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Displacement current and electromagnetic waves

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

Result	Formula	Units or note
Displacement current	I_d = epsilon_0 dPhi_E/dt = C dV/dt (capacitor) Valid when: changing electric flux, e.g. between charging capacitor plates	A
Ampere-Maxwell law	closed integral of B.dl = mu_0 (I_c + I_d) Valid when: any closed loop; I_c is conduction current, I_d displacement current	T m
Wave speed in vacuum	c = 1/sqrt(mu_0 epsilon_0) = f lambda = omega/k Valid when: vacuum (free space); f lambda = omega/k holds for any wave	m/s (c = 3.0 x 10^8 m/s)
Fields ratio	E0/B0 = c (vacuum); E0/B0 = v (medium) Valid when: plane EM wave: E0/B0 = c in vacuum, v in a medium	V/m per T = m/s
Medium speed	v = 1/sqrt(mu epsilon) = c/sqrt(mu_r epsilon_r) Valid when: non-conducting medium with constant mu and epsilon	m/s
Average energy density	u = (1/2) epsilon_0 E0^2 = B0^2/(2 mu_0); u_E = u_B Valid when: plane EM wave in vacuum, E0 and B0 are peak values	J/m^3
Intensity	I = u c = (1/2) epsilon_0 c E0^2 = c B0^2/(2 mu_0) Valid when: plane EM wave in vacuum, E0 peak, time-averaged	W/m^2
Point source	I = P/(4 pi r^2) Valid when: isotropic point source, no absorption, r from source	W/m^2
Field between circular plates	B = mu_0 I r/(2 pi R^2) (r < R); mu_0 I/(2 pi r) (r > R) Valid when: circular plates, uniform charging current I, plate radius R	T

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/physics/electromagnetic-waves/displacement-current-and-electromagnetic-wave

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