1 Section 3.8

1. Find and simplify the first and second derivatives of the following:
   (a) \( f(x) = \sin^2 x \)
   (b) \( y = \frac{1}{x^2 + 1} \)

2. The graph of \( f, f', \) and \( f'' \) are shown below. Label which is which. Explain your reasoning.

3. Find the fiftieth (50th) derivative of \( f(x) = \cos 2x. \)

4. Given \( f(x) = \frac{1}{x}, \) find a formula for the \( n \)th derivative \( (f^{(n)}(x)) \)

2 Section 3.9

1. Find an equation of the line tangent to the curve parametrized by \( x = \sec \theta, \) \( y = \tan \theta \) at the point where \( \theta = \frac{\pi}{3}. \)

2. Find an equation of the line tangent to the curve given by \( x = t^2 + 2t, \) \( y = t^3 - t \) at the point \((3,0).\)

3. Find the points on the curve \( x = 4t - t^2, \) \( y = 1 + t^2 \) where the tangent line is horizontal or vertical.

4. The curve \( x = t^3 - 4t, y = t^2 \) crosses itself at the point \((0, 4).\) Find the point-slope equations of both tangent lines.

3 Section 3.10

1. Oil spilled from a broken tanker spreads in a circular pattern whose radius increases at a constant rate of 0.6 m/sec. How fast is the area of the spill increasing when the radius is 10m?

2. A man sitting on a pier 3m above water pulls on a rope attached at water level to a boat at the rate of 0.5 m/s. At what rate is the boat approaching the pier when 5m of rope remain?

3. A camera is positioned 800m from a rocket launch pad. If the rocket rises vertically at 300 m/sec, how fast is the angle of elevation of the camera changing when the rocket is 1000m above ground?

4. A man 6ft tall is walking at a rate of 3 ft/sec toward a streetlight 18ft high.
   a) How fast is the length of his shadow changing when he is 12ft from the streetlight?
   b) How fast is the tip of his shadow moving at that instant?

5. A feed trough 4m long has a cross section that is an isosceles triangle with a base of 1.5m at the top and a height of 1m. If water pours into the trough at a rate of 0.25 \( m^3/min, \) how fast is the depth of the water changing when the depth is 0.4m?