INSTRUCTIONS: This exam is a closed book exam. You may not use your text, homework, or other aids except for a 3 × 5 notecard. You may use an allowable calculator, TI 83 or 84 to
- perform operations on real numbers,
- evaluate functions at specific values, and
- look at graphs.
A TI 89, Nspire, or a calculator with a computer algebra system, any technology with wireless or Internet capability (i.e. laptops, tablets, smart phones or watches), a QWERTY keyboard, or a camera are not allowed. Unless otherwise stated, you must show all of your work including all steps needed to solve each problem and explain your reasoning in order to earn full credit. This means that correct answers using incorrect reasoning may not receive any credit. Reasoning which will earn credit will use material covered in the course to date, up to and including Section 2.8. Some short-cuts, such as
- the use of L’Hôpital’s Rule for computing limits
- derivative calculations
are not included on the material for this exam and as such may not earn any credit.

Turn off all noise-making devices and all devices with an internet connection and put them away. Put away all headphones, earbuds, etc.

This exam consists of 9 problems on 10 pages. Make sure all problems and pages are present.

The exam is worth 150 points in total.

You have 60 minutes to work starting from the signal to begin. Good luck!
### Exam 1 Grade by Problem Number

<table>
<thead>
<tr>
<th>No.</th>
<th>Out of</th>
<th>Pts.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>3a</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>3b</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>9a</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9b</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9c</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9d</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9e</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td></td>
</tr>
</tbody>
</table>

### Current Course Grade by Category

<table>
<thead>
<tr>
<th>Category</th>
<th>Out of</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam 1</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>WebAssign</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Quiz/HW</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Overall 6 Week Grade</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>
1. (2 points each) True (T) or False (F) statements. Circle your answer. No justification needed. True means always true.

(a) T  F  \[ \sin(3\theta) = 3\sin(\theta). \]

(b) T  F  \[ \lim_{x \to 2} (x + 3)^2 = \lim_{x \to 2} (x^2 + 9). \]

(c) T  F  If \( \lim_{x \to -1} f(x) = 5 \), then \( \lim_{x \to -1} f(x) = 5 \).

(d) T  F  If \( k \) is a continuous function over the interval \([-2, 4]\) such that \( k(-2) = 3 \) and \( k(4) = 1 \), then \( k(x) = 0 \) must have a solution inside the interval \((-2, 4)\) by the Intermediate Value Theorem.

(e) T  F  If \( g(x) \leq f(x) \leq k(x) \) for all \( x \) near \( x = 1 \) and \( \lim_{x \to 1} g(x) = \lim_{x \to 1} k(x) = 7 \), then \( \lim_{x \to 1} f(x) = 7 \).
2. (10 points) Find an equation of a line with slope $\frac{1}{2}$ that goes through the point $(-\sqrt{2}, -3)$.

3. (6 points each) Identify all zeros of $f$ (values of $x$ where $f(x) = 0$), if any, for the following functions:

(a) $f(x) = \frac{x^2 - 7x - 8}{x + 3}$

(b) $f(x) = x^3 - 5x$
4. (5 points each) Let \( f \) be the function defined by

\[ f(x) = 2\sin(x) + e^x, \]

and let \( g \) and \( k \) be functions whose values are given in the table below. Assume \( k^{-1} \) exists.

<table>
<thead>
<tr>
<th>( x )</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>( g(x) )</td>
<td>-3</td>
<td>1</td>
<td>0</td>
<td>-3</td>
<td>-5</td>
</tr>
<tr>
<td>( k(x) )</td>
<td>6</td>
<td>2</td>
<td>-1</td>
<td>-4</td>
<td>11</td>
</tr>
</tbody>
</table>

(a) Find the slope of the line through the points \((4, k(4))\) and \((8, k(8))\).

