Find all x-values where the function is continuous.

1.) $f(x) = 3x^3 + 2x^2 - x + 10$

This function is continuous everywhere. Also all Polynomials are continuous everywhere.

2.) $f(x) = \frac{8x^{10} - 4x + 1}{x+1}$

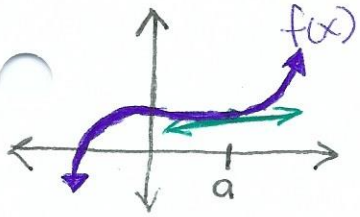
$x+1 \neq 0$

$x \neq -1$

Continuous everywhere except at $x = -1$.

Derivatives

Let f be a function continuous at $x=a$. Then the derivative of $f(x)$ at a is the slope of the line that touches f at $x=a$.



Given by $f'(a) = \lim_{x \to a} \frac{f(x) - f(a)}{x - a}$

Derative Rules

Notation

$\frac{d}{dx}(2x)$

The derivative with respect to x.

↖ independent variable.

Independent Variable - The one we can plug values into.

1.) Constant Rule - If $f(x) = c$, then $f'(x) = 0$

2.) Power Rule - If $f(x) = x^n$, then $f'(x) = n(x^{n-1})$

(ex) $g(x) = x^7$ $g'(x) = \boxed{7x^6}$

(ex) $h(x) = \sqrt{x} = x^{1/2}$ $h'(x) = \frac{1}{2}x^{-1/2} = \frac{1}{2x^{1/2}} = \boxed{\frac{1}{2\sqrt{x}}}$

(ex) $f(x) = x^2$ $f'(x) = 2x^{2-1} = \boxed{2x}$

3.) Constant multiple rule -

$\frac{d}{dx}(c \cdot f(x)) = c \cdot \frac{d}{dx}(f(x)) = c \cdot f'(x)$

(ex) $f(x) = 2x$

$2 \cdot f'(x) = 2 \cdot (1x^0) = 2 \cdot (1 \cdot 1) = \boxed{2}$

4.) Sum/Difference Rule - $\frac{d}{dx}(f(x) \pm g(x)) = \frac{d}{dx}f(x) \pm \frac{d}{dx}g(x)$

ex $f(x) = 2x^2 + 3$ $f'(x) = \frac{d}{dx}(2x^2) + \frac{d}{dx}(3) = 4x + 0$ $= 4x$

ex $g(x) = \sqrt{x} + 12x^3$ $g'(x) = \frac{1}{2\sqrt{x}} + 36x^2$

ex $h(x) = \frac{1}{x^2} + 2x$ $h'(x) = \frac{d}{dx}(x^{-2}) + \frac{d}{dx}(2x) = -2x^{-3} + 2$ $= \frac{-2}{x^3} + 2$

5.) Product Rule - $(f(x) \cdot g(x))\frac{d}{dx}$
$= f'(x)g(x) + g'(x)f(x)$

ex $f(x) = 2x \cdot \sqrt{x}$

$\frac{d}{dx} 2x \cdot \sqrt{x} + \frac{d}{dx}\sqrt{x} \cdot 2x$

$2\sqrt{x} + \frac{1}{2\sqrt{x}} \cdot 2x = \boxed{2\sqrt{x} + \frac{x}{\sqrt{x}}}$

6.) Quotient Rule - $\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{f'(x)g(x) - f(x)g'(x)}{(g(x))^2}$

ex $f(x) = \frac{x^2}{\sqrt{x}}$

$f'(x) = \frac{\frac{d}{dx}(x^2) \cdot \sqrt{x} - x^2 \cdot \frac{d}{dx}(\sqrt{x})}{(\sqrt{x})^2} = \frac{(2x) \cdot \sqrt{x} - x^2\left(\frac{1}{2\sqrt{x}}\right)}{x}$

$= \frac{2x\sqrt{x} - \frac{x^2}{2\sqrt{x}}}{x} = \frac{\frac{2x\sqrt{x}(2\sqrt{x}) - x^2}{2\sqrt{x}}}{x} = \frac{\frac{4x^2 - x^2}{2\sqrt{x}}}{x} = \frac{\frac{3x^2}{2\sqrt{x}}}{x}$

$= \frac{3x^2}{2x\sqrt{x}} = \frac{3x}{2\sqrt{x}}$