EngineeringRise

Faraday law, Lenz law and inductance

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

Result	Formula	Units or note
Magnetic flux	Phi = B A cos(theta) Valid when: uniform B over a plane area; theta is the angle between B and the normal	Wb = T m^2
Faraday's law	e = -N dPhi/dt Valid when: N identical turns, Phi the flux through one turn; minus sign is Lenz's law	V
Induced charge	q = N (change in Phi)/R Valid when: closed loop of constant resistance R; N times total flux change over time	C
Motional emf (straight rod)	e = B l v Valid when: straight rod with B, rod and velocity mutually perpendicular	V
Rotating rod or disc	e = 1/2 B w l^2 Valid when: rod of length l rotating about one end in a plane perpendicular to uniform B	V
Force on sliding rod	F = B^2 l^2 v/R Valid when: rod sliding on rails in uniform B perpendicular to the plane; circuit resistance R	N
Self-inductance	N Phi = L I; e = -L dI/dt Valid when: linear medium (no saturating iron core); L is constant	H (V)
Solenoid inductance	L = mu0 N^2 A/l Valid when: long air-core solenoid, end effects ignored	H
Stored magnetic energy	U = 1/2 L I^2 Valid when: inductor carrying current I	J
Mutual inductance	e2 = -M dI1/dt; M = k sqrt(L1 L2) Valid when: two coils with linear coupling; k is the coupling coefficient, at most 1	H (V)
LR growth	I = (E/R)(1 - e^(-t/tau)), tau = L/R Valid when: L and R in series with a battery switched on at t = 0, zero initial current	A (s)

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/physics/electromagnetic-induction-and-alternating-currents/faraday-law-lenz-law

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