§1 Computation:

1) Calculate the derivatives of the following functions:
   a) \( y(x) = x\sqrt{x + x^2} \),
   b) \( y(x) = \frac{x^2 + x - 2}{x^3 + 6} \),
   c) \( f(x) = xe^x \).

2) Calculate the derivatives of the following functions:
   a) \( y(x) = \sqrt{1 + \tan x} \)
   b) \( f(\theta) = \ln(\cos \theta) \)
   c) \( y(x) = x^e \).

3) Find the tangent line to \( y = \frac{2}{1 + e^x} \) at (0,1). Include a graph of the function and a graph of the tangent line.

4) The Folium of Descartes has the equation \( x^3 + y^3 = 6xy \), and is graphed below. Find the derivative \( \frac{dy}{dx} \). At what points is the tangent line to this curve horizontal? Give exact values.
§2 Comprehension:

5) What is the product rule? Why is it true?

6) What is the derivative of the function $y = \sin^{-1} x$? Prove that your result is correct.

7) Here is the graph of a function, its first derivative, and its second derivative. Identify each.

§3 Applications:

8) If a tank hold 6000 gallons of water which drains from the bottom of the tank in 30 minutes, then Torricelli’s Law gives the volume $V$ of water remaining in the tank after $t$ minutes as

$$V(t) = 6000 \left( 1 - \frac{t}{30} \right)^2 \text{ for } 0 \leq t \leq 30.$$

Find the rate at which the water is draining from the tank after 10 minutes, and after 20 minutes. At what time is water flowing out of the tank the fastest? The slowest?

9) At noon ship A is 150 km west of ship B. Ship A is sailing east at 35 km/hr, and ship B is sailing north at 25 km/hr. How fast is the distance between the ships changing at 3:00 pm?

10) A lighthouse is located on a small island 3 km away from the nearest point P on a straight shoreline, and its light makes four revolutions per minute. How fast is the beam of light moving along the shoreline when it is 1 km from P?