(1) (15 points) Compute the following limits:

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

(b) \( \lim_{t \to 0} \frac{\cos(2t)}{3 + \sin(t)} = \)

(c) \( \lim_{h \to 0} \frac{(2 + h)^2 - 2^2}{h} = \)

(d) \( \lim_{\theta \to 0} \frac{\sin \theta}{\theta} = \)

(e) \( \lim_{\theta \to 0} \frac{1 - \cos \theta}{\theta} = \)

(f) \( \lim_{x \to \infty} \frac{3x^2 + x - 9}{4x^2 - 3x + 7} = \)

(g) \( \lim_{x \to 0} 4x \cot(3x) = \)
(2) (45 points) Compute the following derivatives. You do not have to simplify your answers.

(a) \( y = 6x^5 - 2x^3 + 7x^2 - 6x + 3 \)

\[ y' = \]

(b) \( y = 5x^{-3} + 4\pi^{-2} \)

\[ y' = \]

(c) \( C(q) = \frac{5}{q^3} - \frac{4}{q^4} \)

\[ C'(q) = \]

(d) \( y = \cos(x) \)

\[ y' = \]

(e) \( y = \sin(x) \)

\[ y' = \]
(f) \( y = \tan(x) \)

\[
y' = \]

(g) \( y = \sec(x) \)

\[
y' = \]

(h) \( w = 3\sqrt{z} \)

\[
w' = \]

(i) \( P(t) = 3t^2 \sin(t) \)

\[
P'(t) = \]

(j) \( R(t) = \frac{2t^3 + t}{t^2 + 3t} \)

\[
R'(t) = \]

(k) \( y = 7(x^4 - 3x^2 + 6)^{11} \)

\[
y' = \]
(l) \( y = 3 \cos(x^4) \)
\[ y' = \]

(m) \( y = 4(x + \tan(2x))^3 \)
\[ y' = \]

(n) \( Q(t) = \frac{1 + \cos(2t)}{1 + \sin(2t)} \)
\[ Q'(t) = \]

(o) \( y = 4 \left( \frac{x + 2}{x + 1} \right)^5 \)
\[ y' = \]

(p) \( y = \sqrt{x^2 + \cos^2(3x)} \)
\[ y' = \]
(3) (10 points) Let \( y = f(x) \) have the following graph.

(a) At which of the labeled points is \( f'(x) > 0? \)

(b) At which is the labeled points is \( f'(x) < 0? \)

(c) At which is the labeled points is \( f'(x) = 0? \)

(4) (5 points) The function \( y = f(x) \) has the following graph. Estimate the derivative \( f'(3). \)

(5) (5 points) What is the equation of the tangent line to \( y = x^2 + 3x - 2 \) at the point where \( x = -1? \)
(6) (10 points)
(a) State what it means for a function \( f(x) \) to be continuous on an interval \( I \).

(b) State the Intermediate Value Theorem.

(c) Show that the equation \( 2x^3 + x - 5 = 0 \) has at least one solution between in the interval \([1, 2]\).

(7) (10 points)
(a) Let \( f \) be a function and \( a \) a real number \( h \neq 0 \). Explain the geometric meaning of the difference quotient \( \frac{f(a + h) - f(a)}{h} \) (include a picture).

(b) State the definition of the derivative \( f'(a) \) as a limit.

(c) Use your answers to the last two questions to explain why \( f'(a) \) is the slope of the tangent line to \( y = f(x) \) at \( x = a \).