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

<table>
<thead>
<tr>
<th>θ</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>θ</th>
</tr>
</thead>
<tbody>
<tr>
<td>sin θ</td>
<td>0</td>
<td>$\frac{1}{2}$</td>
<td>$\frac{1}{\sqrt{2}}$</td>
<td>$\frac{\sqrt{3}}{2}$</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>cos θ</td>
<td>1</td>
<td>$\frac{\sqrt{3}}{2}$</td>
<td>$\frac{1}{\sqrt{2}}$</td>
<td>$\frac{1}{2}$</td>
<td>0</td>
<td>$\frac{3\pi}{2}$</td>
</tr>
<tr>
<td>tan θ</td>
<td>0</td>
<td>$\frac{1}{\sqrt{3}}$</td>
<td>1</td>
<td>$\sqrt{3}$</td>
<td>undefined</td>
<td>0</td>
</tr>
</tbody>
</table>

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

$$\cos \theta = -\frac{4}{5}, \quad \tan \theta = -\frac{3}{4}, \quad \csc \theta = \frac{5}{3}$$

$$\sec \theta = -\frac{5}{4}, \quad \cot \theta = -\frac{4}{3}$$

3. ans: $x = \frac{\pi}{2} \pm n\pi$ and $x = \pi \pm 2n\pi$

4. $\cos (\tan^{-1}(x)) = \frac{1}{\sqrt{1 + x^2}}$

5. $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right) = \frac{\pi}{3}$

6. $\lim_{x \to -3} \frac{x^2 - 2x}{x + 1} = \frac{3}{4}$

$$\lim_{x \to -2} \frac{x^2 - 4x + 4}{x^2 + x - 6} = 0$$

$$\lim_{\theta \to 0} \frac{\sin (3\theta)}{\theta} = 3$$

$$\lim_{x \to -1^-} f(x) \text{ where } f(x) = \begin{cases} 2x + 1 & \text{if } x < -1 \\ 3 & \text{if } -1 < x < 1 \end{cases} \quad \text{ANS: } \lim_{x \to -1^-} f(x) = -1$$

$$\lim_{x \to 2} \frac{x^2 - x - 2}{x^2 - 4} = \frac{3}{4}$$

$$\lim_{x \to \pi} \sin \left(\frac{x}{3}\right) + x^2 = \frac{\sqrt{3}}{2} + \pi^2$$
7. (a) \( f(x): D=\text{all reals}, R=\text{all reals} \), \( g(x): D=\text{all reals}, R=[-1,1] \)

(b) \( h(x) = \frac{\cos(x)}{-2x^3 + 16} : D=x \neq 2 \)

(c) \( f^{-1}(x) = \sqrt[3]{\frac{16 - x}{2}} : D=\text{all reals} \).

(d) \( f(g(x)) = -2 \cos^3 \theta + 16 \)

(e) \( k(x) = 2g(x) - 2 \)

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

(a) \( f \circ g = \sqrt{x^2 - 3}, D=x < -\sqrt{3} \) or \( x > \sqrt{3} \)

(b) \( g \circ f = x - 3, D=x \geq -1 \) (from domain of \( f \))

(c) \( \frac{f(x)}{g(x)} = \frac{\sqrt{x+1}}{x^2 - 4}, D=x \geq -1, x \neq 2 \)

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

\[
\ln \left( \frac{1}{x} \right) + \ln \left( 2x^3 \right) = \ln 3 \quad \text{ANS: } x = \sqrt[3]{\frac{3}{2}}
\]

\[
3e^{-2x} = 5 \quad \text{ANS: } x = -\frac{1}{2} \ln \left( \frac{5}{3} \right)
\]

\[
2 \ln (4x) - 1 = 6 \quad \text{ANS: } x = \frac{e^{\frac{7}{4}}}{4}
\]

10. Must write out limit definition of derivative, show work to simplify numerator and eliminate \( h \) in denominator to receive full credit!

11. (a) \( v_{avg} = 10 \frac{ft}{s} \)

(b) \( v_{inst}(2) = 13 \frac{ft}{s} \)

12. \( y = 9x - 5 \).

13. Find the indicated derivatives. You may need to rewrite the function before taking the derivative.

\[ f(x) = x(3x^2 - \sqrt{x}), \text{ find } f'(x) = 9x^2 - \frac{3}{2}\sqrt{x} \]

\[ g(x) = x^3 + \frac{4}{x^2}, \text{ find } \frac{d^2g}{dx^2} = 6x + \frac{24}{x^4} \]

\[ h(t) = (2t + 3)^\frac{2}{3}, \text{ find } h'(t) = \frac{4}{3}(2t + 3)^{-\frac{1}{3}} \]

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) \( H'(2) = 5(3) - 2(7) = 1 \)
(b) \( F'(0) = -2 \)

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) the limit of \( f(x) \) at a specified \( x \) value.
   (c) all \( x \) values where the limit of \( f(x) \) does not exist.
   (d) all horizontal and vertical asymptotes of \( f(x) \).
   (e) all \( x \) values where the derivative of \( f(x) \) is undefined.
   (f) roughly sketch \( f'(x) \) given the graph of \( f(x) \).