Use of books, notes or calculators is NOT permitted.

Please show all your work! Answers without appropriate supporting work may not receive full credit.

Clearly indicate your answers to each problem by underlining them or placing a box around your answers!

1. Fill in the values of the trigonometric functions in the chart below.

<table>
<thead>
<tr>
<th>( \theta )</th>
<th>0</th>
<th>( \frac{\pi}{6} )</th>
<th>( \frac{\pi}{4} )</th>
<th>( \frac{\pi}{3} )</th>
<th>( \frac{\pi}{2} )</th>
<th>( \pi )</th>
<th>( \frac{3\pi}{2} )</th>
<th>2( \pi )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \sin \theta )</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \cos \theta )</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \tan \theta )</td>
<td></td>
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</tr>
</tbody>
</table>

2. Given that \( \sin \theta = \frac{3}{5} \) and \( \frac{\pi}{2} < \theta < \pi \), find the exact values of the remaining five trigonometric ratios.

3. Find all solutions to the equation \( \cos^2(x) + \cos(x) = 0 \).

4. Complete the identity using the triangle method.

\[
\cos(\tan^{-1}(x)) =
\]

5. Determine the exact value without using a calculator.

\[
\sin^{-1}\left(\frac{\sqrt{3}}{2}\right) =
\]

6. Evaluate the following limits:

\[
\lim_{x \to 3} \frac{x^2 - 2x}{x + 1}
\]

\[
\lim_{x \to 2} \frac{x^2 - 4x + 4}{x^2 + x - 6}
\]

\[
\lim_{\theta \to 0} \frac{\sin(3\theta)}{\theta}
\]
\[ \lim_{x \to -1} f(x) \] where \( f(x) = \begin{cases} 2x + 1 & \text{if } x < -1 \\ 3 & \text{if } -1 < x < 1 \\ 2x + 1 & \text{if } x > 1 \end{cases} \]

\[ \lim_{x \to 2} \frac{x^2 - x - 2}{x^2 - 4} \]

\[ \lim_{x \to \pi} \sin \left( \frac{x}{3} \right) + x^2 \]

7. Given \( f(x) = -2x^3 + 16 \) and \( g(x) = \cos(x) \):

(a) What is the domain and range of \( f(x) \) and \( g(x) \)?

(b) Let \( h(x) = g(x)/f(x) \). Write the formula for \( h(x) \) and state the domain of \( h(x) \).

(c) Find the formula for \( f^{-1}(x) \) and state the domain of \( f^{-1}(x) \).

(d) What is \( f(g(x)) \)?

(e) If \( g(x) \) is vertically stretched by a factor of 2 and then shifted down 2 units, call this new function \( k(x) \) and write it in the space below.

8. Given \( f(x) = \sqrt{x + 1} \) and \( g(x) = x^2 - 4 \),

(a) Find the composite function \( f \circ g \) and identify the domain.

(b) Find the composite function \( g \circ f \) and identify the domain.

(c) Find \( \frac{f(x)}{g(x)} \) and identify the domain.

9. Solve each of the following equations for \( x \):

\[ \ln \left( \frac{1}{x} \right) + \ln (2x^3) = \ln 3 \]

\[ 3e^{-2x} = 5 \]

\[ 2 \ln (4x) - 1 = 6 \]

10. Use the limit definition of derivative to find the derivative of \( f(x) = 5x^2 - 3 \).

11. The function \( f(t) = 3t^2 + t \) represents the position given in feet of an object at time \( t \) seconds. Include units in all of your answers.

(a) Find the average velocity between \( t = 1 \) and \( t = 2 \).

(b) Find the instantaneous velocity at \( t = 2 \).

12. Find an equation of the tangent line to \( y = x^3 + 3x^2 \) at \( x = 1 \).
13. Find the indicated derivatives. You may need to rewrite the function before taking the derivative.

\[ f(x) = x(3x^2 - \sqrt{x}), \text{ find } f'(x) \]

\[ g(x) = x^3 + \frac{4}{x^2}, \text{ find } \frac{d^2 g}{dx^2} \]

\[ h(t) = (2t + 3)^\frac{2}{3}, \text{ find } h'(t) \]

14. Given \( f(2) = -3, f(4) = 2, g(0) = 1, g(2) = 5, f'(0) = 0, f'(1) = -1, f'(2) = 3, g'(0) = 2, g'(1) = -6, g'(2) = 7, \)

(a) Find \( H'(2) \) given that \( H(x) = 5f(x) - 2g(x) \).

(b) Find \( F'(0) \) given that \( F(x) = f(g(x)) \).

15. Sketch a graph of a function with the properties \( f(-1) = 2, \lim_{x \to 1^-} f(x) = -3 \) and \( \lim_{x \to 1^+} f(x) = \infty \).

16. Sketch the graph of a function \( f \) that satisfies the conditions that \( f \) is continuous everywhere except at \( x=1 \) and at \( x=3 \). Sketch your graph in such a way that the two-sided limit at \( x=1 \) DOES NOT exist while the two-sided limit at \( x=3 \) DOES exist. Label a few tickmarks to show the scale you are using on your graph.

17. GIVEN A GRAPH OF \( F \): be able to determine:

(a) all \( x \) values where the \( f(x) \) is discontinuous.

(b) a one-sided limit of \( f(x) \).

(c) the limit of \( f(x) \) at a specified \( x \) value.

(d) all \( x \) values where the limit of \( f(x) \) does not exist.

(e) all horizontal and vertical asymptotes of \( f(x) \).

(f) all \( x \) values where the derivative of \( f(x) \) is undefined.

(g) roughly sketch \( f'(x) \) given the graph of \( f(x) \).