9. [6 points] Joey and Sam are running on circular tracks, timed by Holly. Joey runs on the largest circle which has radius 250 meters. Sam runs on the inner most circle which has a radius 100 meters. Suppose that Holly is standing 300 meters east of the center of the track and the point H in the diagram below indicates her position. Joey's position is indicated by the point J. The line JP is perpendicular to the horizontal line passing through the center O of the track.
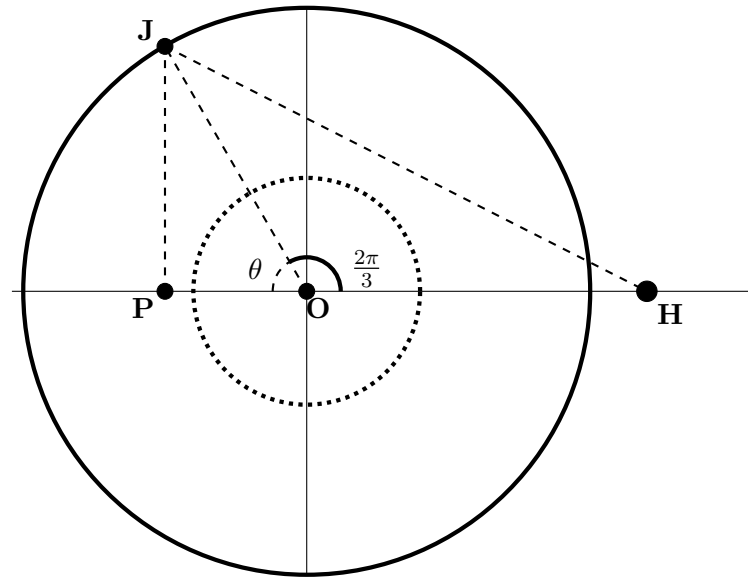
a. [1 point] Suppose that the angle HOJ measures $\frac{2\pi}{3}$ radians, as shown in the diagram. What is the measure, in radians, of θ (the angle JOP in the diagram)?

> *Solution:* $\theta = \frac{\pi}{3}$ radians.

b. [2 points] What is the length of the line segment JP?

> *Solution:*   JP$= 250\sin\left(\frac{\pi}{3}\right) = 125\sqrt{3}$ meters.

c. [3 points] What is the length of the line segment HJ?

> *Solution:*
> HJ$=\sqrt{(250\sin\left(\frac{\pi}{3}\right))^2 + (300 + 250\cos\left(\frac{\pi}{3}\right))^2} = \sqrt{(125\sqrt{3})^2 + (300 + 125)^2} \approx 476.96$ m.