• Show all your work.

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

1. An investment grows according to the formula

\[ A(t) = 100e^{0.1t} \]

where \( A \) is measured in dollars and \( t \) is measured in years.

(a) (5 pts.) Find the average rate of change of \( A \) on the interval \( 0.9 \leq t \leq 1 \) year.

(b) (5 pts.) Find the average rate of change of \( A \) on the interval \( 1 \leq t \leq 1.1 \) years.

(c) (5 pts.) Guess the instantaneous rate of change of \( A \) at time \( t = 1 \) year.
2. (15 pts.) If \( f(x) = \sqrt{2x - 1} \), find the rate of change of \( f \) at the point \( x = 5 \).
3. (15 pts.) Use the graph of \( f \) shown at right to answer the following questions.

(a) \( \lim_{x \to -1^+} f(x) = \) ?
(b) \( \lim_{x \to 2} f(x) = \) ?
(c) \( \lim_{x \to 1^-} f(x) = \) ?
(d) \( \lim_{x \to 1^+} f(x) = \) ?
(e) \( \lim_{x \to 1} f(x) = \) ?

4. Use the graph of \( f \) shown at right to:

(a) (10 pts.) Compute at least two secant slopes with fixed end at \((0,0)\). You choose the free ends.

(b) (5 pts.) Guess the tangent slope at \((0,0)\).
5. (15 pts.) Suppose that $y = x + \frac{1}{x}$. Find the slope of the tangent line at the point (1, 2).
6. (15 pts.) A moving object has position (in meters) given by \( f(t) = 30 + 10t - 2t^2 \), with \( t \) in seconds. Find its position when its velocity is 8 m/s.
7. (10 pts.) You wish to install a cable running from $P$ to $Q$ to $R$ as shown in the figure at right. It costs you $180 per foot for the segment from $P$ to $Q$ and $100$ per foot for the segment from $Q$ to $R$. Total cost, $C$, is a function of the distance $x$ from $T$ to $Q$.

Compute the **average** rate of change of $C(x)$ on the interval $0 \leq x \leq 50$ feet.