Physics 132 Midterm II Equation Sheet

Capacitors, Energy

$q = CV$ $\qquad$ $C = \varepsilon_o \dfrac{A}{d}$ *for a parallel plate capacitor*

$C_{parallel} = C_1 + C_2$ $\qquad$ $\dfrac{1}{C_{series}} = \dfrac{1}{C_1} + \dfrac{1}{C_2}$ $\qquad$ $q_{parallel} = q_1 + q_2$ $\qquad$ $q_{series} = q_1 = q_2$

$U = \dfrac{1}{2}CV^2 = \dfrac{1}{2}\dfrac{q^2}{C}$ $\qquad$ $u = \dfrac{1}{2}\varepsilon_o E^2$

Current, Resistivity

$i = \dfrac{dq}{dt}$ $\qquad$ $i = \dfrac{\Delta q}{\Delta t}$ *for a constant current*

$\vec{J} = (\mathrm{ne})\,\vec{\mathrm{v}}_{\mathrm{d}}$ $\qquad$ $J = \dfrac{i}{A}$ *for a uniform current* $\qquad$ $\vec{E} = \rho\,\vec{J}$

Resistors, Power

$V = iR$ $\qquad$ $R = \rho\dfrac{L}{A}$ *for a conductor with uniform cross-section*

$\dfrac{1}{R_{parallel}} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$ $\qquad$ $R_{series} = R_1 + R_2$ $\qquad$ $i_{parallel} = i_1 + i_2$ $\qquad$ $i_{series} = i_1 = i_2$

$P = iV$ $\qquad$ $P_R = i^2 R = \dfrac{V^2}{R}$

Circuits, RC circuits

$\sum i = 0$ *at a node, or* $i_{in} = i_{out}$. $\qquad$ $\sum \Delta V = 0$ *around a loop*

For a simple RC circuit (battery $\mathscr{E}$, resistor R, capacitor C in series):

$q(t) = C\mathscr{E}\,(1 - e^{-t/\tau})$ *charging* $\qquad$ $q(t) = C\mathscr{E}\,e^{-t/\tau}$ *discharging* $\qquad$ $\tau = RC$

Electrostatic Fundamentals

point charges

$F = k\dfrac{q_1 q_2}{r^2}$ $\qquad$ $U = k\dfrac{q_1 q_2}{r}$

$E = k\dfrac{q}{r^2}$ $\qquad$ $V = k\dfrac{q}{r}$

uniform field

$\Delta V = -\vec{E} \bullet \vec{d}$

$E_x = -\dfrac{\Delta V}{\Delta x}$

$F = qE$

$$\begin{array}{ccc} F & \longleftrightarrow & E \\ \updownarrow & & \updownarrow \\ \Delta U & \longleftrightarrow & \Delta V \end{array}$$

$E_x = -\dfrac{\partial V}{\partial x}$

$\Delta V = -\int E \bullet d\vec{r}$

$\Delta U = q\Delta V$

$U = qV$

Constants

$k = \dfrac{1}{4\pi\varepsilon_o} = 8.99 \times 10^9\ \dfrac{Nm^2}{C^2}$

$\varepsilon_o = 8.85 \times 10^{-12}\ F/m$

$e = 1.60 \times 10^{-19}$ C

$\Phi = \dfrac{1}{\varepsilon_o} q_{enc}$ $\qquad$ $\Phi = \oint \vec{E} \bullet d\vec{A}$ $\qquad$ $\Phi = \vec{E} \bullet \vec{A}$ $\qquad$ $E = \dfrac{\lambda}{2\pi\varepsilon_o r}$ $\qquad$ $E = \dfrac{\sigma}{\varepsilon_o}$ $\qquad$ $E = \dfrac{\sigma}{2\varepsilon_o}$