PHYS 272 (Spring 2019): Introductory Physics: Fields

Final Exam: Tuesday, May 21 (1.30-3.30 pm.)

Name:

Student ID:

Useful formulae:

$F = \frac{1}{4\pi\epsilon_0}\frac{Q_1Q_2}{r_{12}}$	$\mathbf{F} = q\mathbf{E}$	$E = \frac{1}{4\pi\epsilon_0}\frac{Q}{r}$
$\Phi_E = \int \mathbf{E}.d\mathbf{A}$	$\oint \mathbf{E}.d\mathbf{A} = \frac{Q_{\text{encl}}}{\epsilon_0}$	$\mathbf{E}_x = -\frac{\partial V}{\partial x}$
$V = \frac{Q}{4\pi\epsilon_0}\frac{1}{r}$	$Q = Q_{\text{final}}\left(1 - e^{-t/\tau}\right)$	$U = qV$
$V = -\int_a^b \mathbf{E}.d\mathbf{l}$	$I = I_{\text{initial}}e^{-t/\tau}$	$\mathbf{j} = \sigma\mathbf{E}$
$C_{\text{eq}} = C_1 + C_2$	$C_{\text{eq}} = \left(\frac{1}{C_1} + \frac{1}{C_2}\right)^{-1}$	$Q = CV$
$ax^2 + bx + c = 0$	$\Rightarrow x = \frac{-b\pm\sqrt{b^2-4ac}}{2a}$	$U = \frac{1}{2}CV^2$
$C = \frac{\epsilon A}{d}$	$\epsilon = \epsilon_0 K$	$K = \frac{1}{2}mv^2$
$V = IR$	$I = \int \mathbf{j}.d\mathbf{A}$	$\mathbf{j} = nq\mathbf{v}_d$
$R = \rho\frac{l}{A}$	$\rho = \frac{1}{\sigma}$	$P = VI$
$R_{\text{eq}} = \sum_{i=1}^n R_i$	$\mathbf{F} = I\int d\mathbf{l} \times \mathbf{B}$	$I = \int \mathbf{j}.d\mathbf{A}$
$\tau = \mu \times \mathbf{B}$	$B = \frac{\mu_0 IR^2}{2(x^2+R^2)^{3/2}}$	$\tau = RC$
$F = \frac{mv^2}{r}$	$\oint \mathbf{B}.d\mathbf{l} = \mu_0 I_{\text{encl}} + \mu_0\epsilon_0\frac{d\Phi_E}{dt}$	$\mu = NI\mathbf{A}$
$Q = Q_0\left(1 - e^{-t/\tau}\right)$	$\mathbf{F} = q\Big[\mathbf{E} + (\mathbf{v} \times \mathbf{B})\Big]$	$M = \frac{N_2\Phi_{21}}{I_1}$
$\mathbf{B} = \frac{\mu_0 I}{4\pi}\int\frac{d\mathbf{l}\times\mathbf{r}}{r^3}$	$\Phi_B = \int \mathbf{B}.d\mathbf{A}$	$R_{\text{eq}} = (\sum_{i=1}^n 1/R_i)^{-1}$
$B = \frac{\mu_0 I}{2\pi r}$	$B = \mu_0 nI$	$\mathcal{E} = -\frac{d\Phi_B}{dt}$
$L = N\frac{\Phi_B}{I}$	$I = I_{\text{final}}\left(1 - e^{-t/\tau}\right)$	$\omega = 1/\sqrt{LC}$
$\oint \mathbf{E}.d\mathbf{l} = -\frac{d\Phi_B}{dt}$	$\tau = L/R$	$\frac{E_0}{B_0} = v$
$\mathbf{S} = \frac{1}{\mu_0}\mathbf{E} \times \mathbf{B}$	$\oint \mathbf{B}.d\mathbf{A} = 0$	$v = 1/\sqrt{\mu_0\epsilon_0}$

Read the instructions/guidelines below

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

Please read the statement of the problems carefully (if needed, ask for clarifications).

This is an *closed* book/notes exam: any other formula sheets (other than the one given below) are not allowed.

Please write clearly (circle the final answer if possible) and if you continue working on a problem on a later page (i.e., with a gap), then please try to indicate so.

Please indicate directions of vectors (including those of currents etc.) *explicitly*: for example, specify (i) whether it is inward/outward for radial; (ii) clockwise or counter-clockwise (that too, as viewed from the left or the right) for "circumferential" and (iii) positive or negative for along (say, z-)axis

Check that there are a total of 6 problems (8 printed pages including the two cover sheets).

Please try to use the notation (including for currents, distances etc.) which is specified in the statement of the problems (even if it is for intermediate steps).

In case they are needed, more blank paper and stapes are provided.

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

Problem #	Points scored	Maximum points
1		11
2		11
3		12
4		10
5		18
6		8
Total		70