PHYS 231

Practice Exam 1:

1. Read each question carefully and fully beforehand.
2. Setup up all of the problems as much as possible first. You are looking for as many partial credit points as possible.
3. Tackle problems that you can do quickly first, then move on to the problems you can't do.
4. $\ln(0) \neq 1$.
5. Use only in this test what you can use in the real test. Use this time to practice your strategies. These aren't just extra practice problems; this is a rehearsal for the real thing.

Given:

$\varepsilon_0 = 8.85\times10^{-12}\,\text{F/m}$

$\mu_0 = 4\pi\times10^{-7}\,\text{H/m}$

$V = i\times R$

$P = i\times V$

$Q = C\times V$

$dU = d(QV)$

$$\oint \vec{E}\cdot d\vec{A} = \frac{q}{\varepsilon_0}$$

$$\oint B\cdot d\vec{A} = 0$$

$$\oint E\cdot d\vec{s} = -\frac{d\Phi_B}{dt}$$

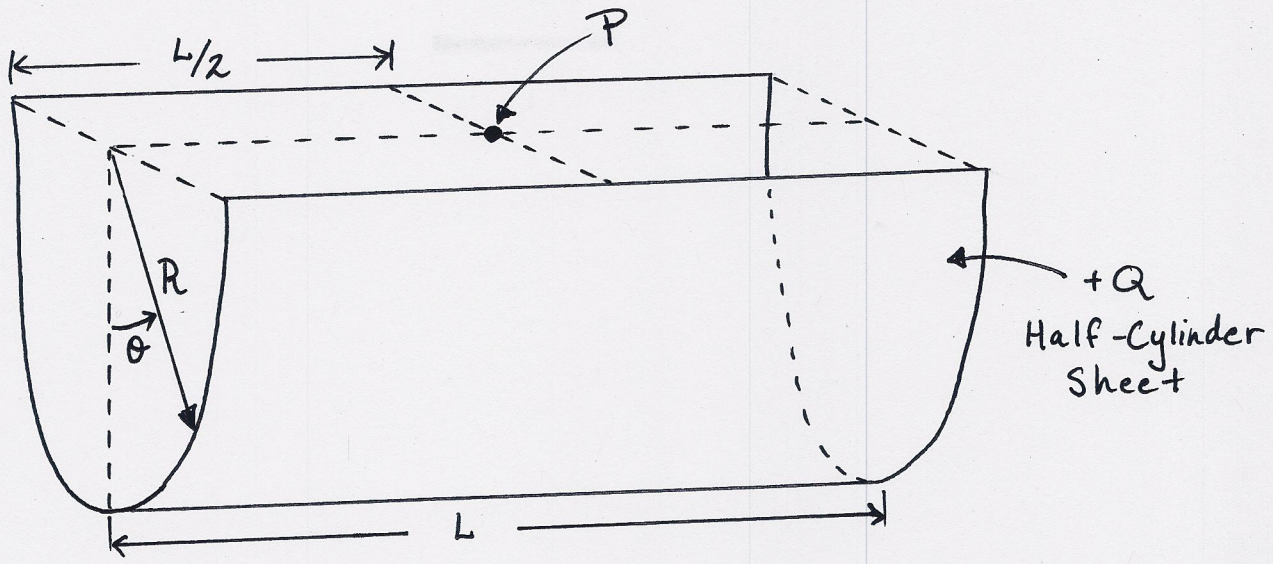
$$\oint B\cdot d\vec{s} = \mu_0 i + \mu_0\varepsilon_0\frac{d\Phi_E}{dt}$$

$$d\vec{B} = \frac{\mu_0 i}{4\pi}\frac{d\vec{s}\times\vec{r}}{r^3}$$

$$\int \sec\theta\cdot d\theta = \ln|\sec\theta+\tan\theta|+C$$

elementary charge:	$1.60\text{ X }10^{-19}$C
electron rest mass:	$9.11\text{ X }10^{-31}$kg
proton rest mass:	$1.67\text{ X }10^{-27}$kg

Question 1:



