

1. *The Circle Roll*: Start (see Figure 1) with a unit circle centered at $(0, 1)$ and point P at the origin. Now roll the circle along the x -axis and record the path taken by point P . As seen in Figure 2, the (dotted) path is a nice curve. Point O' is the intersection of the circle with the x -axis.

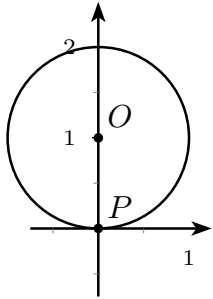


Figure 1: start

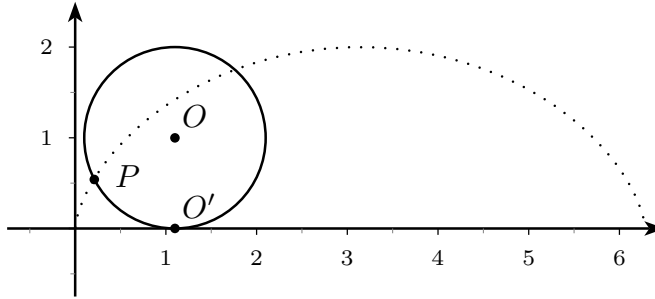


Figure 2: roll and path

- (a) Consider figure 2. Using t as the measure of $\angle O'OP$,
- develop coordinates for point O in terms of t
 - develop coordinates for point P in terms of t
- Be sure you can explain why your answers are correct.
- (b) Check your equations for $x(t)$ and $y(t)$ using parametric mode on *Desmos*. (What is the domain for t ?)
- (c) Find $y'(t)$ and $x'(t)$.
- Does point P ever go backwards?
 - Why is your answer correct?
- (d) Find the area under the curve in figure 2. Be sure to start with an area element dA .

2. Demonstrate how to use the cheer to evaluate $\int \sin^2 x \, dx$.

3. How long is the curve in figure 2? Be sure to start with an arc length element ds . (You can express ds in terms of dt .)