(b) \( f(g(6)) = \)

(c) (note: do NOT simplify your answer) \( f(2 + h) = \)

(d) \( k^{-1}(2) = \)

5. (4 points each) Pistol Pete is seen at a local outdoor shooting range. Forgetting that his pistols are loaded with real bullets, Pete spins his pistols (because that is what he does) and one pistol accidently fires. When the pistol fired the bullet, it was pointing straight up. Let \( d(t) \) be the height of the bullet (in feet) \( t \) seconds after firing.

(a) Write a sentence to explain in words what \( d(2.5) - d(2) \) measures.

(b) Write a sentence to explain in words what \( d^{-1}(576) = 3 \) means.
6. (20 points) Answer the following questions based on the graph of \( f \) below. Dashed lines indicate asymptotes.

(a) (2 points each) Give numeric values for each of the following. Write “DNE” if the value does not exist and “\( \infty \)” or “\( -\infty \)” if appropriate.

\[
\begin{align*}
f(-2) &= \quad & f(1) &= \quad & \lim_{x \to 1} f(x) &= \\
\lim_{x \to -2} f(x) &= \quad & \lim_{x \to 3^+} f(x) &= \quad & \lim_{x \to 5^-} f(x) &= \\
\lim_{x \to 5} f(x) &= \quad & \lim_{x \to -\infty} f(x) &= \quad & \lim_{x \to \infty} f(x) &=
\end{align*}
\]

(b) (2 points) Is \( f \) continuous at \( x = 1 \)? Answer “Yes” or “No.”
7. (16 points) In the space provided to the right of each graph, write the letter(s) of the expression(s) which are valid for the graph. Each graph will have at least one matching expression and could have multiple matching expressions.

<table>
<thead>
<tr>
<th>Graph</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jump Discontinuity</td>
<td>(A) ( \lim_{x \to a} f(x) = f(a) )</td>
</tr>
<tr>
<td></td>
<td>(B) ( \lim_{x \to a} f(x) ) exists but ( \lim_{x \to a} f(x) \neq f(a) )</td>
</tr>
<tr>
<td></td>
<td>(C) ( \lim_{x \to a^-} f(x) \neq \lim_{x \to a^+} f(x) )</td>
</tr>
<tr>
<td>Removable Discontinuity</td>
<td>(D) ( \lim_{x \to a^-} f(x) = \infty )</td>
</tr>
<tr>
<td></td>
<td>(E) ( \lim_{x \to a} f(x) = \infty )</td>
</tr>
<tr>
<td>Vertical Asymptote</td>
<td>(F) ( \lim_{x \to \infty} f(x) ) exists</td>
</tr>
<tr>
<td>Continuous at ( x = a )</td>
<td>(G) ( \lim_{x \to -\infty} f(x) ) exists</td>
</tr>
<tr>
<td>Horizontal Asymptote</td>
<td></td>
</tr>
</tbody>
</table>
8. (14 points) Build an appropriate table to estimate the following limits numerically up to three decimal places. Write at least six values for $x$.

$$\lim_{x \to 0} \frac{25^x - 1}{x}$$
9. (8 points each) Evaluate the following limits as exact numbers, or state that it does not exist ("DNE"). Use $\infty$ or $-\infty$ if either is appropiate. Do NOT use numerical estimation or graphing to find the limits. Show ALL of your work needed to solve each limit by hand to receive any credit! NO CREDIT for answers alone.

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

(b) $\lim_{x \to 0} \frac{\sqrt{4x + 1} - 3}{x - 2} = \quad $ 

(c) $\lim_{\theta \to 0} \frac{\tan(\theta)}{\theta} = \quad $
9. (Continued: 8 points each) Show ALL of your work needed to solve each limit by hand to receive any credit! NO CREDIT for answers alone.

(d) \( \lim_{{x \to 3}} \left( \frac{1}{x - 3} - \frac{6}{x^2 - 9} \right) = \)

(e) \( \lim_{{t \to \infty}} \frac{-2t^3 - 3}{7t^3 + 2t - 8} = \)