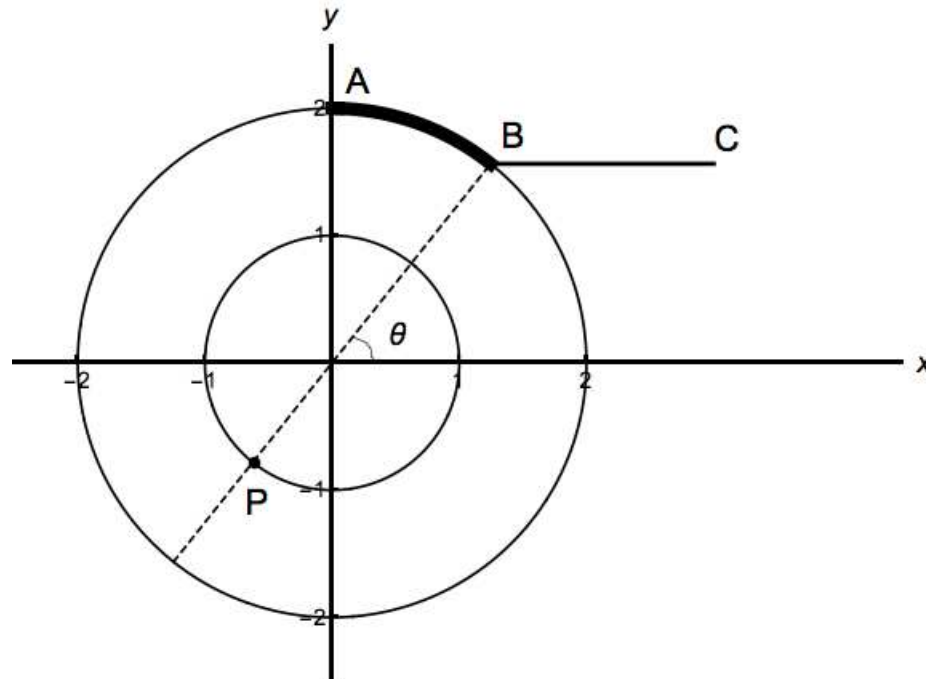**4.** [10 points] In the picture below, there are two circles of radius 1 and 2 centered at the origin. The point A has coordinates $(0, 2)$. The point B is the intersection of the line passing throughout the point $(0, 0)$ and P. The angle θ formed by the line joining $(0, 0)$ and the point B with the positive side of the x-axis is measured in **radians**.

Find a formula for the following quantities. Your answers may depend on the angle θ, but not on any of the constants a, b, c or d.

a) Let $B = (a, b)$.

> *Solution:* Find $b = 2\sin(\theta)$.

b) Let $P = (c, d)$.

> *Solution:* Find $c = \cos(\theta + \pi) = -\cos(\theta)$.

c) Find the length of the arc defined by the points A and B (the arc is shown in bold in the figure above).

> *Solution:* Length of the arc $= 2(\frac{\pi}{2} - \theta) = \pi - 2\theta$.

d) The point C has coordinates $(3, b)$. Find the length of the line segment BC.

> *Solution:* Length of BC $= 3 - 2\cos(\theta)$.