Things to Know for Mid-Term 1

Contants:

$$\begin{aligned} k_e &= \frac{1}{4\pi\varepsilon_0} = 8.99 \times 10^9 Nm^2/C^2 \\ \varepsilon_0 &= 8.885 \times 10^{-12} C^2/Nm^2 \\ N_0 &= 6.02 \times 10^{23} \text{ particles/mole} \end{aligned}$$

Values:

particle	charge	mass
electron	-1.60×10^{-19} C	0.10×10^{-31} kg
proton	$+1.60 \times 10^{-19}$ C	1.67×10^{-27} kg
neutron	0 C	1.67×10^{-27} kg

Formulas:
charge density: $\lambda = \frac{q}{L}$ (line) , $\sigma = \frac{q}{A}$ (surface) $\rho = \frac{q}{V}$ (volume)

object	surface	volume
rectangular prism	$2ab + 2bc + 2ac$	abc
cylinder	$2\pi rL + 2\pi r^2$	$\pi r^2 L$
sphere	$4\pi r^2$	$\frac{4}{3}\pi r^3$

$\vec{F} = k_e \frac{q_1 q_2}{r^2}\hat{r}$	$\Delta U = -q_0 \int_A^B \vec{E} \cdot d\vec{r}$	$U = \frac{q^2}{C}$	$\vec{F} = m\vec{a}$
$\vec{E} = \frac{\vec{F}}{q_0}$	$U = k_e \frac{q_1 q_2}{r_{12}}$	$I \equiv \frac{dq}{dt} = nav_d A$	$KE = \frac{1}{2}mv^2$
$\vec{E} = k_e \sum_i \frac{q_i}{r_i^2}\hat{r}_i$	$\Delta V = \frac{\Delta U}{q_0}$ with $V_\infty = 0$	$j \equiv \frac{I}{A}$	$x - x_0 = v_0 t + \frac{1}{2}at^2$
$\vec{E} = k_e \int \frac{dq}{r^2}\hat{r}$	$V = k_e \sum_i \frac{q_i}{r_i} = k_e \int \frac{dq}{r}$	$j = \sigma E$	$v = v_0 + at$
$\Phi = \int_{\text{surface}} \vec{E} \cdot d\vec{A}$	$C \equiv \frac{q}{V}$ and $C = \kappa C_0$	$R = \frac{I}{V}$	$v^2 - v_0^2 = 2a(x - x_0)$
$\Phi = \oint \vec{E} \cdot d\vec{A} = \frac{q_{\text{in}}}{\varepsilon_0}$	$P = IV$	$R = \rho\frac{L}{A}$ and $\rho = \frac{1}{\sigma}$	$\rho = \rho_0[1 + \alpha(T - T_0)]$

component	series	parallel
resistance	$R_{\text{tot}} = \sum_i R_i$	$\frac{1}{R_{\text{tot}}} = \sum_i \frac{1}{R_i}$
capacitance	$\frac{1}{C_{\text{tot}}} = \sum_i \frac{1}{C_i}$	$C_{\text{tot}} = \sum_i C_i$