Final Exam (2017 Spring)

PHYS 203B-002: College Physics

Date: 2017 May 9

(Name) (Signature)

Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 3.
2. Total time = 120 minutes.
3. There are 10 questions in this exam, worth a total of 100 points.
4. Equation sheet is provided separately.
5. To be considered for partial credit you need to show your work in detail and organize it clearly.
6. A simple calculator (with trigonometric functions) is allowed.
7. Use of mobile phones is strictly prohibited. It should stay out of reach during the exam.

1. (**10 points.**) Two charges, $q_1 = -8.0\,\mu\text{C}$ and $q_2 = -32.0\,\mu\text{C}$, are separated by a distance of 10.0 cm. See Figure 1. Find the spot on the line where the net electric field is zero.

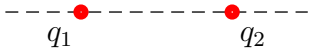

Figure 1: Problem 1

2. (**10 points.**) A particle with a charge of $+6.0 \times 10^{-8}\,\mathrm{C}$ is fixed at the origin. Another particle with a charge of $-2.0 \times 10^{-8}\,\mathrm{C}$ is moved from $x = 3.0\,\mathrm{cm}$ on the x axis to $y = 4.0\,\mathrm{cm}$ on the y axis. What is the change in potential energy of the two-particle system?

3. (**10 points.**) Two identical capacitors store different amounts of energy: capacitor A stores 16×10^{-3} J, and capacitor B stores 4.0×10^{-3} J. The charge stored in capacitor B is $1.0\,\mu$C. Find the charge stored in capacitor A.

4. (**10 points.**) A steady current I flows through a wire shown in Figure 2. Determine the magnitude and direction of the magnetic field at point P for $I = 2.0\,\text{A}$ and $a = 10.0\,\text{cm}$.

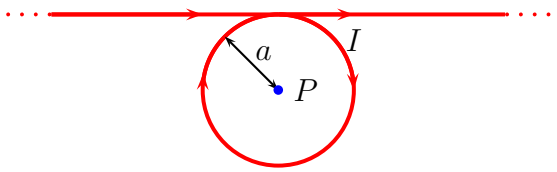

Figure 2: Problem 4.

5. (**10 points.**) A loop of wire having a resistance $R = 100.0\,\Omega$ is placed in a magnetic field whose magnitude is changing in time, as described in Figure 3. The direction of the magnetic field is normal to the plane of the loop. The loop of wire consists of 50 turns and has an area of $A = 25 \times 10^{-4}\,\mathrm{m}^2$. Determine the induced voltage and the induced current in the loop between 0 s to 2 s.

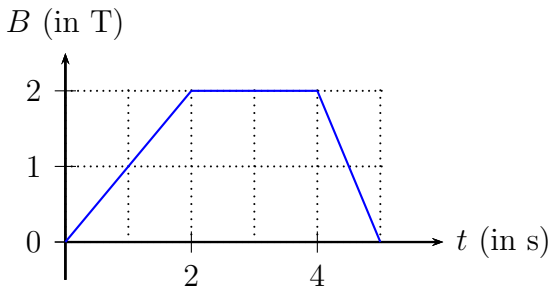

Figure 3: Problem 5.

6. (**10 points.**) In astronomy, distances are often expressed in light-years. One light-year is the distance traveled by light in one year. The distance to Alpha Centauri, the closest star other than our own sun that can be seen by the naked eye, is about 4.4 light-years. Express this distance in meters.

7. (**10 points.**) When you stand in front of a plane mirror, your image is:

(a) real, upright, and smaller than you.

(b) real, upright, and the same size as you.

(c) virtual, upright, and smaller than you.

(d) virtual, upright, and the same size as you.

(e) real, inverted, and the same size as you.

8. (**10 points.**) The index of refraction of air is 1.00. The critical angle for total internal reflection at a liquid-air interface is 50°. Determine the speed of light in the liquid.

9. (**10 points.**) A 1.00 cm high object is placed upright at a distance 5.0 cm from a concave mirror. The mirror's focal length is 10.0 cm.

   (a) Determine the radius of curvature of the mirror.

   (b) Calculate the image distance.

   (c) What is the magnification?

   (d) Is the image real or virtual?

   (e) Is the image inverted or upright?

   (f) What is height of the image?

   (g) Confirm your above results by drawing a ray diagram for the above case. Points will be awarded for precision.

10. (**10 points.**) A 1.00 cm high object is placed upright at a distance 20.0 cm from the center of a convex lens (converging lens). The lens' focal length is 10.0 cm.

    (a) Calculate the image distance.

    (b) What is the magnification?

    (c) Is the image real or virtual?

    (d) Is the image inverted or upright?

    (e) What is height of the image?

    (f) Confirm your above results by drawing a ray diagram for the above case. Points will be awarded for precision.