

Fields

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Non-contact forces

- electric fields (dipoles & monopoles)
- magnetic fields (dipoles only)
- gravitational fields (monopoles only)
- monopoles: field lines radiate towards central object
- dipoles - field lines go from + to -, or N to S
- closer field lines means larger force
- dot means out of page, cross means into page

Gravity

$$F_g = G \frac{m_1 m_2}{r^2} \quad (\text{grav. force})$$

$$g = \frac{F_g}{m} = G \frac{M_{\text{planet}}}{r^2} \quad (\text{grav. acceleration})$$

$$E_g = mg\Delta h \quad (\text{grav. potential energy})$$

$$W = \Delta E_g = Fx \quad (\text{work})$$

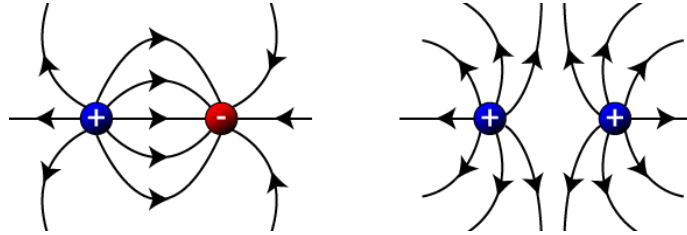
Area under force-distance graph = $\Delta G.P.E$

Area under field-distance graph = $\Delta G.P.E/\text{kg}$

Magnetic fields

$$F = qvB \quad (\text{force on moving charged particles})$$

if $B \perp A, \Phi \rightarrow 0$, if $B \parallel A, \Phi = 0$



Right hand slap: field, current, force are \perp

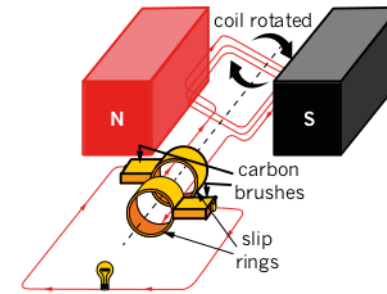
Flux-time graphs: gradient $\times n = \text{emf}$

Transformers: core strengthens & focuses Φ

Power transmission

$$V_{\text{rms}} = \frac{V_{\text{p} \rightarrow \text{p}}}{\sqrt{2}} \quad (\text{rms to peak} \rightarrow \text{peak})$$

$$P_{\text{loss}} = \Delta VI = I^2 R = \frac{\Delta V^2}{R} \quad (\text{power loss})$$



Electric fields

$$F = qE \quad (\text{force on particle - } E \text{ is field strength})$$

$$W = q_{\text{point}} \Delta V \quad (\text{work in field or points})$$

$$F = k \frac{q_1 q_2}{r^2} \quad (\text{Coulomb - force between particles})$$

$$E = k \frac{Q}{r^2} \quad (\text{field at distance from charge})$$

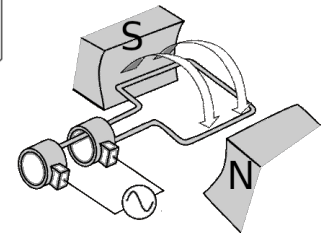
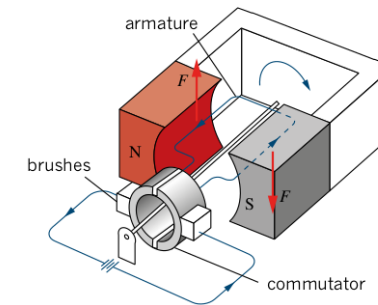
$$F = BIl \quad (\text{force on a coil})$$

$$\Phi = B_{\perp} A \quad (\text{magnetic flux})$$

$$\mathcal{E} = -N \frac{\Delta \Phi}{\Delta t} \quad (\text{Faraday - induced emf})$$

$$\frac{V_p}{V_s} = \frac{N_p}{N_s} = \frac{I_s}{I_p} \quad (\text{xfmr coil ratios})$$

Motors



Lenz's law: " $-n$ " in Faraday - emf opposes $\Delta \Phi$

Eddy currents: counter movement within a field

Right hand grip: thumb points to north or I

DC: split ring (one ring split into two halves)

AC: slip ring (separate rings with constant contact)