

# Physics 24 Practice Midterm - 50 minutes

## 2 Pages - turn over!!

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Friday, Feb. 10

Write your answers in a blue book. Calculators and one page of notes allowed. No textbooks or wireless communications allowed. Please make your work neat, clear, and easy to follow. It is hard to grade sloppy work accurately. Generally, make a clear diagram, and label quantities. Make it clear what you think is known, and what is unknown and to be solved for. Except for extremely simple problems, derive symbolic answers, and then plug in numbers (if necessary) after a symbolic answer is available. Use CGS units. **Put a box around your final answer...** otherwise we may be confused about which answer you really mean, and you could lose credit.

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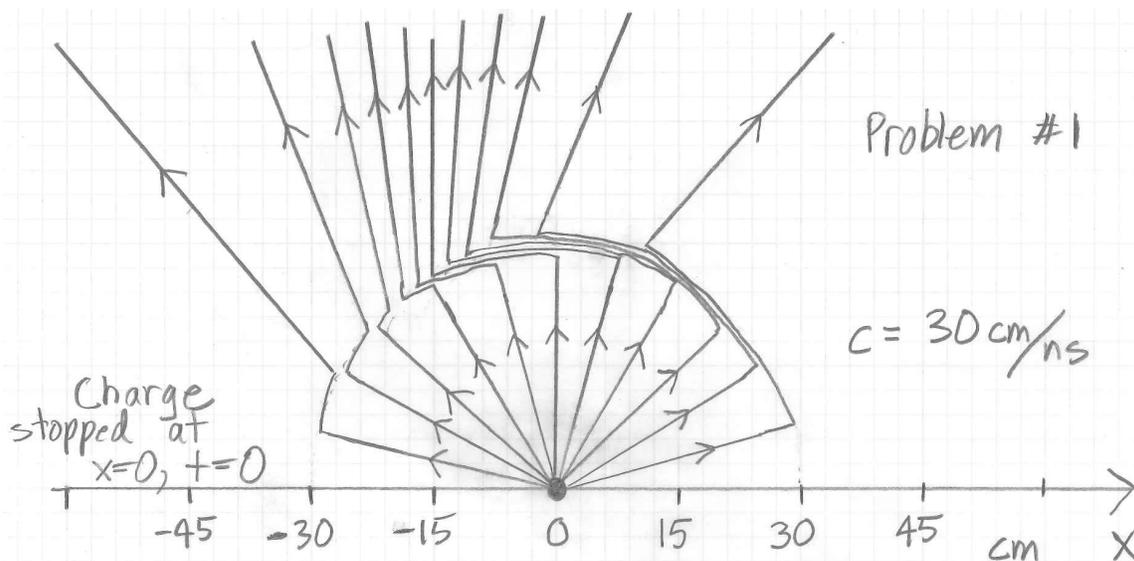


Figure 1: For Problem 1.

1. Fig. 1 shows an electric charge that had been moving along the  $x$  axis with constant velocity, but is now at rest.
  - (a) For how long (in nanoseconds) has the charge been at rest?
  - (b) Prior to stopping, what was the direction and magnitude of the velocity of the charge? What is the magnitude of the velocity relative to the speed of light,  $\beta = v/c$ ?

2. Wire #1 is on top of the  $x$  axis, and has a current  $I_1 = 3 \times 10^9$  esu/sec flowing from  $x = -\infty$  to  $x = \infty$ . Wire #2 is perpendicular to the first wire, and is parallel to the  $y$  axis, and is at  $x = 0$ . However, it is displaced above the  $x - y$  plane in the  $z$  direction by  $d = 1$  cm. A current of  $I_2 = 3 \times 10^9$  esu/sec flows in wire #2 from  $y = -\infty$  to  $y = \infty$ . Both wires are electrically neutral.
- (a) If the net force on wire #2 due to wire #1 is non-zero, give its direction. For full credit, you must make clear diagrams.
  - (b) If the net torque on wire #2 about its center due to wire #1 is non-zero, give its direction. For full credit, you must make clear diagrams.
3. A square loop of wire measures 1 cm along each side. The loop is in the same plane as an infinite straight wire, and the closest side of the loop, which is parallel to the wire, is a distance of 1 cm from the wire. The current in the wire at  $t = 0$  is  $1 \times 10^9$  esu/sec, while for later times the current grows at a rate of  $2 \times 10^{15}$  esu/sec<sup>2</sup>.
- (a) Find the electromotive force around the loop of wire.
  - (b) In what direction does the current go in the side of the loop closest to the straight wire, relative to the current in the straight wire?
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