

PHYS 411 (Fall 2012): Electricity and Magnetism

Final exam: Thursday, December 13, 8.00-10.00 am.

Read the instructions below and do *not* flip to next page till you are told to do so.

Name:

Student ID:

Useful formulae:

$q' = -\frac{R}{a}q$	$b = \frac{R^2}{a}$	$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$
$\mathbf{F} = Q(\mathbf{v} \times \mathbf{B})$	$V(\vec{r}) = -\int_{\mathcal{O}} \vec{r} \cdot d\mathbf{l}$	$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0}$
$\mathbf{F} = \frac{1}{4\pi\epsilon_0} \frac{qQ}{r^2} \hat{\mathbf{r}}$	$\mathbf{P} = \epsilon_0 \chi_e \mathbf{E}$	$\int \mathbf{E} \cdot d\mathbf{a} = \frac{Q_{enc}}{\epsilon_0}$
$\mathbf{E}_{above} - \mathbf{E}_{below} = \frac{\sigma}{\epsilon_0} \hat{\mathbf{n}}$	$d\tau = s \, ds \, d\phi \, dz$	$\mathbf{B} = \frac{\mu_0 I}{4\pi} \int \frac{d\mathbf{l}' \times \hat{\mathbf{r}}}{r^2}$
$\int \mathbf{B} \cdot d\mathbf{l} = \mu_0 I_{enc}$	$V = IR$	$\nabla \times \mathbf{B} = \mu_0 \mathbf{J}$
$\mathcal{E} = -d\phi/dt$	$\phi = \int \mathbf{B} \cdot d\mathbf{a}$	$\phi = LI$
$B = \mu_0 nI$	$\int \mathbf{D} \cdot d\mathbf{a} = Q_{fenc}$	$\hat{\mathbf{s}} \times \hat{\phi} = \hat{\mathbf{z}}$
$d\mathbf{a} = s \, ds \, d\phi \, \hat{\mathbf{z}}$	$\mathbf{B}_{above} - \mathbf{B}_{below} = \mu_0 (\mathbf{K} \times \hat{\mathbf{n}})$	$I_{enc} = \int \mathbf{J} \cdot d\mathbf{a}$
$\mathbf{S} = \frac{1}{\mu_0} (\mathbf{E} \times \mathbf{B})$	$\mathbf{D} = \epsilon_0 \mathbf{E} + \mathbf{P}$	$d\mathbf{a} = s \, d\phi \, dz \, \hat{\mathbf{s}}$
$\nabla \cdot \mathbf{D} = \rho_f$	$P = \frac{\mu_0 \ddot{\mathbf{p}}^2}{6\pi c}$	$\mathbf{p}(t) = \int \mathbf{r}' \rho(\mathbf{r}', t) \, d\tau'$
$\sigma_b = \mathbf{P} \cdot \hat{\mathbf{n}}$	$\rho_b = -\nabla \cdot \mathbf{P}$	$Q = CV$
$\mathbf{K}_b = \mathbf{M} \times \hat{\mathbf{n}}$	$\mathbf{J}_b = \nabla \times \mathbf{M}$	$\int \mathbf{H} \cdot d\mathbf{l} = I_{fenc}$
$\mathbf{M} = \chi_m \mathbf{H}$	$\mathbf{B} = \mu_0 (1 + \chi_m) \mathbf{H}$	$\nabla \times \mathbf{H} = \mathbf{J}_f$

It is necessary to show the *details* of the derivation and not just the final answer for *all* problems.

This is a closed book exam: crib sheets are not allowed.

Please write clearly and if you use the backside of a page, then please indicate so.

Check that there are total of 7 printed pages (6 problems and this page) + 1 blank page for doing problem 5.

Remember the honor pledge that you signed at the start of the semester.

Problem #	Points scored	Maximum points
1		9
2		12
3		14
4		8
5		9
6		8
Total		60