EngineeringRise

Magnetic dipole, bar magnet and magnetic materials

Formulas and units, JEE Main. Status: Reviewed on 2026-11-20.

Result	Formula	Units or note
Dipole moment of a loop	M = N I A Valid when: planar current loop of N turns, area A	A m^2 = J/T
Bar magnet	M = m (2l) Valid when: bar magnet of pole strength m and length 2l (distance between poles)	A m^2 (m in A m)
Short magnet, axial field	B = (mu0/4 pi) 2M/d^3 Valid when: short magnet, d much larger than magnet length, d from centre	T
Short magnet, equatorial field	B = (mu0/4 pi) M/d^3 Valid when: short magnet, d much larger than magnet length, d from centre	T
Torque on a dipole	tau = M B sin(theta) Valid when: dipole in uniform field; theta is angle between M and B	N m
Potential energy	U = -M B cos(theta) Valid when: dipole in uniform field; zero of energy at theta = 90 degrees	J
Small oscillations	T = 2 pi sqrt(I/(M B)) Valid when: small angular oscillations of a magnet in uniform B; I is moment of inertia	s
Magnetisation and permeability	M_vol = chi H; mu_r = 1 + chi; B = mu0 mu_r H Valid when: linear magnetic material, H is the magnetising field	A/m (dimensionless, T)
Curie law (paramagnet)	chi = C/T Valid when: paramagnetic substance, T in kelvin, not near saturation	dimensionless; T in kelvin

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/physics/magnetic-effects-of-current-and-magnetism/magnetic-dipole-bar-magne

EngineeringRise is an unofficial study site. It is not affiliated with NTA, the IITs, BITS, VIT, SRM or any exam body.