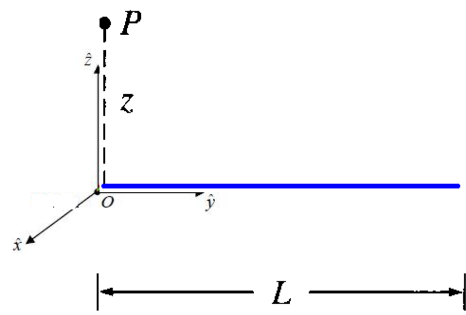
**Lesson #2: Electric Field of a Line Charge** **Name: ______________________**

**Due M2**

**Review the in-class example from Lesson 1 and answer the following questions. You will also need to look over Example 2.1 from the text.**




1. Draw and label the field vector ( $\vec{r}$ ), the source vector ( $\vec{r}\,'$ ) and the separation vector ( $\vec{\mathscr{r}}$ ) in the Figure.

2. Express the vectors $\vec{r}$ , $\vec{r}\,'$ and $\vec{\mathscr{r}}$ in Cartesian coordinates.

   $\vec{r}$ =

   $\vec{r}\,'$ =

   $\vec{\mathscr{r}}$ =

3. On Lesson 1 we showed that the electric field at point *P* for this charge distribution is

$$\vec{E} = \frac{\lambda}{4\pi\varepsilon_o}\left[\frac{1}{\sqrt{L^2+z^2}} - \frac{1}{z}\right]\hat{y} \quad + \quad \frac{\lambda}{4\pi\varepsilon_o}\left[\frac{L}{z\sqrt{L^2+z^2}}\right]\hat{z}$$

   Does this answer make sense? Describe at least one way you could assess the physical reasonableness of this result.

4. How does this expression simplify if point *P* is taken to be very far from the wire (i.e., in the limit $z \to \infty$)? Write down the electric field in this limit, and explain why your answer makes sense.

5. In contrast to this result, the line charge in Example 2.1 has no *y*-component to its electric field—why not?

6. Note that the expression for $\vec{E}$ in question 3 does not depend on the source vector $\vec{r}\,'$ . In fact, the electric field <u>will never</u> depend on $\vec{r}\,'$ . In your own words, explain why this is true.