Name _____ Date _____ Period_____

A 2.0-kg particle moves directly eastward at a constant speed of 4.5 m/s along an east-west line.

(*a*) What is its angular momentum (including direction) about a point that lies 6.0 m north of the line?

(*a*) The magnitude of the particle's angular momentum is given by:

$$L = rp\sin\phi = rmv\sin\phi = mv(r\sin\phi)$$

Substitute numerical values and evaluate L:

$$L = (2.0\,\text{kg})(4.5\,\text{m/s})(6.0\,\text{m}) = 54\,\text{kg}\cdot\text{m}^2/\text{s}$$

Use a right-hand rule to establish the direction of $\vec{\boldsymbol{L}}$:

$$L = \boxed{54\,\text{kg}\cdot\text{m}^2/\text{s, upward}}$$

(*b*) What is its angular momentum (including direction) about a point that lies 6.0 m south of the line?

(*b*) Because the distance to the line along which the particle is moving is the same, only the direction of $\vec{\boldsymbol{L}}$ differs:

$$L = \boxed{54\,\text{kg}\cdot\text{m}^2/\text{s, downward}}$$

(*c*) What is its angular momentum (including direction) about a point that lies 6.0 m directly east of the particle?

(*c*) Because $\vec{\boldsymbol{r}}\times\vec{\boldsymbol{p}} = 0$ for a point on the line along which the particle is moving:

$$\vec{\boldsymbol{L}} = \boxed{0}$$