Lesson 102 Objective: SWBAT understand and determine if a function is continuous.

Kickoff- Evaluate each of the following limits.

USE HA Rule!

1) $\lim_{x\to-\infty} \frac{\boxed{x}+2}{\boxed{x^2}+x+1}$

$\frac{x}{x^2}=0$

2) $\lim_{x\to-\infty} \frac{\boxed{2x^2}}{\boxed{x^2}-4}$

$\frac{2x^2}{1x^2}=\frac{2}{1}$

$\boxed{2}$

3) $\lim_{x\to\infty} \frac{\boxed{3x^2}}{\boxed{4x}+4}$

$\frac{3x^2}{4x}$ ~~DNE~~

Really big!

$\frac{3(1{,}000{,}000)}{4(1{,}000{,}000)+4}$

$-\infty$

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

$\lim_{x\to 2} \frac{1}{x-2} = \frac{1}{0}$

1.99	1.999	2	2.001	2.01
-100	-1000	$-\infty$	1000	100

$\frac{1}{1.99-2}$ $\frac{1}{1.999-2}$

$-\infty$

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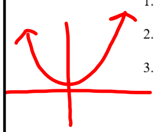
Continuity

Continuous Function- when you can draw any curve without picking up your pen!! More formally, a function is continuous at c if and only if the following conditions are true:



1. $f(c)$
2. $\lim_{x\to c} f(x)$ exist!
3. $f(c) = \lim_{x\to c} f(x)$

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Example 1: Is $f(x)$ continuous at x = 1?

$$f(x) = \begin{cases} -5x+5, & x<1 \\ 1-x, & x\ge 1 \end{cases}$$

① $f(1)=1-1=0$

② $\lim_{x\to 1} f(x)$ exist? yes!

$\lim_{x\to 1^-} -5x+5 = -5(1)+5 = 0$ $\quad \lim_{x\to 1^+} 1-x = 1-1 = 0$

③ $f(1) = \lim_{x\to 1} f(x)$

$0=0$

Continuous!

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Example 2: Is $g(x)$ continuous at x = -1?

$$f(x) = \begin{cases} -\frac{5}{2}x-2, & x\le -1 \\ -\frac{5}{2}x^2+3, & x>-1 \end{cases}$$

① $f(-1)$

$-\frac{5}{2}(-1)-2=\frac{1}{2}$

② $\lim_{x\to -1} f(x)$ exist? yes.

$\lim_{x\to -1^-} -\frac{5}{2}x-2=\frac{1}{2}$ $\quad \lim_{x\to -1^+} -\frac{5}{2}x^2+3=\frac{1}{2}$

③ $f(-1) \stackrel{?}{=} \lim_{x\to -1} f(x)$

$\frac{1}{2}=\frac{1}{2}$

Continuous!

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Example 3: Find the value of k, so that $f(x)$ is continuous at $\boxed{x = 5.}$

$$f(x) = \begin{cases} kx+1, & x<5 \\ x^2, & x\ge 5 \end{cases}$$

$5k+1 = k(5)+1$

$25 = (5)^2$

$5k+1=25$

$-1 \quad -1$

$\frac{5k}{5}=\frac{24}{5}$

$k=\frac{24}{5}$

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Determine if the function is continuous at the given x.

1.

$$f(x) = \begin{cases} 5x+7, & x<3 \\ 7x+1, & x>3 \end{cases} \quad \text{at } x = 3.$$

2.

$$f(x) = \begin{cases} x+7, & x<2 \\ 9, & x=2 \\ 3x+3, & x>2 \end{cases} \quad \text{at } x = 2$$

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3.

$$f(x) = \begin{cases} 4x^2 - 2x, & x < 3 \\ 10x - 1, & x = 3 \\ 30, & x > 3 \end{cases} \quad \text{at x = 3}$$

4.

$$f(x) = \begin{cases} -x + 1, & 0 \le x < 1 \\ 1, & 1 \le x < 2 \\ 2, & x = 2 \\ x - 1, & 2 < x \le 3 \\ -x + 5, & 3 < x \le 4 \end{cases} \quad \text{at}$$

a) x = 1
b) x = 3

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5.

$$(x) = \begin{cases} 1, & x < 0 \\ \sqrt{1 - x^2}, & 0 \le x \le 1 \\ x - 1, & x > 1 \end{cases}$$

a) Determine the graph of f(x).
b) Is f continuous?

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Find the value of k that would make the function continuous at the given x value.

6.

$$f(x) = \begin{cases} kx + 5, & x < 4 \\ x^2 - x, & x \ge 4 \end{cases} \quad \text{at x = 4}$$

7.

$$f(x) = \begin{cases} 3x^2 - 11x - 4, & x \le 4 \\ kx^2 - 2x - 1, & x > 4 \end{cases} \quad \text{at x = 4}$$

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8.

$$f(x) = \begin{cases} k^2x + k, & x \ge 3 \\ 4, & x < 3 \end{cases} \quad \text{for all values of x.}$$

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