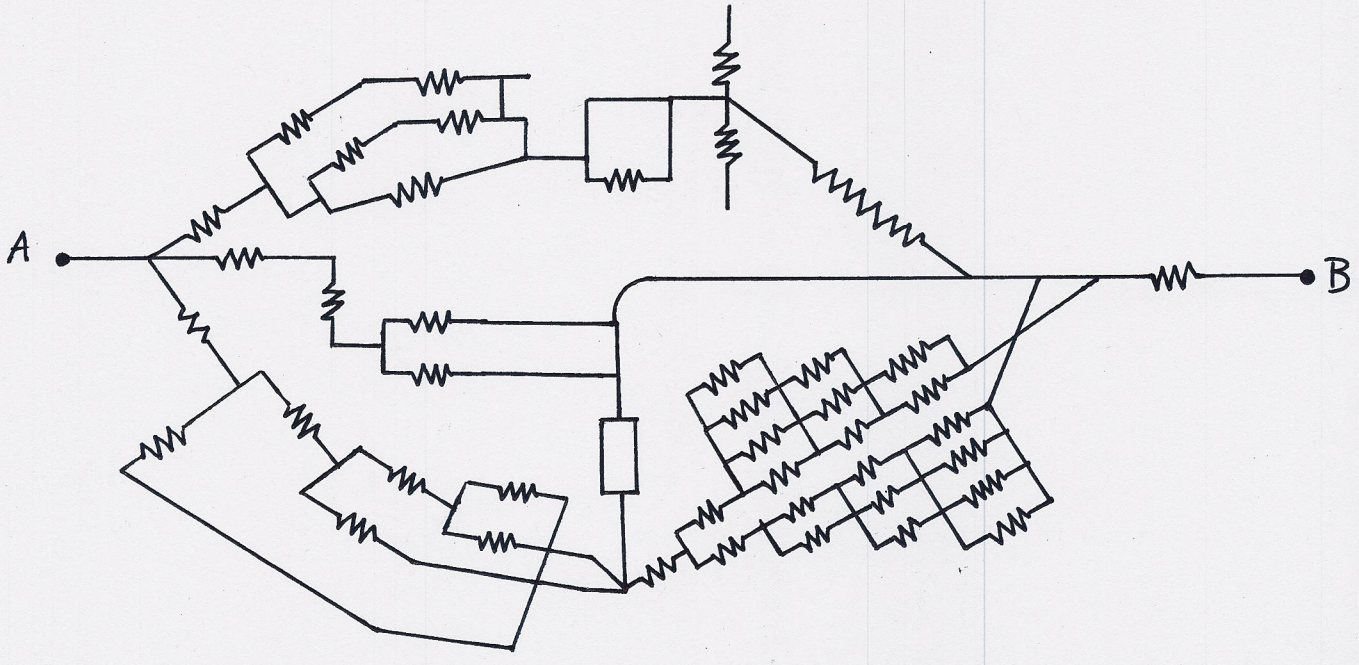
Given $\sigma \propto \cos^2(\theta)$, find:

a) Electric Field at Point P

b) Electric Potential at Point P, relative to $V(\infty)=0$.

Question 2:

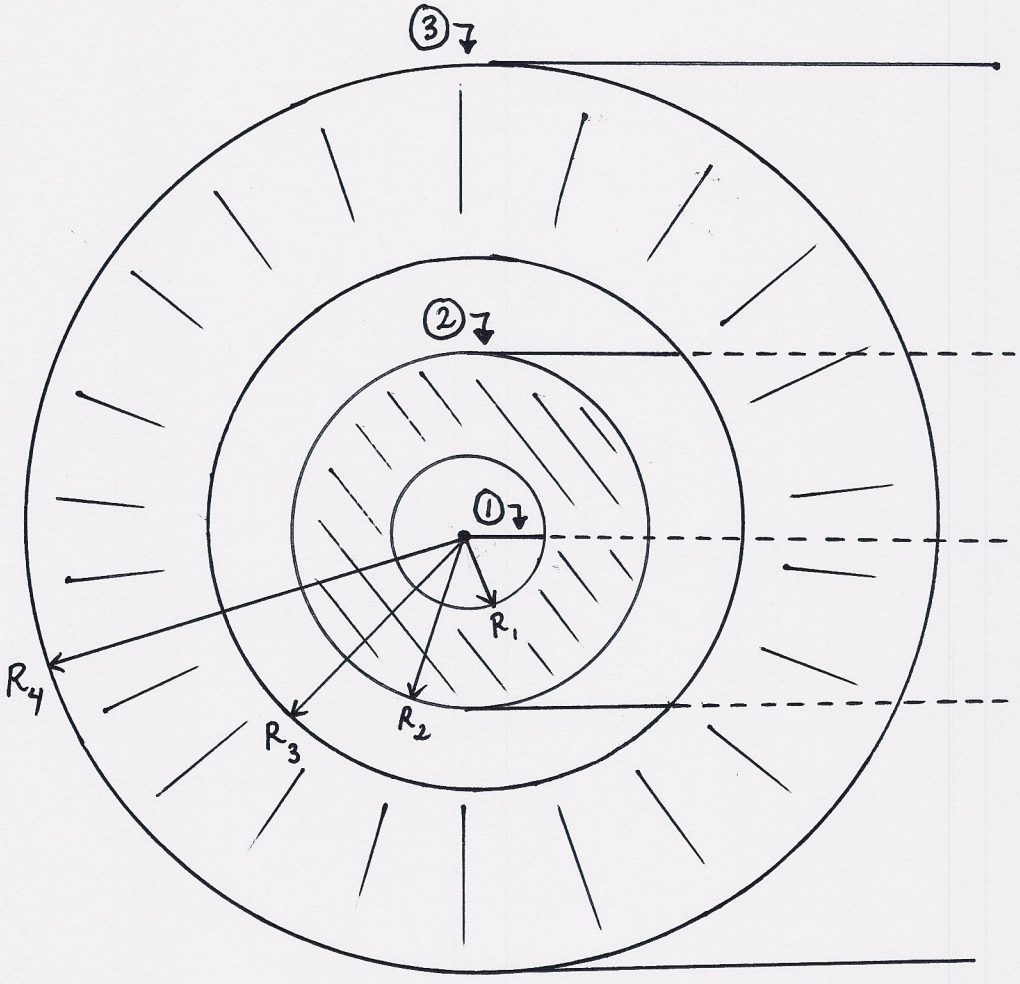
Find the equivalent resistance of the following circuit between Points A and B. **All resistors have a resistance of "R."**



