Suppose that $f(x)$ and $g(x)$ are continuous functions on a domain $D$ and $c$ is any real number. Then the following statements are true:

1. $f(x) \pm g(x)$ is continuous on $D$.
2. $cf(x)$ is continuous on $D$.
3. $f(x) \cdot g(x)$ is continuous on $D$.
4. $\frac{f(x)}{g(x)}$ is continuous on $D$ wherever $g(x) \neq 0$.
5. $f(g(x))$ and $g(f(x))$ may be continuous on some domain, depending on the respective ranges of $f$ and $g$. 
Basic Continuous Functions

Here are some functions that we know are always continuous on certain domains see below).

1. Polynomials. These functions are continuous everywhere.
   i. \( x^2 - 2x + 1 \)
   ii. \(-17x^{54} + 300x^{17} - 1011\)

2. Rational Functions. Function of the form \( \frac{p(x)}{q(x)} \), where \( p, q \) are polynomials, these functions are continuous everywhere that \( q(x) \neq 0 \).
   i. \( \frac{x^2 - 2x + 1}{-17x^{54} + 300x^{17} - 1011} \)
   ii. \( \frac{2 - x}{x^2} \)

3. Exponentials and Logarithms.
   i. \( 3^x, e^x \): These functions are continuous everywhere.
   ii. \( \ln(x), \log_4(x) \): These functions are continuous for \( x > 0 \).

4. Trig Functions. The functions \( \sin(x), \cos(x), \tan(x), \sec(x), \cot(x), \csc(x) \), these functions are continuous everywhere in their domains.

5. Root Functions. Function of the form \( x^{m/n} \).
   i. \( x^{1/3}, x^{-19/7} \): If \( n \) is odd, then these functions are continuous everywhere (not including at \( x = 0 \) when \( m/n < 0 \)).
   ii. \( x^{3/4}, x^{13/2} \): If \( n \) is even, then these functions are continuous for \( x \geq 0 \) (not including at \( x = 0 \) when \( m/n < 0 \)).

Example: Since \( f(x) = 3^x \), \( g(x) = x^{1/3} = \sqrt[3]{x} \), and \( h(x) = \sin(x) \) are all continuous everywhere, we can say that \( u(x) = 7\sqrt[3]{\sin(3x)} \) is continuous everywhere.