SPRING-2016

A hoop (of negligible thickness) occupies the circle $x^2 + (y - 10)^2 = 100$. A wheel of radius 6 rolls without slipping along the *inside* of the hoop such that the point of contact between the wheel and hoop moves counterclockwise around the hoop with constant angular speed 3 radians/sec. A small reflector on one spoke of the wheel is located halfway between the center of the wheel and the outer edge of the wheel. At time $t = 0$ the point of contact between wheel and hoop is at $(10, 10)$ and the reflector is at $(7, 10)$.

(a) Find parametric equations for the curve traced out by the reflector. Use time t as the parameter.

(b) Express the speed of the reflector as a function of time.

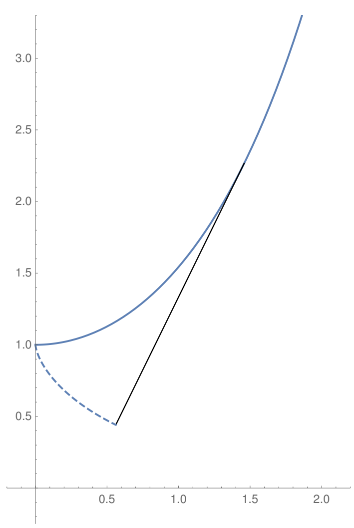
(c) Set up (but do not evaluate) an integral for the arclength traversed by the reflector from time $t = 0$ to time $t = 3$.

SPRING-2017

A circle of radius a (for some $a < 2$) rolls without slipping on the outside of the fixed circle $x^2 + y^2 = 4$. The point of contact between the circles moves counterclockwise around the fixed circle with a constant angular speed of 5 radians per second. Let P be the point on the rolling circle which is at $(2 + 2a, 0)$ at time $t = 0$. Express the position of P in terms of the parameter t, time.

SPRING-2019

Let C be a track along the graph $y = \cosh x$ from $x = 0$ to $x = 2$. One end of a string (whose length is precisely equal to the length of C) is attached to C at $(2, \cosh 2)$, and then the string is wrapped along the bottom of C. Finally, the string is kept taut while unwrapped. Construct parametric equations to describe the path traced out by the (unattached) end of the string during unwrapping. (Show your work.)



FALL-2021

One end of a 2cm rod, say Q, travels along the parabola $y = x^2$ (from left to right). Label the other end of the rod P, and label the fixed point $(1, -3)$ as R. As the rod moves it rotates so that P, Q, and R are always collinear with P between Q and R. Find parametric equations for the curve traced out by the end of the rod labelled P. (Show your work.)

SPRING-2022

One end of a rod of length 3 moves along the first quadrant portion of the hyperbola $y = \frac{1}{x}$ from $(\frac{1}{11}, 11)$ to $(11, \frac{1}{11})$. Label this end of the rod P, call the other end Q, and let R be the fixed point $(-5, 7)$. While the rod moves it rotates so that P, Q, and R are always collinear. Suppose, furthermore, that the x coordinate of Q is always less than the x coordinate of P. Construct parametric equations for the curve traced out by the end of the rod labelled Q. (Show your work.)

FALL-2022

One end of a rod of length 11 (call it P) is attached to a track which occupies the radius 3 circle centered at the origin of the xy-plane and is constrained to move counterclockwise around this circular track. The rod is supported by a peg located at $(7, 0)$ and is free to slide back and forth along this peg. Construct parametric equations for the curved traced out by point Q (the end of the rod opposite P) as P makes one complete trip around the circular track. (Show your work.)