Question 3:

Find the electric field as a function of radius "r" in the following regions. Note the coaxial infinitely long wire inside the cylinders.

a) $r < R_1$
b) $R_1 < r < R_2$
c) $R_2 < r < R_3$
d) $R_3 < r < R_4$
e) $r > R_5$
f) Graph E(r) for the regions in parts a-e.



① : $\lambda_1 = +2\lambda$

② : $\lambda_2 = -3\lambda$

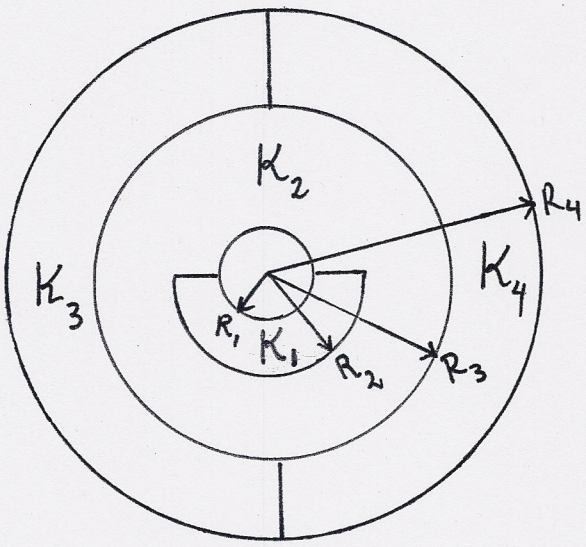
$\rho_2 \propto r^{-2}$

③ : $\lambda_3 = +5\lambda$

$\rho_3 \propto e^{r^2}$

Question 4:

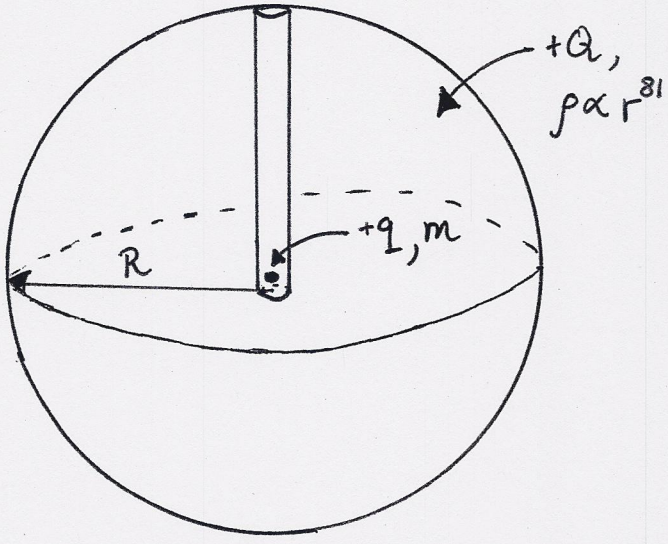
Find the capacitance of the **spherical** capacitor below.



$K_1 = 5$
$K_2 = 10$
$K_3 = 15$
$K_4 = 25$
$R_1 = 7\ m$
$R_2 = 10\ m$
$R_3 = 42\ m$
$R_4 = 420\ m$

Question 5:

Shown below is a variable charge density solid sphere. An infinitely thin tunnel has been carved out of the sphere along it's radius. A point charge "q" is located in the center of the sphere, and *just barely* starts to move toward the outside of the sphere along the tunnel. What is the velocity of the point charge when it has left the sphere and reached a distance of 3R past the exit of the tunnel?



