Calculus 1.1 Understanding Limits Numerically and Graphically

Homework:

Limits are one of the BIG Ideas in the AP Calculus Curriculum

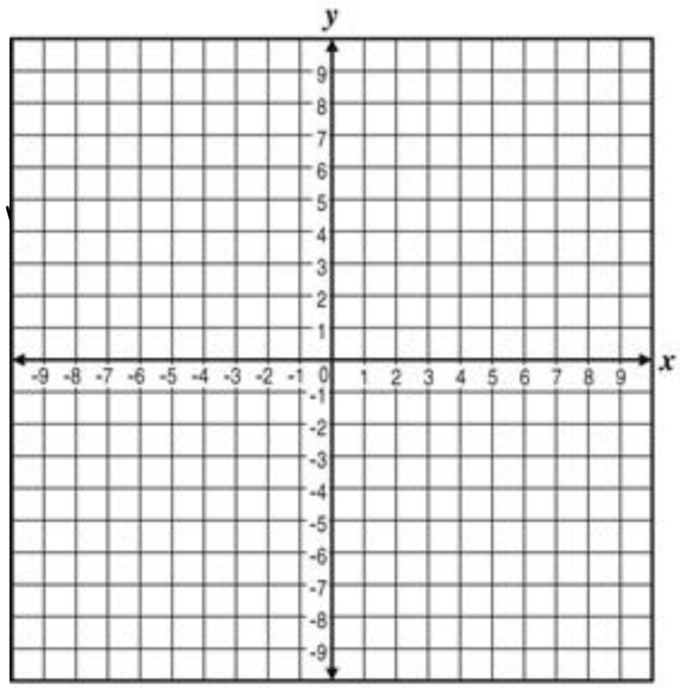
Working Definition: The value of f(x) as x approaches a certain number when approaching from either direction. The limit doesn't have to equal f(x) at x.

Example 1

Graph and Analyze

$$f(x) = \frac{3x^2 - 8x - 3}{x^2 - 9}$$

Factor and Simplify



Hole(s)

Domain

Range

Vertical Asymptote(s)

Horizontal Asymptote

End Behavior

Analyze the Behavior of the graph at x=-3 and x=3 also discuss and left and right hand limits

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Proper Limit Notation

PROPER LIMIT NOTATIONS		
TYPE OF LIMIT	**PROPER NOTATION**	**VERBALLY:**
Right-hand limit		
Left-hand limit		
General limit		

Limit Existence Theorem

When finding limits, ask yourself, "What is happening to y as x gets close to a certain number?" You are finding the ***y*-value** for which the function is approaching as x approaches c.

LIMIT EXISTENCE THEOREM:

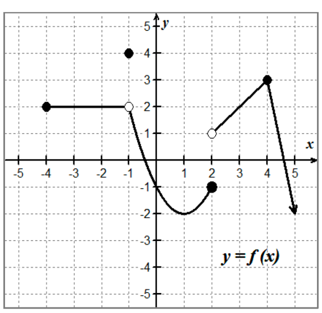
$\lim_{x\to c} f(x)$ exists if and only if $\lim_{x\to c^-} f(x) = \lim_{x\to c^+} f(x) = L$

where L is a real number.

__**Verbally**__: The limit as x approaches c on $f(x)$ will exist if and only if the limit as x approaches c from the left is equal to the limit as x approaches c from the right.

Example 2:

