Honors Physics – P222

Final Exam

Distributed on Friday, May 2, 2003
and due at 5:00 pm on Monday, May 5, 2003

Guidelines:

- This exam consists of five problems, each worth 20 points. Please show all your work in the blue books available in SW135.
- You can use your text, notes and computer – but you may not consult with anyone while taking this exam.
- If you have a question about any of these problems please send me an e-mail. I will try to respond as quickly as possible.
- Please take the time to write your solutions neatly and clearly. Be sure to specify units.
- Return your exam on Monday anytime (but before 5 pm) to my secretary – Donna Martin – in SW256. You must return your SW135 key to Donna at that time and your name has to be checked off the list.
  NO KEY – NO GRADE – IT'S THAT SIMPLE.

Thank you,

Alex R. Dzierba

Please print your name below and also sign your name. By so doing you are stating your understanding of the rules under which this exam is given and that you followed these rules.

_____

Problem 1 (20 points)

Two concentric conducting spheres have radii a and b where $a = 2b = 50\ cm$. They carry charges $-q$ and $+q = 2\ \mu C$. At $t = 0$ the two spheres are connected by a $1\ K\Omega$ resistor.

a. How long does is take for the absolute value of the charge on either sphere to decrease to one-half of its initial value?
b. What is the maximum current in the resistor?
c. What is the net energy dissipated as heat in the resistor after the charge on each sphere disappears?

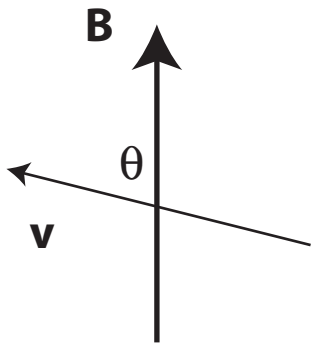
Problem 2 (20 points)

An electric dipole $\vec{p}$ is located at the origin of (x, y) coordinates and is oriented along the +y-axis. The dipole is fixed – it cannot move nor rotate. A point charge $+q$ is brought from $x = +\infty$ along the x-axis to the point *A:* $(+r, 0)$ where r is much larger than the dimensions of the dipole. The charge is then moved to point *B:* $(0, +r)$ along a circle of radius r. The charge is then moved from point B along the y-axis to $y = +\infty$. How much work is done in moving the charge:

a. from $x = +\infty$ to point A?
b. from point A to point B?
c. from point B to $y = +\infty$?

Problem 3 (20 points)

A particle of mass *m* and velocity *v* suddenly finds itself (at $t = 0$) in a uniform magnetic field **B**. The velocity vector of the particle makes angle θ with the **B** field. What total distance has the particle traveled just after having made three complete revolutions as seen in a plane perpendicular to **B**?



Problem 4 (20 points)

In a two-slit interference experiment the slit width is *a* and the slit separation is *b* and they are in this ratio: $b/a = 5$. The interference pattern observed on screen a distance *L* away from the slits has a central peak with a maximum intensity I_o. We will refer to the central peak by $m = 0$ and to the two peaks on either side by $m = 1$ and so on. What is the maximum of the two peaks corresponding to $m = 3$?

Problem 5 (20 points)

Here are some questions about the transmission of electricity:

a. Why is a.c. used to power cities rather than d.c.?
b. Why do transmission lines that carry electricity over long distances use high voltage?
c. Why is the voltage stepped down before it goes to your house?
d. What is the typical cost of electrical power for a household?

Make your answers brief but as complete as possible.