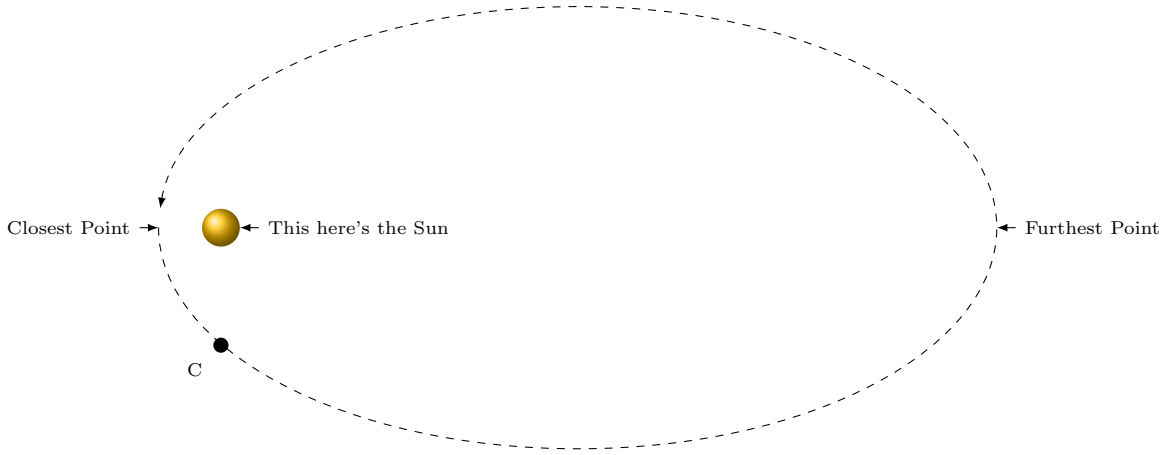
Please answer the questions below to the best of your ability either in the space provided. Everything should be scanned or photographed and submitted through gradescope.com.

Objective: *I can calculate the angular momentum of a mass about a point.*

Objective: *I can use a known angular momentum and geometry to determine unknown values.*

1. Comet Encke is popular for having the shortest period of a reasonably bright comet, with a period of 3.3 years. At its closest point to the sun, Encke is a mere 0.33 AU from the Sun, while it is 4.11 AU from the Sun at its furthest. Encke has a mass of 5.31×10^{13} kg and at its furthest point Encke was traveling at 5.711 km/s. You also know that 1 AU is equal 149.6×10^{9} m. (*One AU or astronomical unit is the average distance from the Earth to the Sun.*) Use this information and the image below to answer the questions.



   (a) What is the angular momentum of Encke about the Sun when it is at its furthest point from the Sun?

(b) As we'll discover, a nice property of orbits is that the angular momentum is the same everywhere in an object's orbit. Use this fact to determine how fast Encke is moving when it is at its closest approach to the Sun.

(c) Interestingly enough, you can not go backwards with a cross product to find either the vector value of $\vec{\mathbf{r}}$ or $\vec{\mathbf{p}}$ even if you know $\vec{\mathbf{L}}$ and the other value. It simply is not uniquely determined and you need more information. Take the instant of time when $\vec{\mathbf{r}} = \langle 0, -.6218, 0\rangle$ AU (where we have let the Sun be at the origin). I tell you that via some extra means it has been determined that the speed of the comet is 49.53 km/s at that point. What is the velocity of the comet in vector notation?