122 Exam 2 Equations, Tipler Chapters 23-25

Exam 1 equations:

$e = 1.60\times10^{-19}C$ $\vec{E} = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}\hat{r}$ Gauss: $\phi_{net} = \oint_S \vec{E}\bullet\hat{n}\,dA = \frac{Q_{inside}}{\varepsilon_0}$

$k = \frac{1}{4\pi\varepsilon_0} = 8.99\times10^9\,N\bullet m^2/C^2$ $\varepsilon_0 = \frac{1}{4\pi k} = 8.85\times10^{-12}\ C^2/(N\bullet m^2)$

∞ line: $E_R = \frac{1}{2\pi\varepsilon_0}\frac{\lambda}{R}$ ∞ plane: $E_z = sign(z)\bullet\frac{\sigma}{2\varepsilon_0}$ thin sph. shell: $E_r = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}$ $r > R$; $E_r = 0$ $r < R$

Chapter 23:

Define: $\Delta V = V_b - V_a = \frac{\Delta U}{q_0} = -\int_a^b \vec{E}\bullet d\vec{\ell}$ Coulomb: $V = \frac{kq}{r}$ ($V = 0$ if $r = \infty$)

Point chgs: $V = \sum_{i=1}^{n}\frac{kq_i}{r_i}$ Distributed chgs: $V = \int\frac{k\,dq}{r}$ $E_{\tan} = -\frac{dV}{d\ell}$ $E_x = -\frac{dV}{dx}$

$\vec{E} = -\vec{\nabla}V = -\left(\frac{\partial V}{\partial x}\hat{i} + \frac{\partial V}{\partial y}\hat{j} + \frac{\partial V}{\partial z}\hat{k}\right)$ Potl Energy: $U = q_0V$ 2 pt chgs: $U = \frac{kq_0q}{r}$

Electric potential due to a single point charge : V = k Q / r
(same expression when external to a uniformly charged sphere or spherical shell)

Pt Chgs: $U = \frac{1}{2}\sum_{i=1}^{n}q_iV_i$ Conductor: $U = \frac{1}{2}QV$ System of conductors: $U = \frac{1}{2}\sum_{i=1}^{n}Q_iV_i$

Chapter 24:

Def: $C = \frac{Q}{V}$ isol. sphere: $C = 4\pi\varepsilon_0R$ par plate: $C = \frac{\varepsilon_0A}{d}$ cyl: $C = \frac{2\pi\varepsilon_0L}{\ln(R_2/R_1)}$

$U = \frac{1}{2}QV = \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}CV^2$ $u_e = \frac{1}{2}\varepsilon_0E^2$ Par: $C_{eq} = C_1 + C_2 + C_3 + \ldots$

Ser: $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \ldots$ Dielectric: $E = \frac{E_0}{\kappa}$ and $C = \kappa C_0$

Chapter 25:

$I = \frac{\Delta Q}{\Delta t}$ $I = qnAv_d$ $\vec{J} = qn\vec{v}_d$ $R = \frac{V}{I}$ $R = \rho\frac{L}{A}$ Ohm: $V = IR$, for $R = const$

$P = IV$ Resistor: $P = IV = I^2R = \frac{V^2}{R}$ Par: $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$ Ser: $R_{eq} = R_1 + R_2 + \ldots$

Kirchhoff: (1) sum of ΔV's around loop = 0. (2) sum of currents in = sum of currents out of junction
For an RC circuit, Q(t) = Qmax($1 - e^{-t/\tau}$). τ = RC time constant, Q is the charge on C, charging up from zero at t = 0