



Directions: Closed book, closed notes, no calculators. Put all phones, etc., away. You will need only a pencil or pen.

1. (10 points) Answer the questions about the function f graphed below.

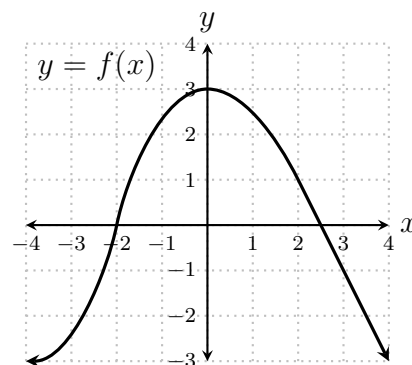
(a) $\lim_{z \rightarrow 3} \frac{f(z) - f(3)}{z - 3} =$

(b) $\lim_{x \rightarrow 0} \frac{1}{3 - f(x)} =$

(c) $\lim_{x \rightarrow \infty} f\left(2 + \frac{1}{x}\right) =$

(d) $\lim_{x \rightarrow -2} \frac{\sin(f(x))}{f(x)} =$

(e) $\lim_{x \rightarrow -2} \frac{\sin(f(x))}{f(x) + 1} =$



2. (20 points) Find the limits

(a) $\lim_{x \rightarrow 0} \tan^{-1}(x - 1) =$

(b) $\lim_{x \rightarrow \pi/2} e^{\cos(x)} =$

(c) $\lim_{x \rightarrow 3} \frac{x^2 - 7x + 12}{3x - 9} =$

(d) $\lim_{x \rightarrow 4} \frac{\sqrt{x} - 2}{x - 2} =$

3. (7 points) Use a **limit definition** of the derivative to find the derivative of $f(x) = \frac{1}{1-x}$.

4. (7 points) Suppose $f(x) = x^3 - 3x$ and $g(x) = 3x^2 + 6x$. Find all x for which the tangent to $y = f(x)$ at $(x, f(x))$ is parallel to the tangent to $y = g(x)$ at $(x, g(x))$.

5. (7 points) An object moving on a straight line is $s(t) = t^3 - 3t^2$ feet from its starting point at time t seconds. Find its acceleration when its velocity is -3 feet per second.

6. (35 points) Find the derivatives of these functions. You do **not** need to simplify your answers.

(a) $f(x) = \sqrt{2}x^2 + e$

(b) $f(x) = x \ln |x| - x$

(c) $f(x) = e^{\sec(x)}$

(d) $f(x) = e^x \sec(x)$

(e) $f(x) = \left(\frac{x+1}{x-1}\right)^3$

(f) $f(x) = \frac{1}{\sqrt{1-x}}$

(g) $y = \cos^2(\ln(x^3 + x))$

7. (7 points) Given the equation $xy^3 = xy + 6$, find y' .

8. (7 points) Find the derivative of $f(x) = x^x$.