
For this assignment... Work out the following problems on separate sheets. Staple all, including this front page, for your submission.

1) Derive assuming static fields (a) Faraday's and (b) Ampere's laws in "PS250" integral form. For each, start with the "differential" point form, but without time derivatives. *Explain* your process step-by-step in a manner that an interested PS250 student might understand. This solution is *easily* found – *You will be graded in part on the quality of your explanation.*

2) Show (and, again, explain!) using the divergence theorem that the integral form of Gauss's laws (for both **E** and **B** fields) can be recovered very easily from the point form. After demonstrating this, "go backwards", recovering again the point form. Comment on the treatment of charge q (or density ρ) and current I (or density **J**).

3) Show that the continuity equation $\frac{\partial \rho}{\partial t} = -\nabla \cdot \mathbf{J}$ can be written in an integral form.

Note that ρ is the charge density, such that $q = \int_v \rho dv$.

4) Apply Maxwell's equations in differential form to:

... determine whether the following static **B**-field satisfies Gauss's Law:

$$\mathbf{B} = \frac{1}{R^2} \sin\phi \cos^2\theta \mathbf{a_R}$$

... determine the current density **J** associated with the same field.

5) Find the charge density associated with the following electric field at [2, π, 1]:

$$\mathbf{E} = 3r^2\mathbf{a_r} + r\cos\phi\mathbf{a}_\phi + r^3\mathbf{a_z}$$