*JOIN YOUR AP CALCULUS CLASS SECTION*

*collegeboard.org/joinapclass*

*2nd hour:  NVQ3MV*

*I will be checking that you joined on Friday. (1st HW grade)*

www.myschoolapps.com

*To Do list:*

*1) join AP calculus with join code*
*2) Remind*
*3) Student info (google form)*
*4) Parent info (google form)*
*5)  HW Day 1*

## 1.2 Finding Limits Graphically and Numerically

- What is a limit?

*The value that a function approaches as the input, x, approaches some value, y.*

- 3 Ways to Find Limits:
    1. Graphically
    2. Numerically
    3. Analytically (Algebraically)

## *Numerical limit example*

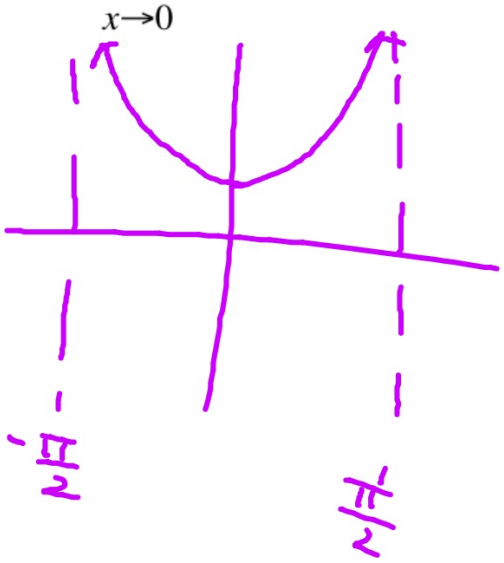
$\frac{0}{0}$ indeterminate form

$$\lim_{x \to 2} \frac{x-2}{x^2-4} = .25$$

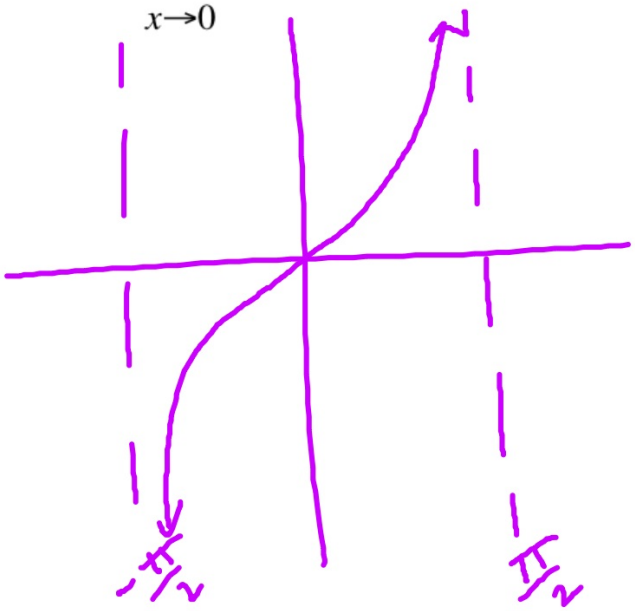
| $x$ | 1.9 | 1.99 | 1.999 | 2.001 | 2.01 | 2.1 |
|---|---|---|---|---|---|---|
| $f(x)$ | .256 | .251 | .250 | .2499 | .249 | .244 |

