1. Express the limits as a derivative and evaluate
   
   \[ a) \lim_{x \to 1} \frac{x^{15} - 1}{x - 1}, \quad b) \lim_{h \to 0} \frac{\sqrt{16 + h} - 2}{h}, \quad c) \lim_{\theta \to \frac{\pi}{3}} \frac{\cos \theta - 0.5}{\theta - \frac{\pi}{3}}. \]

2. A window has the shape of a square surmounted by a semicircle. The base of the window is measured as having width 60 cm with a possible error in measurement of 0.1 cm. Use differentials to estimate the maximum possible error in computing the area of the window.

3. Find the linearization of \( f(x) = \sqrt{1 + 3x} \) at \( a = 0 \) and use it to approximate \( \sqrt{1.03} \).

4. A paper cup has the shape of a cone with height 10 cm and radius 3 cm at the top. If water is poured into the cup at a rate of 2 cm\(^3\)/s, how fast is the water level rising when the water is 5 cm deep?

5. The volume of a cube is increasing at a rate of 10 cm\(^3\)/min. How fast is the surface area increasing when the length of an edge is 30 cm?

6. Cobalt-60 has a half-life of 5.24 years. Find the mass that remains from a 100-mg sample after 20 years. How long would it take for the mass to decay to 1 mg?

7. An equation of motion of the form \( s = 2e^{-3t} \cos(2\pi t + \pi/6) \) represents the damped oscillation of an object. Find the velocity and the acceleration of the object when \( t = 0 \).

8. Find \( f' \) in terms of \( g, g' \)
   
   \[ a) f(x) = \ln |g(x)|, \quad b) f(x) = e^{g(x)}, \quad c) f(x) = \tanh g(x), \quad d) f(x) = \arccos(2g(x)). \]

9. Compute the limits
   
   \[ a) \lim_{x \to 0} \frac{\sin(x^2)}{x}, \quad b) \lim_{\theta \to 0} \frac{\cos \theta - 1}{2\theta^2}, \quad c) \lim_{x \to \pi/4} \frac{1 - \tan x}{\sin x - \cos x}. \]

10. If \( g(\theta) = \theta \sin 2\theta \), find \( g''(\pi/6) \).

11. Find \( y' \)

   \[ a) y = \frac{e^{1/x}}{x^2}, \quad b) y = 3^x \arctan x, \quad c) \arcsin(xy) = x^2 - y, \]

   \[ d) y = \cosh^{-1}(x + y), \quad e) y = \ln(x^5(3x - 4)^4). \]

12. Find an equation of the tangent line to the curve at the given point

   \[ a) x^2 + 4xy + y^2 = 13 \text{ at } (2, 1), \quad b) xy^2 + 3xy + 2 = 0 \text{ at } (1, -1). \]