Electrostatics Review – Chapters 23-26

In American polls in the early 1990s, 42% didn't know where Japan is; but the proportion was in the high 90s who had heard of the Menendez, Bobbitt and O.J. Simpson criminal cases. *Sagan*

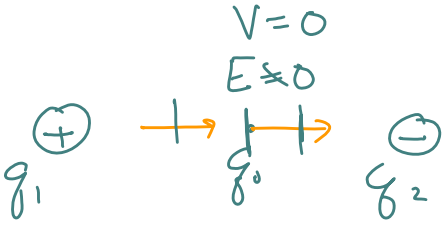
If the aliens would only keep all the folks they abduct, our world would be a little saner.

I. Charges, methods of charging, insulators, conductors

+, − 1. friction
2. contact/ conduction
3. induction

II. Point charges

(A) Coulomb's Law: $F = \frac{k_e q_1 q_2}{r^2}$



(B) $E = \frac{F}{q_0} = \frac{kq_1}{r^2}$ (vector)

(C) $V = \frac{kq}{r}$ (scalar)

(D) $U = \frac{kq_1q_2}{r}$

(E) Field Lines indicate direction of Force on $+q_0$ away from $+Q$, toward $-Q$

(F) Equipotentials same potential, ⊥ to field lines

III. Charge Distribution

(A) $E = k_e \int \frac{dq}{r^2}$

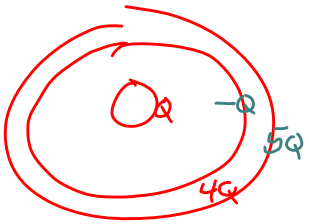
(B) $V = k_e \int \frac{dq}{r}$

(C) $\Delta V = -\int E \cdot dr$ or $\frac{-dV}{dr} = E_r$

IV. Symmetric Charge Distribution

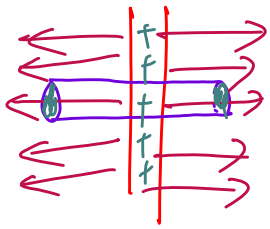
(A) Gauss's Law: $\oint E \cdot dA = \frac{q_{in}}{\epsilon_0}$

(1) Concentric sphere/shells $\oint dA = 4\pi r^2$



(2) Coaxial $\oint dA = 2\pi r l$

(3) Sheet endcap A



(B) $\Delta U = -q_0 \int E \cdot ds$

(C) $\Delta V = \frac{\Delta U}{q_0} = -\int E \cdot ds$

(D) Equilibrium – charge on each surface

V. General

(A) $E_x = -\frac{dV}{dx}$

(B) Flux = $\Phi_E = E \cdot A$ (+, −, 0)

(C) $C = \frac{Q}{\Delta V}$

(1) Capacitors in series: $\frac{1}{C_{eq}} = \sum \frac{1}{C_i}$

(2) Capacitors in parallel: $C_{eq} = \sum C_i$

(3) Dielectric: $C = \kappa C_0$

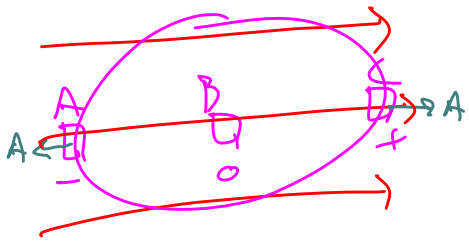
(4) $U = \frac{Q^2}{2C} = \frac{Q\Delta V}{2} = \frac{1}{2} C \Delta V^2$

(5) $C_{plates} = \frac{\epsilon_0 A}{d}$

(6) $C_{shells} = \frac{ab}{k(b-a)}$

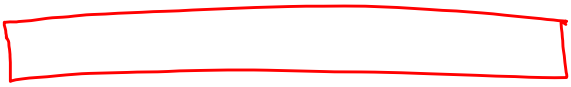
F.R. Types

1. Point charge
2. Distributed q, λ
3. Gauss
4. 



$$\Delta V = \frac{\Delta U}{q}$$

$$4\,e^{-} = \Delta U$$



$$\oint E \cdot cdA = \frac{Sin}{\epsilon_0}$$