

## Review/ Practice Problems before Exam 2

In addition to this page, I will include the “purple equation sheet” from Griffiths.

No phones or other device that connects to the internet.

You may use a calculator, though I don't think you'll need it.

### **Present clear and complete answers:**

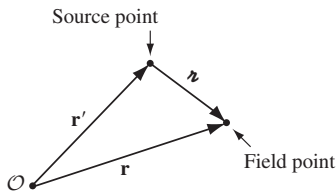
Explain your answers clearly but briefly. You want to aim for a level of solution that someone taking this class would be able to understand. A diagram and a few words may help.

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 definitions:**



**Some more math:**

$$z^2 = r^2 + r'^2 - 2rr' \cos \alpha$$

$$V_s = \frac{4}{3}\pi R^3$$

**Helpful Equations:**

$$\vec{F} = \frac{qQ}{4\pi\epsilon_0 z^2} \hat{z}$$

$$\oint \vec{E} \cdot d\vec{a} = \frac{q_{enc}}{\epsilon_0}$$

$$V(r) = - \int_{ref}^r \vec{E} \cdot d\vec{\ell}$$

**Helpful Integrals:**

$$\int \sqrt{1-x^2} dx = \frac{1}{2}[x\sqrt{1-x^2} + \sin^{-1} x]$$

$$\int \frac{dx}{\sqrt{1-x^2}} = \sin^{-1} x$$

$$\int \frac{x dx}{\sqrt{1-x^2}} = -\sqrt{1-x^2}$$

$$\int \frac{x^2 dx}{\sqrt{1-x^2}} = -\frac{x}{2}\sqrt{1-x^2} + \frac{1}{2}\sin^{-1} x$$

**Helpful Taylor series expansions (for small  $\epsilon$ ):**

$$e^\epsilon \approx 1 + \epsilon + \dots$$

$$\ln(1 + \epsilon) \approx \epsilon + \dots$$

$$(1 + \epsilon)^n \approx 1 + n\epsilon + \dots$$

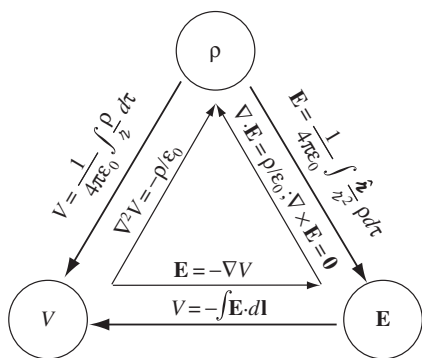


FIGURE 2.35

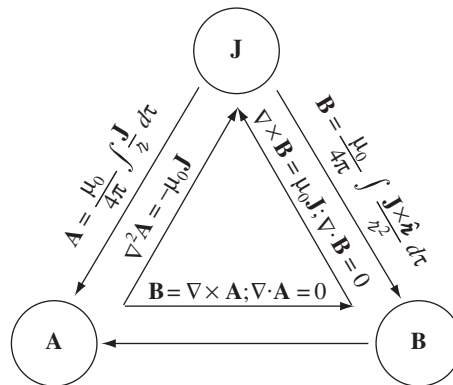


FIGURE 5.48

$$W = \frac{\epsilon_0}{2} \int E^2 d\tau$$

$$\vec{F} = Q\vec{E} + Q\vec{v} \times \vec{B}$$

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

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

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