NAME:_____

Cover Sheets for Exam 3
Modified May 2, 2019 to add current density

Some direction:

No phones or other device that connects to the internet.

You may use a calculator, **plug in numerical answers** and keep three sig figs regardless of the correct number of sig figs in the problem.

Present clear and complete answers:

Explain your answers clearly but briefly. You want to aim for a level of solution that someone taking this class would be able to understand. A diagram and a few words may help.

Start calculations with first principles: things like definitions ($\vec{E} \equiv \frac{\vec{F}}{Q}$) or empirical laws (like Coulomb's Law or Newton's Laws) or conservation laws.

Check time:

The point values for each problem are shown next to the question number. Time yourself accordingly. The total value of the exam is 100 points. **Good luck!**

Some constants:

$$K = k = \frac{1}{4\pi\epsilon_0} = 8.99 \times 10^9 Nm^2/C^2 \approx 9 \times 10^9 Nm^2/C^2$$

$$\epsilon_0 = 8.85 \times 10^{-12} C^2/N/m^2$$

$$\mu_0 = 4\pi \times 10^{-7} Tm/A$$

$$e = 1.6 \times 10^{-19} C$$

Helpful Equations:

$$E_i = E_f$$

$$E = K + U$$

Definitions	Point charges	Uniform $\vec{E}$
	$\lvert\vec{F}\rvert = k\frac{\lvert qQ\rvert}{r^2}$	$\vec{F} = Q\vec{E}$
$\vec{E} \equiv \frac{\vec{F}}{Q}$	$\lvert\vec{E}\rvert = k\frac{\lvert q\rvert}{r^2}$	$\vec{E} = const$
$\Delta U \equiv -W$	$U = k\frac{qQ}{r}$	$\Delta U = QEs$
$V \equiv \frac{U}{Q}$	$V = k\frac{q}{r}$	$\Delta V = Es$

$$dq = \lambda d\ell$$

$$dq = \sigma da = \eta da$$

$$dq = \rho dV$$

$$\Phi = \int \vec{E} \cdot d\vec{A}$$

$$\int \vec{E} \cdot d\vec{A} = \frac{q_{enc}}{\epsilon_0}$$

$$C \equiv \frac{|Q|}{|V|}$$

$$C = \epsilon_0 \frac{A}{d}$$

$$W = \frac{1}{2}CV^2$$

$$I = \frac{dQ}{dt} = \frac{\Delta Q}{\Delta t}$$

$$V = IR$$

$$R_{eq} = R_1 + R_2 + ...$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + ...$$

$$q(t) = Q_{max}(1 - e^{-\frac{t}{RC}})$$

$$q(t) = Q_{max}e^{-\frac{t}{RC}}$$

$$P = IV$$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + ...$$

$$C_{eq} = C_1 + C_2 + \ldots$$

$$\vec{B} = \frac{\mu_0 I}{4\pi} \int \frac{d\vec{\ell} \times \hat{\boldsymbol{r}}}{\boldsymbol{r}^2}$$

$$\oint \vec{B} \cdot \vec{dl} = \mu_0 I_{enc}$$

$$B = \frac{\mu_0 I}{2\pi r}$$

$$I = \int \vec{J} \cdot d\vec{A}$$

$$\vec{F} = \int I d\vec{\ell} \times \vec{B}$$

$$\vec{F} = q\vec{v} \times \vec{B}$$

$$\Phi_B = \int \vec{B} \cdot d\vec{A} = \int B dA \cos\theta$$

$$\mathcal{E} = -N\frac{d\Phi_B}{dt}$$