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

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

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

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

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

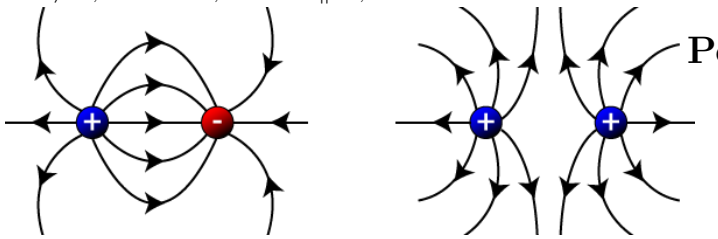
Area under force-distance graph $= \Delta G.P.E$

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

Magnetic fields

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

if $B \not\perp A, \Phi \to 0$, if $B \parallel A, \Phi = 0$



Electric fields

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

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

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

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

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

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

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

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

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

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

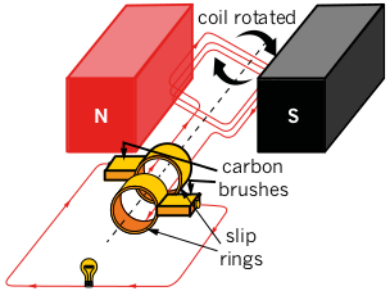
Flux-time graphs: gradient $\times n =$ emf

Transformers: core strengthens & focuses Φ

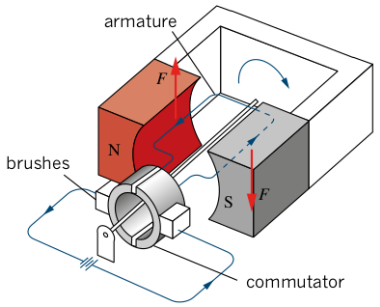
Power transmission

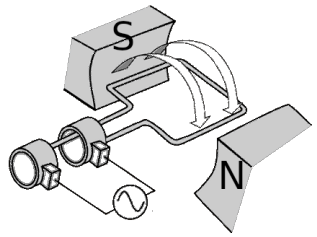
$$V_{\text{rms}} = \frac{V_{\text{p}\to\text{p}}}{\sqrt{2}} \quad \text{(rms to peak} \to \text{peak)}$$

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



Motors





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

AC: slip ring (separate rings with constant contact)