Final Exam (2017 Spring)

PHYS 205B: University Physics

Date: 2017 May 9

____________________ (Name)

____________________ (Signature)

Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 4.
2. Total time = 120 minutes.
3. There are 10 questions in this exam.
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.**) An electron and a proton are each placed at rest in a uniform electric field of the same magnitude. Calculate the ratio of their speeds a time $t = 52.4\,\mathrm{ns}$ after being released.

2. (**10 points.**) Calculate the speed of a proton that is accelerated from rest through an electric potential difference of $146\,\mathrm{V}$.

3. (**10 points.**) Determine the equivalent resistance in the circuit in Figure 1. Given $R_1 = R_2 = R_3 = R_4 = 100.0\,\Omega$.

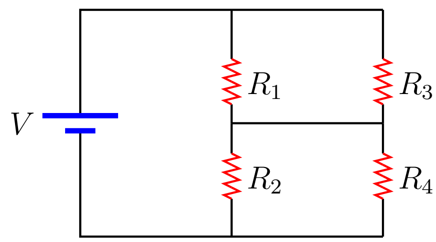

Figure 1: Problem 3

4. (**10 points.**) An electron moves in a circular path perpendicular to a uniform magnetic field with a magnitude of $2.21\,\mathrm{mT}$. Determine the time interval required for the electron to complete one revolution.

5. (**10 points.**) A flat loop of wire consisting of a single turn of cross-sectional area $5.00\,\mathrm{cm}^2$ is perpendicular to a magnetic field that increases uniformly in magnitude from $0.500\,\mathrm{T}$ to $2.50\,\mathrm{T}$ in $1.00\,\mathrm{s}$. What is the resulting induced current if the loop has a resistance of $2.50\,\Omega$?

6. (**10 points.**) Light takes 8.0 minutes to travel from A to B. Determine the distance between A and B in light-years.

7. (**10 points.**) When light passes from air ($n = 1.0$) to glass ($n = 1.5$), it bends:

(a) toward the normal without changing speed.

(b) toward the normal and slows down.

(c) toward the normal and speeds up.

(d) away from the normal and slows down.

(e) away from the normal and speeds up.

8. (**10 points.**) The critical angle at a material-water interface for total internal reflection is 60.0°. Given that the refractive index of water is 1.33. Determine the speed of light in the material.

9. (**10 points.**) A 1.0 cm object is placed upright at a distance 10.0 cm away from a convex mirror. The mirror's focal length is 10.0 cm.

   (a) What is 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) Determine the height of the image.

   (g) Confirm your results by drawing a ray diagram for the above case. Choose the scale for the two relevant directions appropriately so that the relevant features are illustrated well. Points will be awarded for clarity.

10. (**10 points.**) A 1.0 cm object is placed upright at a distance 10.0 cm away from a convex 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) Confirm your results by drawing a ray diagram for the above case. Choose the scale for the two relevant directions appropriately so that the relevant features are illustrated well. Points will be awarded for clarity.