1. Compute the following limits. If the limit does not exist, explain why. Do not use L’Hopital’s rule.

a) \( \lim_{t \to \infty} \frac{t^2 + 2t + 1}{3 - 4t^2} \)

b) \( \lim_{x \to -1} \frac{3x}{(x + 1)^3} \)

c) \( \lim_{u \to 2} \frac{\sqrt{4u + 1} - 3}{u - 2} \)

d) \( \lim_{x \to 0} \frac{\tan 3x}{\sin x} \)
2. Suppose \( f(x) = x^2 - 2x \). Find \( f'(x) \) from the DEFINITION of the derivative.

3. Find \( f'(x) \) for the following functions. You need not simplify your answers.
   
   a) \( f(x) = \frac{7x^2}{7} - 5x^{7/2} \)

   b) \( f(x) = (1 + 5x^4)^{-4}(1 - x^3)^3 \)
c) \( f(x) = \left( 1 + 2e^{2x} + \sin 3x - \frac{1}{x^2} \right)^{3/5} \)

d) \( f(x) = (x + 1)^\cos x \)

e) \( f(x) = \int_{e^{2x}}^{\sqrt{7}} \sin t^2 \, dt \)
4. Find $dy/dx$ by implicit differentiation if $\sqrt{x^2 + y^2} = x + \cos y$.

5. Find an equation of the tangent line to $f(x) = xe^{\sin x}$ at the point $x = \frac{\pi}{2}$.
6. Find the absolute maximum and absolute minimum of \( f(x) = x^3 - 3x^2 + 1 \) on \( \left[ \frac{1}{2}, 4 \right] \).

7. A street light is mounted at the top of a 15-ft-tall pole. A man 6 ft tall walks away from the pole with a speed of 5 ft/s along a straight path. How fast is the tip of his shadow moving when he is 40 ft from the pole?
8. A farmer has 2400 ft of fencing and wants to fence off a rectangular field that borders a straight river. He needs no fence along the river. What are the dimensions of the field that has the largest area?

9. Evaluate the following indefinite integrals.

a) \[ \int 3\sqrt{x}(x^2 + 6\pi + x^{-1})dx \]

b) \[ \int (e^{-2x} + 8\sin 4x - 5\cos 4x)\ dx \]
c) \[ \int \frac{x}{\sqrt{x+1}} \, dx \]

d) \[ \int \frac{\sin 2x}{1 + \cos 2x} \, dx \]
10. Find the following definite integrals.

a) \[ \int_{1}^{2} (8x^3 + 3x^2) \, dx \]

b) \[ \int_{e}^{e^4} \frac{dx}{x \sqrt{\ln x}} \]
11. Let \( R \) be the region bounded by \( y = x^3 \) and \( y = \sqrt{x} \). Find the following.

a) Area of \( R \).

b) Volume of the solid obtained by rotating \( R \) about the line \( y = 1 \). SETUP ONLY.

c) Volume of the solid obtained by rotating \( R \) about the line \( x = 1 \). SETUP ONLY.
12. Suppose that the DERIVATIVE $f'$ of a function $f$ has the graph

This graph is not the graph of the function. It is the graph of the derivative of $f$.

a) Find the intervals where $f$ is increasing/decreasing.

b) Find the intervals where $f$ is concave up/down.

c) Assuming $t(2) = 0$, sketch a graph of $f$. Clearly label minima, maxima and inflection points.