• Complete all questions.
• You may use a calculator during this examination. Other electronic devices are not allowed, and should be turned off for the duration of the exam.
• You may use one double-sided, hand-written, 8.5 by 11 inch page of notes.
• Show all work for full credit.
• You have 80 minutes to complete the exam.
1. Evaluate each of the following limits.

(a) \[ \lim_{x \to 4^+} \frac{x - 4}{2x - 8} \]

(b) \[ \lim_{x \to 2^-} \frac{1}{x^2 - 4} \]

(c) \[ \lim_{x \to -3^-} \frac{x}{x + 3} \]

(d) \[ \lim_{x \to 0^+} \frac{|x| - x}{x^2} \]

(e) \[ \lim_{x \to 0^-} \frac{|x| - x}{x^2} \]
2. The graph of $f(x)$ for $-5 \leq x \leq 5$ is shown below.

(a) Is $f(x)$ continuous at $x = -4$?

(b) What is $\lim_{x \to -4} f(x)$?

(c) What is $\lim_{x \to -3^+} f(x)$?

(d) What is $\lim_{x \to -3^-} f(x)$?

(e) What is $\lim_{x \to 1} f(x)$?
3. Find the two points on the unit circle that have tangent lines which pass through the point \((2, 3)\).
4. For a certain function \( f(x) \) and \( h \neq 0 \),

\[
\frac{f(x + h) - f(x)}{h} = \frac{-x^2 + (-h - 2)x - h}{x^4 + 2hx^3 + h^2x^2}.
\]

(a) Find the slope of the secant line through \((2, f(2))\) and \((5, f(5))\).

(b) Find the slope of the tangent line to \( y = f(x) \) at the point \((2, f(2))\).
5. A stone is thrown upward. Its height (in meters) $t$ seconds later is given by

$$A(t) = 5 + 10t - 4.9t^2.$$ 

(a) Suppose $h \neq 0$. Express the average velocity of the stone from time $t$ to time $t + h$. Simplify your expression as much as possible.

(b) Evaluate the limit of your expression in part (a) as $h$ approaches zero.

(c) What is the instantaneous velocity of the stone at time $t = 2$?
6. Suppose \( j \) is a non-zero number. Consider the following function.

\[
f(x) = \begin{cases} 
3jx - \frac{2}{x} & \text{if } x \geq 1, \\
2jx + \frac{1}{j} & \text{if } x < 1.
\end{cases}
\]

Find all values of \( j \) that make \( f \) continuous at \( x = 1 \).
7. Suppose an object is moving in the plane so that its coordinates at time \( t > 0 \) are given by the functions

\[
x(t) = 3t - 1, \quad y(t) = -t^2 + 3t.
\]

(a) Express the \( y \)-coordinate of the object as a function of \( x \).

(b) What is the largest \( y \) value attained by the object?