1. If \( f(x) = \frac{x^3 + 8}{3x^4} \), find an equation for the tangent line to the graph of \( f \) at the point \( (2, f(2)) \).

2. Differentiate the following functions. (Do not simplify your answers.)
   a) \( f(x) = \left(2x^2 + (4x^2 + 1)^5\right)^9 \)
   b) \( f(x) = (\sin x + x)(\tan \frac{x}{2}) \)

3. Find equations for the asymptotes to the graph of \( f(x) = \frac{3x^2 - 5x - 2}{x^2 + 3x - 10} \).
   Vertical: __________
   Horizontal: __________

4. Find the following limits:
   a) \( \lim_{x \to 9} \frac{\sqrt{x} - 3}{x^2 - 9x - 18} \)
   b) \( \lim_{x \to \infty} \left[ 2\ln \left(\frac{1x}{2x + 3}\right) + \cos \left(\frac{2x}{x^2 + 4}\right) \right] \)

5. If \( G'(x) = \frac{x^3}{x^4 + 8} \) and \( H(x) = G(\cos x) \), find \( H'(x) \).

6. Find \( \frac{dy}{dx} \) for the equation \( y^3 + 2xy - 5y^2 = \frac{4}{x} + 9y \).

7. Use the definition of the derivative as a limit to find \( f'(x) \) for \( f(x) = \sqrt[4]{x^3 - 5x} \).

8. Let \( f(x) = 5x + \frac{20}{x} \),
   a) find the critical numbers for \( f \).
   b) find the relative extrema for \( f \).

9. The height (in feet) of a projectile above the ground after \( t \) seconds is given by \( h(t) = -16t^2 + 48t + 160 \). Find the speed of the projectile when it hits the ground.

10. A rancher wants to use 400 ft of fencing to construct a rectangular corral divided into 3 rectangular sections. Find the largest possible area of the corral.

11. If \( f(x) = \frac{1}{x^3 + 12} \), find the open intervals on which the graph of \( f \) is concave up or concave down.
2. A ladder 20 ft long is leaning against a wall, with the top of the ladder 15 ft above the ground. If the top of the ladder starts sliding down the wall at the rate of $\frac{1}{2}$ ft/sec, how fast is the angle between the ladder and the ground changing 6 seconds later?

3. Find the absolute extrema for $f(x) = 3x^{\frac{3}{2}} - 12x^{\frac{1}{3}}$ on $[-1,4]$.

4. Let $f(x) = \frac{8(2-x)}{(x-1)^2}$, so that $f'(x) = \frac{8(x-3)}{(x-1)^3}$ and $f''(x) = \frac{16(4-x)}{(x-1)^4}$.

   a) Find equations for the asymptotes to the graph of $f$.
      Vertical: __________
      Horizontal: __________

   b) Find the open intervals on which $f$ is increasing or decreasing.

   c) Find the open intervals on which the graph of $f$ is concave up or concave down.

   d) Sketch the graph of $f$, showing all asymptotes, relative extrema, points of inflection, and intercepts.

5. Find the critical numbers and relative extrema for $f(x) = \sin^2 x - \sin x$ on the interval $(0, \pi)$.

6. At noon Sam is 200 miles due north of Tucson and Jill is 20 miles due west of Tucson. If Sam is driving south at a rate of 60 mph and Jill is driving east at a rate of 40 mph, find the rate at which the distance between them is changing at 2 pm.

7. A company wants to make a box with a square base and a volume of 10 ft$^3$. If the material for the top and bottom costs $1.2/ft^2$ and the material for the other sides costs $1.60/ft^2$, find the dimensions of the least expensive such box.

8. A right triangle is formed in the first quadrant by the x- and y-axes and a line through the point $(4, 5)$. Find the smallest possible area of such a triangle.