1. In each case, find the limit if it exits. If the limit does not exist, explain why.

(a) \( \lim_{x \to 0} \left( \frac{x}{x} - \cot x \right) \)

(b) \( \lim_{x \to 0} \frac{\sin 3\pi x}{\sin 2\pi x} \)

2. In each case, find the value of the limit if it exists. If the limit does not exist, explain why.

(a) \( \lim_{h \to 0} \frac{f(0.5 + h) - f(0.5)}{h} \) where \( f(x) = \cos \pi x \)

(b) \( \lim_{x \to 1^+} (x - 1)^{\ln x} \)
3. For each of the following:

(a) \( f'(x) \) if \( f(x) = \frac{5x^2 + 3x + 1}{x^3} \)

(b) \( f'(x) \) if \( f(x) = \frac{2x^3 + 1}{\cos x} \)
4. For each of the following:
   
   (a) $\frac{dy}{dx}$ when $x = 0$, where $y$ is a function defined implicitly by $x^2 - y = 3xy^2 - 1$

   (b) $h'(1)$ where $h(x) = f(g(x))$, $g(1) = 3$, $f'(3) = 4$, $f'(1) = 6$, and $g'(0) = 3$

5. For each of the following:

   (a) All antiderivatives of $(5x - 7)^{10}$

   (b) $\int \frac{2x - 1}{(2x^2 - 2x + 8)^4} \, dx$
6. Find each of the following:

(a) \( \int 3x\sqrt{x^2 + 1} \, dx \)

(b) \( \int_0^\pi \cos^3 x \sin x \, dx \)
7. Sketch the region under the curve $y = 4 - x^2$ and the $x$-axis.

(a) Find $\sum_{i=1}^{n} f(x_i) \Delta x$

(b) Find the area under the curve using the limit of the sum in part (a)
8. Suppose that the water is being emptied from a spherical tank of radius 8 ft. If the radius of the water in the tank is 6 ft and is decreasing at the rate of 2 ft/s, at what rate is the depth $h$ of the water in the tank decreasing?
9. There is a 16 ft ladder leaning against a vertical wall. The tip of the ladder is sliding down the wall at the rate of 5.6 ft/s. What is the rate of change, in radians per second, of the angle $\theta$ at the instant when the tip of the ladder is 7.0 ft above the ground?
10. Let $f$ be a function given by $f(x) = x^3 - 5x^2 + 5x + k$, where $k$ is a constant.

(a) On what intervals is $f$ increasing? Find the critical points.

(b) On what intervals is the graph of $f$ concave downward? Find the inflection points.

(c) Find the value of $k$ for which $f$ has 11 as its relative minimum.