

First Name: _____ Last Name: _____ Section: _____

PHYSICS 202 - FINAL EXAM

December 19, 2006

Print your name and section clearly on all pages. (If you do not know your section number, write your TA's name.) **Show all work in the space immediately below each problem; you may use the backs of pages for scratch work. If you need extra space, clearly guide the grader to where he/she should look; otherwise work outside the space provided will not be inspected. Your final answer must be placed in the box provided.**

Problems will be graded on reasoning and intermediate steps as well as on the final answer. Be sure to include units whenever necessary, and the direction of vectors.

Erase (or cross out) any mistakes or you will be marked down. Grading is based on everything you have written down.

You are allowed four 5" x 8" sheets, both sides, no other references.

The exam lasts exactly 120 minutes.

TA (please circle) : Michael Baker, Michael Glatzmaier, Creighton Hogg, David Hover, Andrew Long, Hao Luo, Paul McGuirk, Dan Sikes, Mark Stockett, Marc Weinberg

Possibly useful information:

$$\frac{1}{\epsilon_0} = (1/\mu_0 c^2) = 8.85 \times 10^{-12} \text{ C}^2/(\text{Nm}^2)$$

$$\mu_0 = 4 \pi \times 10^{-10} \text{ T m/A}$$

$$g = 9.8 \text{ m/s}^2$$

(If you find that a constant is missing, please, ask during the exam.)

SCORE

Problem 1: _____

Problem 2: _____

Name:.....

Problem 3: _____

Problem 4: _____

Problem 5: _____

Problem 6: _____

Problem 7: _____

Problem 8: _____

Problem 9: _____

TOTAL: _____

Name:.....

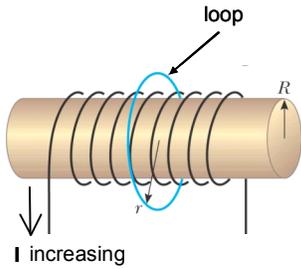
PROBLEM 1

[20 pts]

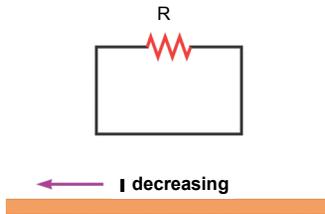
(Quizzes and simple questions)

Problem ?? (25 points):

a) What is the direction of the induced emf in the loop? (5 points)



b) What is the direction of the current passing through R? (5 points)

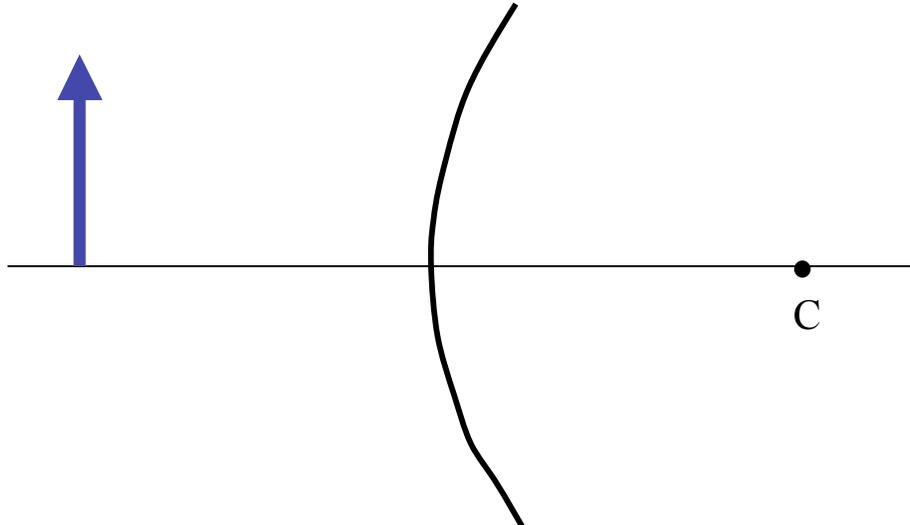


c) electrostatics

something with point charges

Name:.....

d) Determine the location of the image by drawing a complete ray diagram:



1.5) Interference

1.6) Wave particle

a.) What is the wavelength of an x-ray photon of energy 1000 eV?

b.) At the particle accelerators protons and electrons are accelerated to energies of 10^{11} eV.

If the particle is an electron, what is its wavelength?

