx 2\, N_{\text{atoms}}$, 2 electrons per atom