$Q = 20\ \mu C$
$q = 5\ \mu C$
$R = 5\ km$
$m = 9.691507171 \times 10^{-18}\ kg$

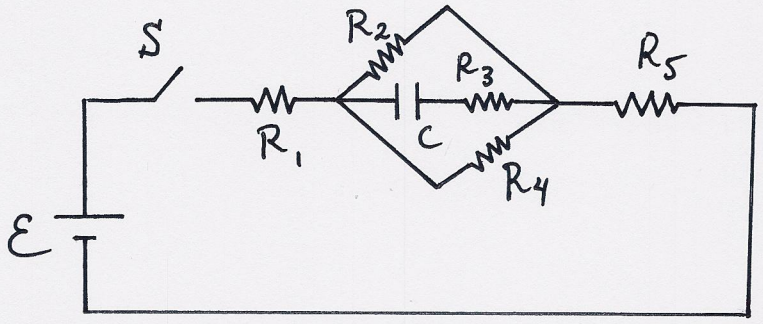
Question 6:

A circuit is constructed as shown below. The switch "S" has been open for a long time. The switch is then closed. After the switch is closed, find:

a) i(t) through the capacitor
b) V(t) across the capacitor

After the switch has been closed for a long time, the switch is then opened. After the switch has been opened, find:

c) i(t) through the capacitor
d) V(t) across the capacitor
e) The total energy dissipated during both the charge and discharge of the capacitor.



$\mathcal{E} = 100\,V$

$C = 400\,\mu F$

$R_1 = 50\,\Omega$

$R_2 = 100\,\Omega$

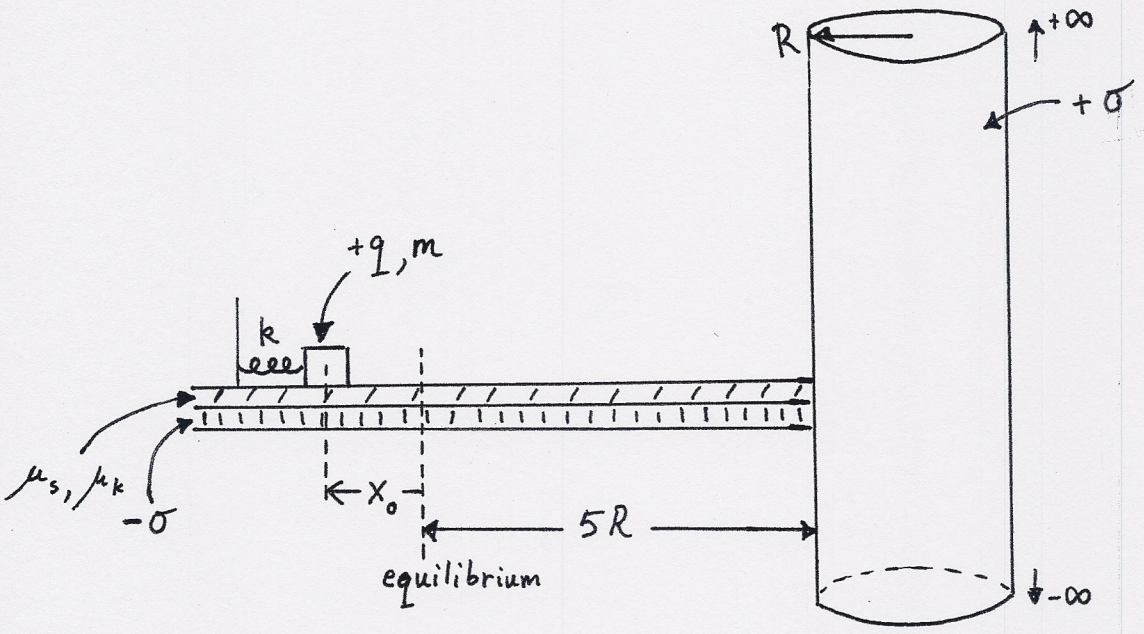
$R_3 = 200\,\Omega$

$R_4 = 400\,\Omega$

$R_5 = 777\,\Omega$

Question 7:

A charged block is held against a compressed spring. The spring is released and the block slides along a surface with friction toward a charged, infinite cylindrical sheet. A charged, infinitely large squarcle sheet lies underneath the surface that the block slides on. Find the block's maximum velocity. No Gravity!



$m = 69\ kg$

$R = 1\ km$

$x_o = 54\ m$

$k = 1.79\ N/m$

$\sigma = 42\ C/m^2$

$\mu_s = 0.17$

$\mu_k = 0.13$

$q = 4.6 \times 10^{-11}\ C$