• Show all your work.
• Regardless of your prior experience with calculus, you must use limit methods for all derivatives on this exam.

1. (15 pts.) The position of a moving object (measured in meters) is given by

\[ f(t) = 3 \cos(\pi(t - 1)) \]

with \( t \) measured in seconds. Compute the following:

(a) The position of the object at time \( t = 0.5 \) seconds.
(b) The change in position on the interval \( 0 < t < 0.5 \) seconds.
(c) The rate of change of position on the interval \( 0 < t < 0.5 \) seconds.
2. (20 pts.) The graph of a function $g(x)$ is shown at right. Use the graph to do the following:

(a) Find the rate of change of $g$ on the interval $[0.5, 1]$.

(b) Sketch the corresponding secant line.

(c) Find the rate of change of $g$ on the interval $[1, 1.5]$.

(d) Sketch the corresponding secant line.

(e) Find the rate of change of $g$ at the point $x = 1$. 

![Graph of a function $g(x)$ showing rates of change and secant lines.](image)
3. (15 pts.) The height of a falling object is given by \( h(t) = 64 + 4t - 16t^2 \) feet after \( t \) seconds. Find the velocity at the instant \( t = 2 \) sec.
4. (15 pts.) Find $\frac{dy}{dx}$ for $y = \sqrt{x + 1} - 4x$. 
5. (10 pts.) Use the graph of $f$ shown at right to mark each of the following statements TRUE or FALSE. Circle the appropriate answer. (Read carefully; there will be no partial credit.)

(a) $\lim_{x \to 1^+} f(x) = 2$. TRUE or FALSE

(b) $\lim_{x \to 2} f(x) = 2$. TRUE or FALSE

(c) $f(2) = 2$. TRUE or FALSE

(d) $\lim_{x \to 1} f(x)$ Does Not Exist. TRUE or FALSE

(e) $f$ is continuous on $(0, 1)$. TRUE or FALSE
6. (15 pts.) A function measures the temperature of an object to be

\[ f(t) = \frac{100}{t + 1} \]

degrees Fahrenheit, with \( t \) measured in minutes. When is the rate of change of temperature equal to \(-50\) degrees per minute? (Assume \( t > 0 \)).
7. (10 pts.) The cost of a certain item is changing according to the function \( C(t) = 100e^{-0.12t} \), with \( C \) measured in dollars and \( t \) measured in years.

(a) Graph the cost function on the axes provided below. Be sure to label your graph properly.

(b) Hypothetically, a calculus professor asks a (hypothetical) student, “What is the rate of change of cost when \( t = 1 \) year?” The student answers “10.6 dollars.” What two things did the student get completely wrong, and how would you correct them?