

1. Let  $H$  be the hyperbola with the equation  $x^2 - y^2 = 1$ .
  - (a) Sketch the hyperbola,  $H$ .
  - (b) Find the slope of the tangent line to the hyperbola at the point  $(a, \sqrt{a^2 - 1})$  for  $a = 10, 100$  and  $1000$ .
  - (c) Determine if there are any tangent lines to the hyperbola,  $H$ , which pass through  $(0, 0)$ . Give all such tangent lines.
  - (d) Explain why your answer in part c) is plausible.
  
2. A particle is moving in the  $x, y$ -plane starting at the point  $P = (1, 0)$  and so that after  $t$  seconds, the particle is located at  $Q = (\cos(t), \sin(t))$ .
  - (a) Describe geometrically the path of the particle.
  - (b) Find the angle between the  $x$ -axis and the line through  $Q$  and  $P$  after  $\pi/4$  seconds.
  - (c) Find the rate of change of this angle after  $\pi/4$  seconds.
  - (d) Find the distance between  $Q$  and  $P$  after  $\pi/4$  seconds.
  - (e) Find the rate of change of the distance between  $P$  and  $Q$  after  $\pi/4$  seconds.