Evaluating Limits from graphs



A. $f(2)$

B. $f(-1)$

C. $\lim_{x\to 4^-} f(x)$

D. $\lim_{x\to 2^+} f(x)$

E. $\lim_{x\to 2^-} f(x)$

F. $\lim_{x\to -1^+} f(x)$

G. $\lim_{x\to -1^-} f(x)$

H. $\lim_{x\to -4^+} f(x)$

I. $\lim_{x\to -4^-} f(x)$

J. $\lim_{x\to -1} f(x)$

K. $\lim_{x\to 2} f(x)$

L. $\lim_{x\to 5} f(x)$

M. $\lim_{x\to 0} f(x)$

N. $\lim_{x\to 1} f(x)$

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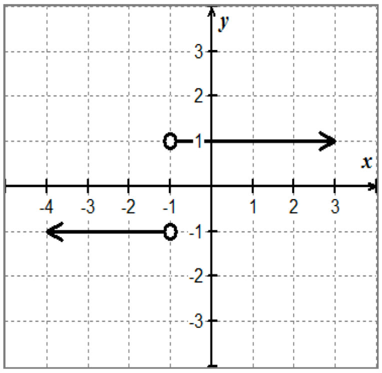
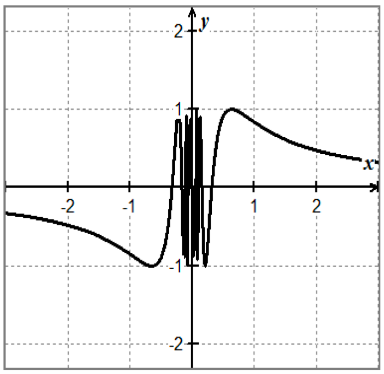
Limits can fail to exist in one of three ways

CASE 1: ____



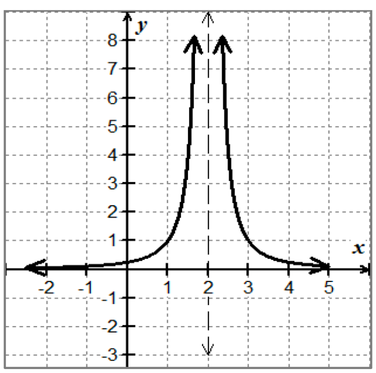
Justify why the limit does not exist at $x = -1$ for $f(x) = \frac{|x+1|}{x+1}$

CASE 2: ____



Justify why the limit does not exist at $x = 0$ for $f(x) = \sin\left(\frac{1}{x}\right)$

CASE 3: ____



Justify why the limit does not exist at $x = 2$ for $f(x) = \frac{1}{(x-2)^2}$

Example 3 : Evaluating Limits from Tables

$f(x) = \frac{x-3}{x^2+2x-15}$

x	2.9	2.99	2.999	3	3.001	3.01	3.1
$f(x)$							

Based on your analysis, what are the values of each of the limits below?

$\lim_{x\to 3^-} f(x) =$	$\lim_{x\to 3^+} f(x) =$	$\lim_{x\to 3} f(x) =$

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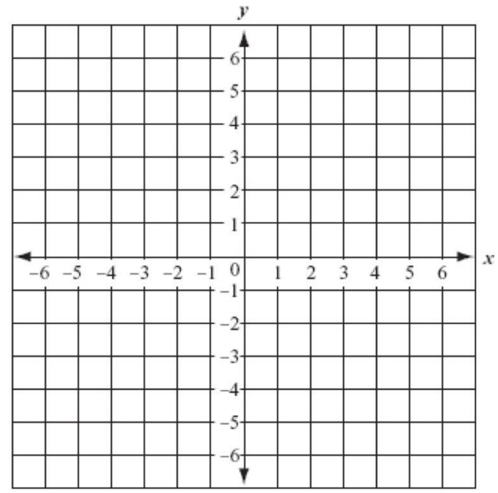
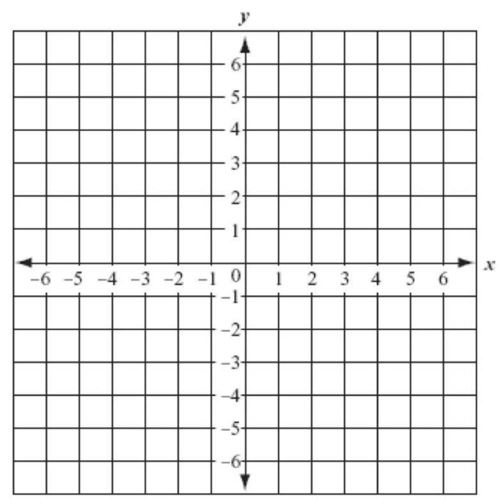
Example 4 : Sketch a Graph to satisfy each set of conditions

1. $f(a)$ is undefined
2. $x = a$ is a point discontinuity
3. $\lim_{x \to a} f(x)$ exists



1. $\lim_{x \to a} f(x)$ DNE
2. $x = a$ is a jump discontinuity
3. $f(a)$ is defined



Study Notes