Section 3.7

1. Find the angle between the tangent vector and the position vector for \( r(t) = \langle t^2, 2t^3 \rangle \) at the point where \( t = -1 \).

2. Find the vector and parametric equations of the line tangent to \( r(t) = \langle t^3 + 2t, 4t - 5 \rangle \) at the point where \( t = 2 \).

3. Sketch the curve \( r(t) = \langle t^2, t \rangle \). Find the tangent and unit tangent vector to the curve at the point \((4, 2)\). Draw the position and tangent vector along with the sketch of the curve at the point \((4, 2)\).

4. Find the angle of intersection of the curves \( r_1(s) = \langle s - 2, s^2 \rangle \) and \( r_2(t) = \langle 1 - t, 3 + t^2 \rangle \).

Section 3.8

5. Given \( y(t) = 4t^3 - 15t^2 + 12t + 5 \) is the position of an object at time \( t \). Assume \( y \) is measured in feet and \( t \) is measured in seconds.
   a) Find the velocity and acceleration of the object at time \( t > 0 \).
   b) Find the times when the velocity is 0 and find the acceleration of the object at these times.

6. Given \( f(x) = \sqrt{3x + 1} \), compute \( f''(0) \).

7. Find the 83rd derivative of \( f(x) = \sin(2x) \).

8. Suppose the position of a particle at time \( t \) is given by \( r(t) = \sin(2t)i + (\cos 2t)j \). Find the velocity, speed, and acceleration of the particle when \( t = \frac{\pi}{2} \). Plot the position, velocity, and acceleration vectors along with the sketch of the curve.

Section 3.9

9. A curve is given parametrically by \( x = t^3 - 3t^2, \ y = t^3 - 3t \).
   a) Find the equation of the line tangent to the curve at the point where \( t = -1 \)
   b) Find all the points on the curve where the tangent line is horizontal or vertical