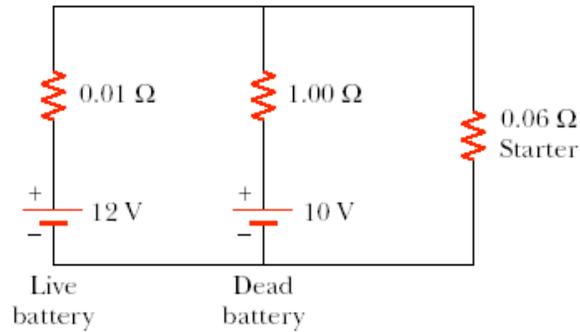
Protons are 2000 times more massive. What is the wavelength of the protons compared to the electrons.

Why can an electron microscope have fundamentally a better resolution than an optical microscope?

Name:.....

Problem 2 (20 points):

A dead battery is charged by connecting it to the live battery of another car with jumper cables (Fig. P28.27).

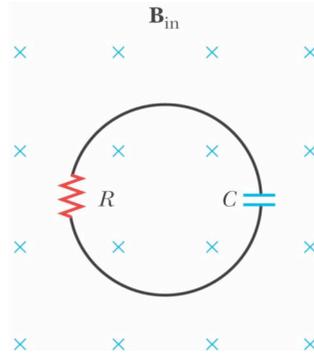


- Determine the current in the starter and in the dead battery.
- Indicate the direction of the currents in all three resistors in the diagram.
- What is the power consumed by the system?

Name:.....

Problem 3 (25 points): As shown in the figure, a circular circuit loop of area A containing a resistor R and a capacitor C is placed inside a uniform magnetic field. The plane of the loop is normal to the field. At $t=0$, the magnetic field starts to increase at a constant rate $dB/dt=K$.

- Indicate the direction of the current in the figure.
- Find the charge Q on the capacitor when it is fully charged. (5 points)
- How long does it take to charge the capacitor to 80% of its full charge? (5 points)

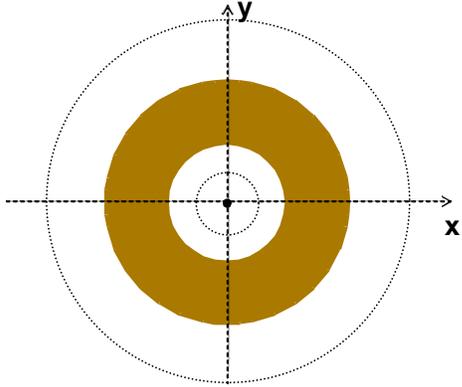


- Is there a force on the loop?
 - If yes, in which direction?
 - What is the force per unit length of wire?

Name:.....

Problem 4 (20 points): A conducting shell, of inner radius R and outer radius $2R$, carries a total charge $+3Q$ ($Q>0$). A point charge $+Q$ is placed at the center of the shell.

- a) Use Gauss's law to find the electric field at $x=0.5R$ (5 points)
- b) Find the electric field at $x=1.5R$. (5 points)
- c) Compare($>$, $<$, $=$) the electric potential at $x=R$ and $x=2R$. (5 points)



Name:.....

Problem 5 (25 points):

A standing wave interference pattern is set up by radio waves between two metal sheets, which are a distance of 2m apart. An engineer observes that the electric field component has 3 maxima (nodes). She measures a maximum field strength of 100 V/m at locations.

- a) What is the fundamental frequency?
- b) What is the maximal magnetic field?
- c) What is the radiation pressure the standing wave will exert to the metal sheets?
- d) What is the average intensity (average Poynting vector)?

Name:.....

Problem 7 (10 points):

A convex mirror forms a virtual image half the size of the object. The distance between image and object is 20 cm.

Determine the radius of curvature of the mirror.

Problem 8:

A screen is placed 50.0 cm from a single slit, which is illuminated with 690-nm light. The distance between the second and fifth minimum in the diffraction pattern is 9.00 mm.

- a) What is the width of the slit?
- b) Simple additional question: What would be the width of the slit if the entire experimental set-up is immersed in water ($n=1.33$) with the same light source.

Name:.....

Problem 9

A student studying the photoelectric effect from two different metals records the following information: (i) the stopping potential for photoelectrons released from metal 1 is 1.48 V larger than that for metal 2, and (ii) the threshold frequency for metal 1 is 40.0% smaller than that for metal 2.

Determine the work function for each metal.