Assignment 9-5

1. The position of a particle in the xy-plane is given by $x = 4t^2$ and $y = \sqrt{t}$. Find the following:

   a. the velocity vector at $t = 4$
   b. the acceleration vector at $t = 4$
   c. the speed of the particle at $t = 4$
   d. the distance the particle moves between $t = 0$ and $t = 4$
   e. the direction of the particle at $t = 4$

2. The position of a particle is given by $x = t^2$ and $y = t^3$. Find the following:

   a. the speed of the particle at $t = 2$
   b. the direction of the particle at $t = 2$
   c. the distance the particle moves between $t = 1$ and $t = 4$
   d. the velocity vector at $t = 3$
   e. the acceleration vector at $t = 4$

3. A particle moves in the xy-plane so that at time t its velocity vector is $v(t) = \langle t^3, \cos(\pi t) \rangle$ and the particle's position vector at time $t = 0$ is $\langle 2,1 \rangle$.

   a. What is the position vector of the particle when $t = 2$? Do not use a calculator.
   b. What is the acceleration vector of the particle when $t = 2$? Do not use a calculator.
   c. What is the direction of the particle when $t = 1$?
   d. What is the distance the particle travels between $t = 0$ and $t = 2$?
   e. When is the particle at rest?
   f. What is the speed of the particle when $t = 2$?

4. A particle moves on the xy-plane so that at time t its coordinates are $x = t^3 + t$ and $y = t^5 - 2t^2$. Find its velocity vector at time $t = 2$.

5. A calculator is allowed on this problem.
   The position of an object moving on a curve is $(x(t), y(t))$ at time t.
   Given $\frac{dx}{dt} = \sqrt{\frac{t}{2+t}}$ and $\frac{dy}{dt} = \cos(t^2 - 1)$. At time $t = 1$, the position of the object is $(2,4)$.

   a. Find the position of the object at time $t = 3$.
   b. Find the speed of the object at time $t = 3$.
   c. Find the total distance traveled by the object over the interval $1 \le t \le 3$.
   d. Find an equation of the line tangent to the curve at time $t = 3$.
   e. Find the acceleration vector at time $t = 3$.

6. Given a parametric curve defined by $x = e^t$ and $y = t + 1$.
   a. Find the length of the arc of the curve on the interval $1 \le t \le 6$.
   b. Find an equation of the line tangent to the curve when $t = 1$.
   c. Is the curve concave upward or downward when $t = 2$?
   d. Give a rectangular equation for the curve.
   e. Show an integral setup with respect to the variable x that gives the length of the same arc as that in part a.

7. Find all points of horizontal and vertical tangency to the curve $x = 2 - 2\cos\theta$, $y = 2\sin(2\theta)$.

8. Find the tangents at the pole for $r = 1 + 2\cos\theta$.