2. [11 points] A drone starts at the origin $O$, and flies in a straight line to a point $P$ with coordinates $(a, b)$. From there, it travels counterclockwise around a circle of radius 8 centered at the point $C = (20, 15)$, until it reaches the point $Q$. This is illustrated in the diagram below, though the diagram is not drawn to scale.

Note that $\theta$, $\beta$ and $\varphi$ are the positive measures of the angles $PCK$, $DCQ$ and $QCK$ (respectively) given in radians. You do not need to show any work for this problem, but you should write your answers in the spaces provided.

a. [2 points] Find the length of the line segment $OP$ in terms of $a$ and $b$ alone.

The length of $OP$ is $\sqrt{a^2 + b^2}$

b. [2 points] Find a formula for $\varphi$ in terms of $\beta$ alone.

$\varphi = \pi - \beta$

c. [3 points] Find the length of the (bolded) circular arc $PQ$ in terms of $\theta$ and $\beta$ alone.

The length of the circular arc $PQ$ is $8(\theta + (\pi - \beta))$

d. [4 points] Write a formula for $b$ in terms of $\theta$ alone.

$b = 15 - 8 \sin \theta$