

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

1. (10 pts.) The triangular region shown at right has an area of 4 square feet. Express its perimeter as a function of the length of the base, $x$.

\[
\begin{tikzpicture}
\draw[thick] (0,0)--(4,0)--(0,2)--cycle;
\draw[thick] (0,0) node[below] {$x$};
\end{tikzpicture}
\]

2. (10 pts.) Solve for $x$.

\[e^{2x} = 10e^{5x}\]

3. (10 pts.) Use the table of values for $f$ to compute the following:

\[
\begin{array}{c|c|c|c|c|c|c|c}
  x & -2 & -1 & 0 & 1 & 2 & 3 & 5 \\
  f(x) & 7 & 5 & 3 & 1 & 0 & -2 & -3 \\
\end{array}
\]

(a) $f(3)$
(b) $(f \circ f)(3)$
(c) $f^{-1}(3)$
(d) $(f^{-1} \circ f^{-1})(3)$
(e) $(f^{-1} \circ f)(3)$
4. (10 pts.) Use the graph of $f(x)$ shown below to compute the following limits.

   i) $\lim_{x \to 1^-} f(x)$

   ii) $\lim_{x \to 2} f(x)$

   iii) $\lim_{x \to 3} f(x)$

   iv) $\lim_{x \to 3^+} f(x)$

   v) $\lim_{x \to 1^-} x[f(x)]^2$
5. (10 pts.) Use the graph of \( g(x) \) shown below to answer the following questions. You may assume the domain of \( g \) extends to infinity in both directions.

i) At what points is \( g \) discontinuous?

ii) On what intervals is \( g \) continuous?

iii) What is \( \lim_{x\to 2} g(x) \)?

iv) What is \( \lim_{x\to -\infty} g(x) \)?

6. (10 pts.) Find the slope of the tangent line to \( f(x) = \frac{3}{x} \) at the point \( x = 2 \).

7. (10 pts.) Find the rate of change of the function \( f(x) = \sqrt{1-x} \) at the point \( x = a \).

8. (10 pts.) Suppose that \( f(x) = x^2 - x + 1 \). Find \( f'(x) \).
9. (10 pts.) Given the graph of $f$ shown below:

(a) Compute (approximately) $f'(1)$.
(b) Compute (approximately) $f'(2)$.
(c) Graph $f'$ on the axes provided.
10. (10 pts.) A falling object has a height of \( h \) feet (ft) after time \( t \) seconds (s) as shown in the table below.

\[
\begin{array}{c|c|c|c|c|c}
  t & 0 & 1 & 2 & 3 & 4 & 5 \\
  h(t) & 100 & 98 & 93 & 83 & 68 & 48 \\
\end{array}
\]

(a) Compute the average velocity of the object on the following time intervals:
   i. [0, 1]
   ii. [1, 2]
   iii. [2, 3]
   iv. [3, 4]
   v. [4, 5]

(b) At approximately what instant in time is velocity of the object \(-12 \text{ ft/s}\)?