

In all of your answers, make the necessary substitutions so that your results are simplified as much as possible!

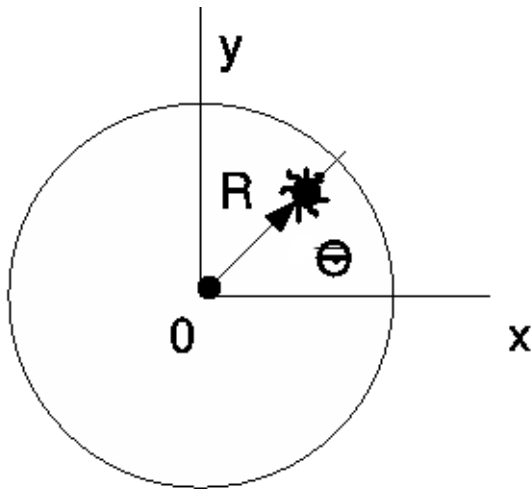


Figure 1: Problem 1

1. (35 points) An insect is walking outwards on a radius of a disk that is rotating with constant speed. Because of the rotation, the the radius makes an angle θ with the x -axis such that $\theta(t) = \omega t$, where ω is a constant and t is the time. The distance of the insect from the center is given by $R(t) = \alpha t$ where α is another constant.

- (a) What are the units of ω and α ?
- (b) What is the position vector of the insect at time t ?
- (c) What is the velocity of the insect at time t ?
- (d) What is the aceleration of the insect at time t ?

2. (35 points) Atilla is traveling on a train which is moving at 10m/s. Cemal is initially at rest, but then starts running after the train with a constant acceleration of $g/2$, where $g = 10\text{m/s}^2$. Just when Cemal starts running, Atilla is 10m away, and at that instant Atilla throws a ball in the direction of Cemal, at an angle 45° with respect to the train.

- (a) With what initial speed must Atilla throw the ball so that it will hit Cemal?
- (b) For how much time does the ball fly?
- (c) In which direction is the ball moving with respect to ground?
- (d) How fast is Cemal running when he catches the ball?

3. (30 points) A small body moves along the x axis with constant acceleration according to the equation

$$\frac{dx}{dt} = cx^p,$$

where c and p are constants.

Show that the acceleration of the body is

$$a = \frac{1}{2}c^2.$$