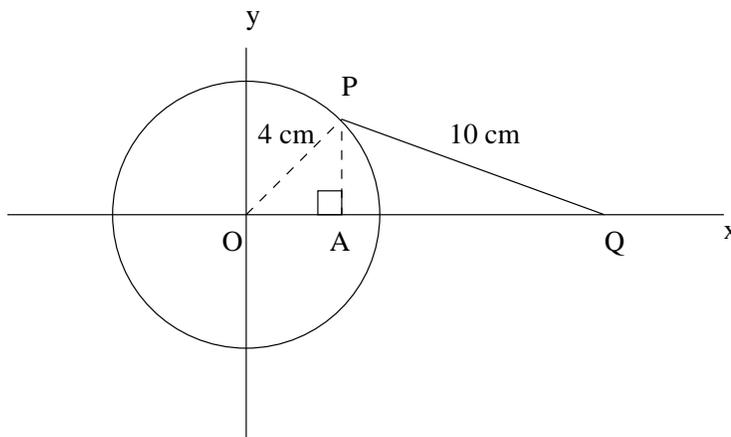


1. (a) Give the values of the two basic limits

$$\lim_{t \rightarrow 0} \frac{\sin(t)}{t} \quad \lim_{t \rightarrow 0} \frac{1 - \cos(t)}{t}.$$

- (b) Using the definition of the derivative, the two limits in part a) and the addition formula for cos, find the derivative of  $\cos(x)$ . Try to justify each step.
2. Let  $PQ$  be a line segment of fixed length 10 cm. Suppose that one end of the line segment  $Q$  is allowed to slide back and forth along the  $x$ -axis. The other end,  $P$ , is attached to a circle of radius 4 cm which is centered at the origin and rotates counter-clockwise at 20 revolutions per minute.



- (a) At time  $t = 0$ , the point  $P$  has coordinates  $(4, 0)$ . Find functions  $x(t)$  and  $y(t)$  which give the coordinates of  $P$  at time  $t$  where time is measured in minutes.
- (b) Give the location of  $P$  after 8 seconds.
- (c) Find a function  $q(t)$  which gives the  $x$  coordinate of  $Q$  at time  $t$ . Find the velocity of the point  $Q$  as a function of  $t$ .
- (d) Give the velocity of  $Q$  34 seconds after the point  $P$  is at  $(4, 0)$ .
- (e) At this time is  $Q$  moving towards the origin, away from the origin or is  $Q$  stationary?