PHY 207 Practice Final

Prof. F. Zuo

Name: _____

Student ID: _____

"On my honor, I have neither given nor received any aid on this examination"

Signature: _____

Answer six out the seven problems. Partial credits are based on the clarity and the quality of the work you show.

1._____

2._____

3._____

4._____

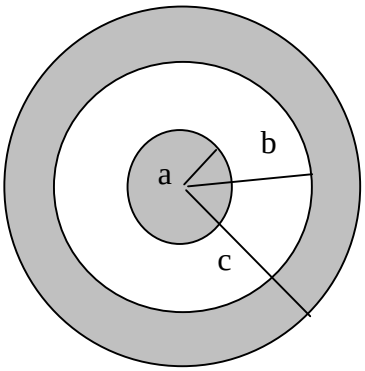
5._____

6._____

7._____

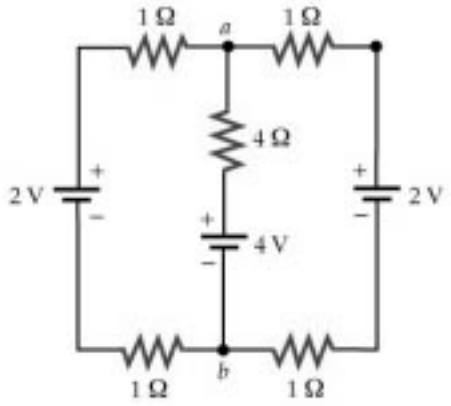
Total _____

1. Consider two concentric conducting spheres. The outer one (inner radius *b* and outer radius *c*) is hollow and initially has a charge of –3Q on it. The inner one (radius *a*) is a solid conductor and has a charge of +2Q on it. A) Find the charge distribution. B) Find and graph the electric field as a function of radius r. C) If the two spheres are connected using a conducting wire, what is the new charge distribution?

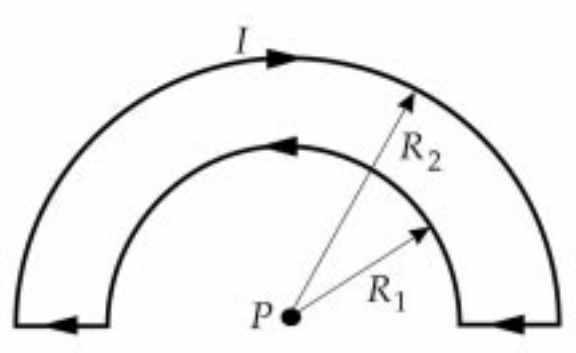


2. A long, cylindrical wire of radius *a* carries current *I* uniformly distributed over its cross-sectional area. A) Find the magnetic field everywhere ($r<a$, and $r>a$); B) Find the magnetic field energy per unit length within the wire.

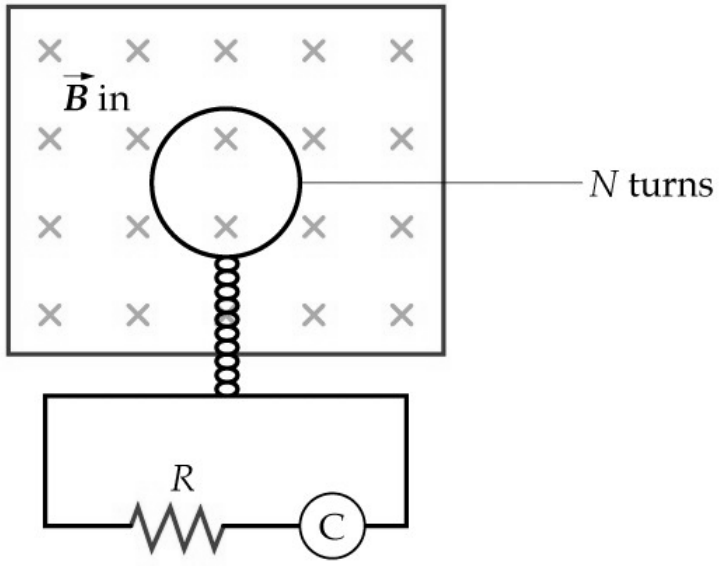
3. For the circuit shown, find the potential difference between points *a* and *b*.



