**7.*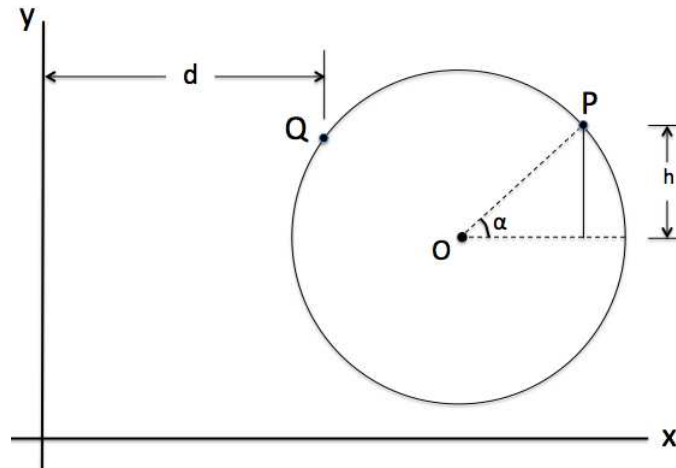* [10 points] Let C be a circle lying entirely in the first quadrant with radius 4 meters and center at the point $O = (a, b)$ (see the diagram below). A spider is standing at the point P on the circle. The point P makes an angle $\alpha = \frac{\pi}{4}$ radians (measured counterclockwise) with the horizontal line passing through the point O.

a. [2 points] Find the length of the vertical distance h from the point P to the horizontal line passing through the center O of the circle.

> *Solution:* $h = 4\sin\left(\dfrac{\pi}{4}\right) = 4\left(\dfrac{1}{\sqrt{2}}\right) = \dfrac{4}{\sqrt{2}} \approx 2.828.$

b. [3 points] The spider walks 7 meters around the circle, in the counterclockwise direction, from the point P until it reaches the point Q. Find the measure of the angle POQ (in radians).

> *Solution:*   Using the arclength formula $s = r\theta$ with θ = angle POQ, we have θ = angle $POQ = \frac{7}{4}$ radians.

c. [5 points] Find the horizontal distance d, in meters, between the point Q and the y-axis. Your answer must be in **exact form** and may contain the constants a and/or b.

> *Solution:* $d = a + 4\cos\left(\dfrac{\pi}{4} + \dfrac{7}{4}\right).$