1. Evaluate $L = \lim_{x \to 0} \frac{x^4 + 9x^3 + 2}{x^2 - 5x - 7}$. Show your algebraic work.

2. Evaluate $L = \lim_{x \to 3} \frac{x^2 - 10x + 21}{x^2 - x - 6}$. Show your algebraic work.

3. A machinist is required to make a circular disk of area $25\pi = 78.5398 \text{ cm}^2$, which requires a radius of exactly 5 cm. (a) If the error tolerance for the area is $\pm 2 \text{ cm}^2$ (i.e., the area is $78.5398 \pm 2$), find the range of radii (smallest and largest radii) that a disk might have and still have an acceptable area. The area of a circle is $A = \pi r^2$.

   (b) In terms of the generic definition of a limit, $\lim_{x \to a} f(x) = L$, identify numerical values for $\epsilon$, $\delta$, $a$ and $L$.

4. Differentiate $f(x) = \frac{9}{48}x^{-12/19} - \frac{1}{\sqrt{x}} + x^{287} + \pi^3$. 
5. Let \( f(x) = \begin{cases} 
2x + 4, & \text{if } x < 2; \\
k, & \text{if } x = 2 \quad (k \text{ will be determined in parts b and c}); \\
3x - 8, & \text{if } x > 2; 
\end{cases} \)

a) State the formal definition of the continuity of a function \( f \) at the point \( x = a \).

\[
5a: 3 \text{ pts}
\]

b) What value of \( k \) should be used to make \( f \) continuous from the left at \( x = 2 \) (note that \( f(2) = k \))?

\[
5b: 3 \text{ pts}
\]

c) What value of \( k \) should be used to make \( f \) continuous from the right at \( x = 2 \) (note that \( f(2) = k \))?

\[
5c: 3 \text{ pts}
\]

6. Use the Intermediate Value Theorem to show that \( f(x) = x^5 - 7 \) has at least one real root. Find an interval in which the root lies, and be sure to verify that each hypothesis of the Theorem is satisfied.

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6: 7 \text{ pts}
\]

7. Differentiate \( g(r) = \frac{r^5 + 2r}{r^4 + 1} \). Simplify the numerator.

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7: 8 \text{ pts}
\]
8. My kids Max and Mikayla like to throw toys around at home. One day, Mikayla grabs a Tonka truck and accidentally tosses it out an open window. The truck’s height above the ground is given by \( h(t) = 15 + 2t - 16t^2 \) feet after \( t \) seconds. (a) At what time does the truck hit the ground? Report the answer using 2 digits after the decimal. (b) At the instant of impact, what is the truck’s instantaneous velocity? Use any appropriate method to compute the velocity.

9. Draw a sketch of a function that has a removable discontinuity at \( x = 1 \), a jump discontinuity at \( x = 2 \) and is continuous from the left there, a jump discontinuity at \( x = 3 \) and is continuous from the right there, an infinite discontinuity at \( x = 4 \), a jump discontinuity at \( x = 5 \) without being continuous from the left or from the right there, a kink at \( x = 6 \) and a vertical tangent at \( x = 7 \).
10. a) State the formal definition of the derivative of $f(x)$ at $x = a$.

b) Use the definition to find $f'(x)$ for $f(x) = \frac{1}{\sqrt{x}}$.

11. Find the derivative of $h(t) = (t^2 + t)(t^3 + t^2)(t^4 + 2t)$. Do not simplify.

12. Evaluate $\lim_{x \to 1^+} \frac{x}{x+1}$. It is especially important to show your work on this problem.