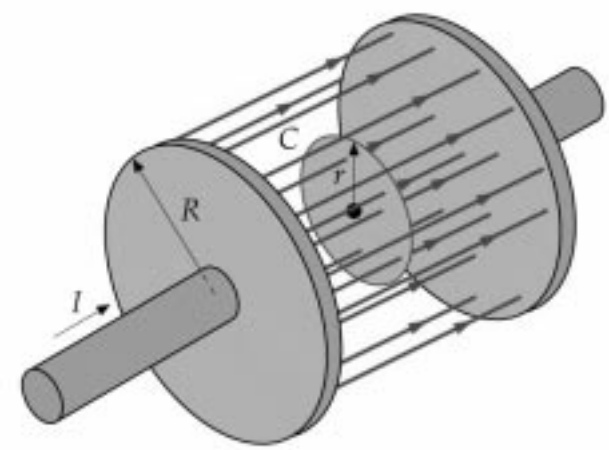
4. In the figure shown, find the magnetic field at point P, which is at the common center of the two semicircular arcs.



5 A small coil of N turns has its plane perpendicular to a uniform magnetic field B as shown. The coil is connected to a current integrator, a device used to measure the total charge passing through it. Find the charge passing through the coil if the coil is rotated through 180^{o} about its diameter.



6. The circular plates in the figure below have a radius R. Find the magnetic field at a point between the plates and at a distance r (r<R) from the axis of the plates when the current into the positive plate is I.



7. You have a 200-Ω resistor, a 0.4-H inductor. Suppose you take the resistor and the inductor and make a series circuit with a voltage source that has voltage amplitude 30.0V and an angular frequency of 250 rad/s. A) What is the impedance of the circuit?
B) What is the phase angle ϕ of the voltage source with respect to the current? Does the voltage lag or lead the current? C) Construct the phasor diagram.

Formula Sheet

$\vec{E} = \frac{kq}{r^2}\hat{r}$, $k = \frac{1}{4\pi\varepsilon_o} = 9\text{x}10^9\ \text{NM}^2\text{C}^{-2}$, $\vec{F} = q\vec{E}$, $\oint \vec{E}\cdot d\vec{A} = \frac{Q_{in}}{\varepsilon_o}$,

$V = \frac{kq}{r}, V = \int \frac{kdq}{r}$

$dV = \frac{dU}{q} = -\vec{E}\cdot dl = -(E_x dx + E_y dy + E_z dz)$, $\vec{E} = -\nabla V = -(\frac{\partial V}{\partial x}\hat{i} + \frac{\partial V}{\partial y}\hat{j} + \frac{\partial V}{\partial z}\hat{k})$,

$V = Ed, C = \frac{Q}{V}, U = \frac{1}{2}\sum q_i V_i, U = \frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C}, u_e = \frac{1}{2}\varepsilon E^2, \varepsilon = K\varepsilon_o$

$V = IR, P = IV = I^2 R$, $I = \frac{dQ}{dt} = nqvA$, $J = \frac{I}{A}$, $E = \rho J$, $R = \frac{\rho l}{A}, R = R_1 + R_2 + ..., \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + ...$

$I = I_o \exp(\frac{-t}{RC})$, $F = qv \times B, dF = Idl \times B, \mu = NIA\hat{n}, \tau = \mu \times B$

$B = \frac{\mu_o}{4\pi}\frac{qv\times\hat{r}}{r^2}, dB = \frac{\mu_o}{4\pi}\frac{Idl\times\hat{r}}{r^2}, u_m = \frac{B^2}{2\mu_o}, B = \mu_o nI$

$\oint B\cdot dl = \mu_o(I + \varepsilon_o\frac{d\Phi_E}{dt}), \mu_o = 4\pi\times10^{-7}\ Tm/A,$

$\oint E\cdot dl = -\frac{d\Phi_M}{dt}, \Phi_M = \int B\cdot dA, \Phi_M = LI$

$\varepsilon = Blv, \varepsilon = -\frac{d\Phi_M}{dt}, \varepsilon = -L\frac{dI}{dt}$, $I = I_o \exp(\frac{-R}{L}t)$

$X_L = L\varpi$, $X_C = \frac{1}{\varpi C}$, $Z = \sqrt{R^2 + (X_L - X_C)^2}$, $V = IZ$, $\tan\phi = \frac{X_L - X_C}{R}$

$\vec{S} = \frac{1}{\mu}\vec{E}\times\vec{B}$, $E = E_{\max}\sin(\varpi t - kx), B = B_{\max}\sin(\varpi t - kx), I = S_{av}$

$A_{sph} = 4\pi r^2, V_{sph} = \frac{4}{3}\pi r^3, dV_{sph} = 4\pi r^2 dr$

$A_{cyl} = 2\pi rL, A_{cir} = \pi r^2, dV_{cyl} = 2\pi r dr L$

$dq = \lambda dl = \sigma dA = \rho dV$