

Physics 2212 Fall 2014 Lab Quiz #5

Name: Key Section: \_\_\_\_\_

Show all work clearly and in order, and box your final answers.

At a particular instant a proton and an electron are at the locations shown in the diagram below. The velocity of the proton is  $\vec{v}_p = \langle -b, -c, 0 \rangle$  and the velocity of the electron is  $\vec{v}_e = \langle d, 0, 0 \rangle$ . Taking the location of the proton as the origin, the electron is located at  $\vec{r} = \langle a, 0, 0 \rangle$ .



1. (10 points) On the diagram, draw and label the magnetic field vectors on the electron and on the proton. If one of these forces is zero, please state this explicitly.
2. (10 points) On the diagram, draw and label the magnetic force on the electron and on the proton. If one of these forces is zero, please state this explicitly.
3. (10 points) On the diagram, draw and label the electric field vectors on the electron and on the proton. If one of these forces is zero, please state this explicitly.
4. (10 points) On the diagram, draw and label the electric force on the electron and on the proton. If one of these forces is zero, please state this explicitly.

5. (25 points) Calculate the magnetic force acting on the electron. Your answer should be a vector.

$$\begin{aligned}\vec{B} &= \frac{\mu_0}{4\pi} q \vec{v}_+ \times \hat{r} & \vec{v}_+ &= \langle -b, -c, 0 \rangle \\ & & \hat{r} &= \langle 1, 0, 0 \rangle \\ & & \|\vec{r}\| &= a \\ &= \frac{\mu_0 e}{4\pi a^2} \langle 0, 0, c \rangle\end{aligned}$$

$$\vec{F}_{+on-} = q \vec{v}_- \times \vec{B} = \frac{-e^2 \mu_0}{4\pi a^2} \langle 0, -cd, 0 \rangle = \frac{\mu_0 e^2}{4\pi a^2} \langle 0, cd, 0 \rangle$$

6. (25 points) Calculate the magnetic force acting on the proton. Your answer should be a vector.

$$\vec{B} = 0$$

$$\vec{F}_{-on+} = 0$$

7. (10 points) Calculate the net force acting on the proton and the electron. Your answer should be a vector.

$$\vec{F}_{net} = \vec{F}_{+on-} + \vec{F}_{-on+} = \frac{\mu_0 e^2}{4\pi a^2} \langle 0, cd, 0 \rangle$$