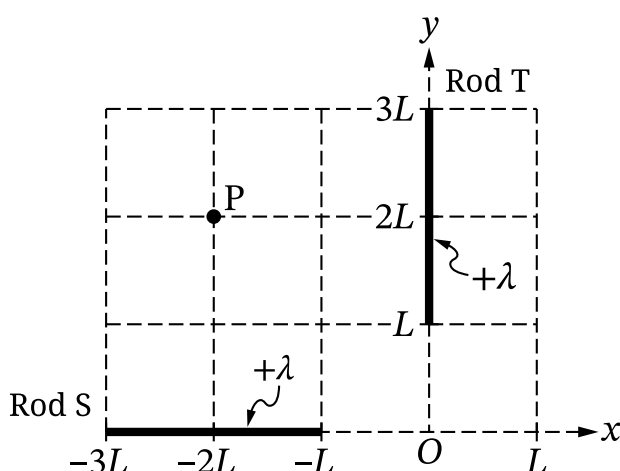


2. Thin, nonconducting, charged Rods S and T are held fixed in the xy -plane, as shown in Figure 1. Rod S is oriented along the x -axis in the region $-3L \leq x \leq -L$. Rod T is oriented along the y -axis in the region $L \leq y \leq 3L$. Each rod has uniform, positive linear charge density $+\lambda$. Point P is located at $(-2L, 2L)$.

Figure 1

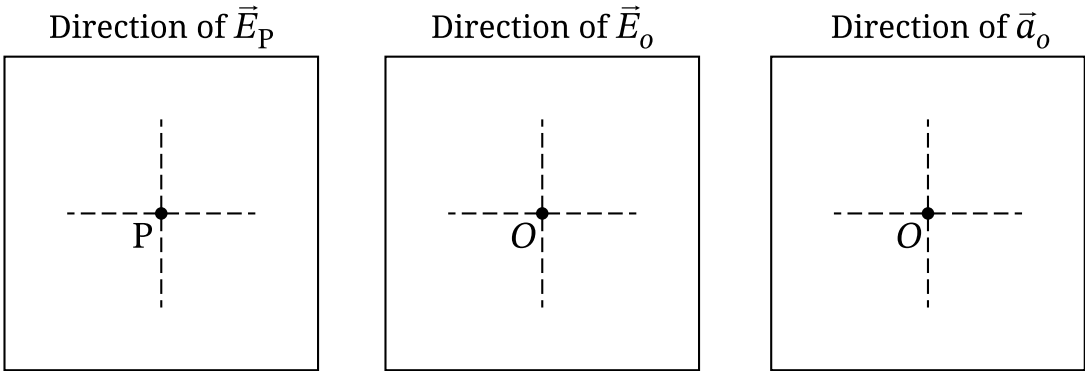


Part A

Complete the following tasks in Figure 2.

- **Draw** an arrow starting on the dot that indicates the direction of the net electric field $\vec{E}_P$ at Point P due to Rods S and T.
- **Draw** an arrow starting on the dot that indicates the direction of the net electric field $\vec{E}_O$ at the origin O due to Rods S and T.
- **Draw** an arrow starting on the dot that indicates the direction of the net acceleration $\vec{a}_O$ of a small, negatively charged sphere (not shown) immediately after the sphere is released from rest at the origin O.

Figure 2



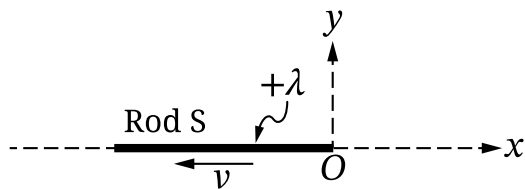
Part B

Derive an expression for the magnitude E_O of the net electric field at the origin O due to Rods S and T in terms of L , λ , and physical constants, as appropriate. Begin your derivation by writing a fundamental physics principle or an equation from the reference information.

Part C

Rod T is removed. Rod S is then moved such that the right end of Rod S is at the origin O. Rod S is then moved with speed v in the $-x$ -direction, as shown in Figure 3.

Figure 3



On the axes shown in Figure 4, **sketch** a graph of the electric potential V_O at the origin O due to Rod S as a function of the distance r between the origin and the right end of Rod S.

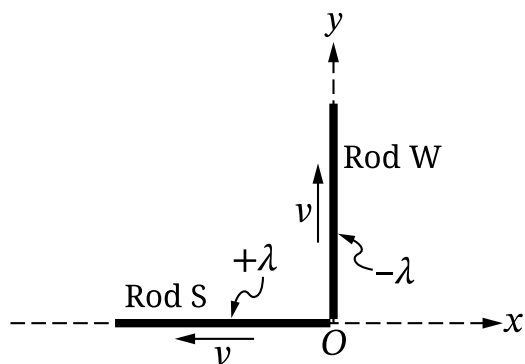
Figure 4



Part D

A new thin, nonconducting, charged Rod W has the same length as Rod S. Rod W has uniform, negative linear charge density $-\lambda$ and is oriented along the y -axis. Rods S and W are initially held fixed with one end at the origin. Starting at the same time, Rod S is moved with speed v in the $-x$ -direction and Rod W is moved with speed v in the $+y$ -direction, as shown in Figure 5.

Figure 5



Indicate how a sketch of V_O at the origin O due to both Rods S and W as a function of r would be different from the sketch made in part C. Briefly **justify** your answer.