Final Exam (2017 Spring)

PHYS 203B-001: College Physics

Date: 2017 May 10

(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 objects have the same mass ($m_1 = m_2 = 10.0\,\mathrm{g}$) but different amount of charges on them ($q_1 = +1.0\,\mu\mathrm{C}$ and $q_2 = +2.0\,\mu\mathrm{C}$). They are released from rest in a uniform electric field pointing vertically down. Determine the ratio of the times t_1 and t_2,

$$\frac{t_1}{t_2}, \tag{1}$$

the charges take to move (or 'fall') a vertical distance $y = 1.0\,\mathrm{m}$. (Assume that the electric field is large enough that the gravitational effects are negligible.)

2. (**10 points.**) Two charges, $q_1 = +1.0\,\mu\text{C}$ and $q_2 = +4.0\,\mu\text{C}$, 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.

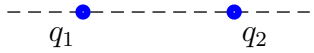

Figure 1: Problem 2.

3. (**10 points.**) Charges of $q_1 = +1.0\,\mu\text{C}$, $q_2 = +2.0\,\mu\text{C}$ are assembled as shown in Figure 2. Given $a = 10.0\,\text{cm}$. Determine the electric potential difference between points A and B.

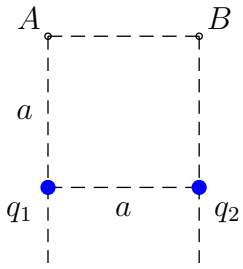

Figure 2: Problem 3.

4. (**10 points.**) A potential difference $V = 10.0\,\mathrm{V}$ is applied across a capacitor arrangement with two capacitances connected in series, $C_1 = 10.0\,\mathrm{nF}$ and $C_2 = 20.0\,\mathrm{nF}$. Find the ratio V_1/V_2 of the voltages across the capacitors.

5. (**10 points.**) A magnetic field has a magnitude of 1.50 mT and points in the $\hat{\mathbf{z}}$ direction, and an electric field has a magnitude of 6.00 kN/C pointing in the $\hat{\mathbf{x}}$ direction. A positive 1.0 μC charge moves at a speed of 2.00×10^6 m/s in the direction of $\hat{\mathbf{y}}$. Determine the magnitude of the net force that acts on the charge.

6. (**10 points.**) In a dentist's office, an X-ray of a tooth is taken using X-rays that have a frequency of 9.00×10^{18} Hz. What is the wavelength of these X-rays in vacuum?

7. (**10 points.**) How far (in meters) is a light-year?

8. (**10 points.**) The index of refraction of air is 1.00. The index of refraction of benzene is 1.80. Determine the critical angle for total internal reflection, at a benzene-air interface.

9. (**10 points.**) A 1.00 cm high object is placed upright at a distance 20.0 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 5.0 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.