# Graphical limit examples

1) $\lim_{x \to 0} \sec x = 1$

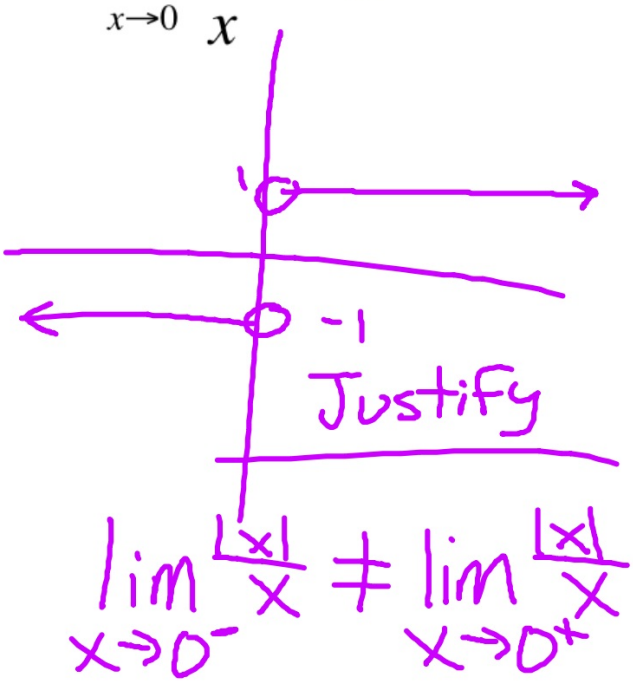



2) $\lim_{x \to 0} \tan x = 0$



# Graphical limit examples

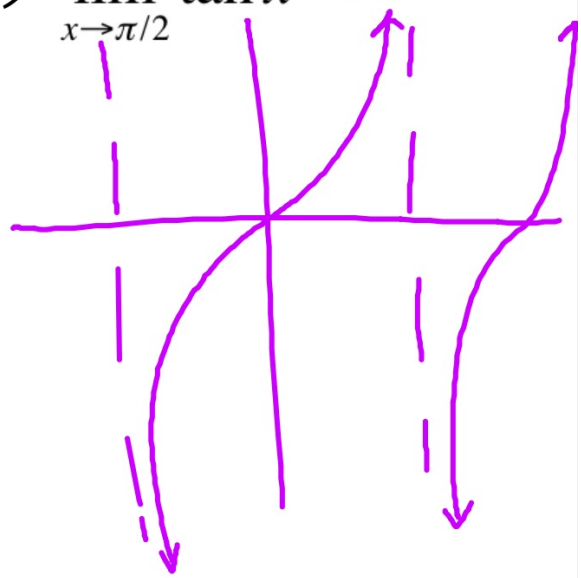
3) $\lim_{x \to 0} \frac{|x|}{x}$ dne




Justify

$\lim_{x \to 0^-} \frac{|x|}{x} \neq \lim_{x \to 0^+} \frac{|x|}{x}$

4) $\lim_{x \to \pi/2} \tan x$ dne



In general, Limits DO NOT EXIST if:

1. f(x) approaches two different y-values from the left and right.

2. f(x) oscillates between two or more y-values.

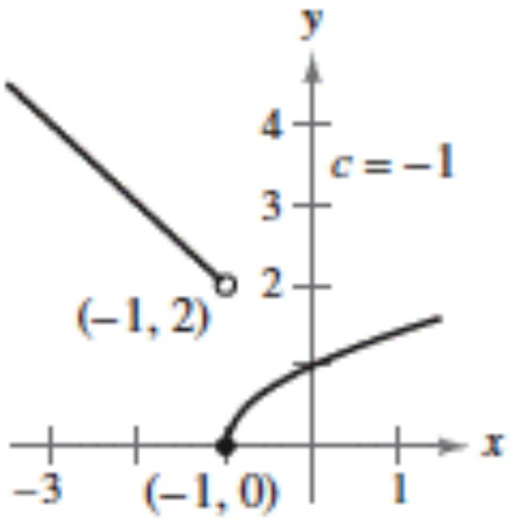
3. f(x) approaches infinity or negative infinity.*

*Infinity is a special case of DNE*

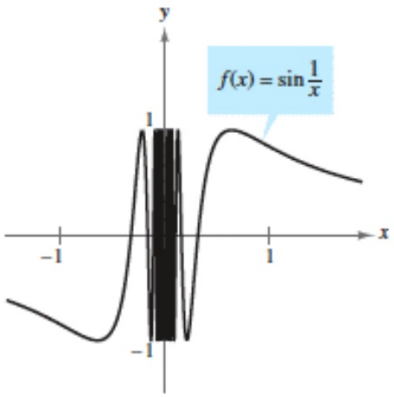
What to write:

| If c is finite: | If c is infinite: |
| --- | --- |
| $\lim_{x \to c} f(x)$ DNE because | $\lim_{x \to c} f(x)$ DNE because |
| $\lim_{x \to c^+} f(x) \neq \lim_{x \to c^-} f(x)$ | (justify in words) |

**DNE**
**Type #1**



# DNE Type #2




$\lim_{x \to 0} f(x)$ does not exist.

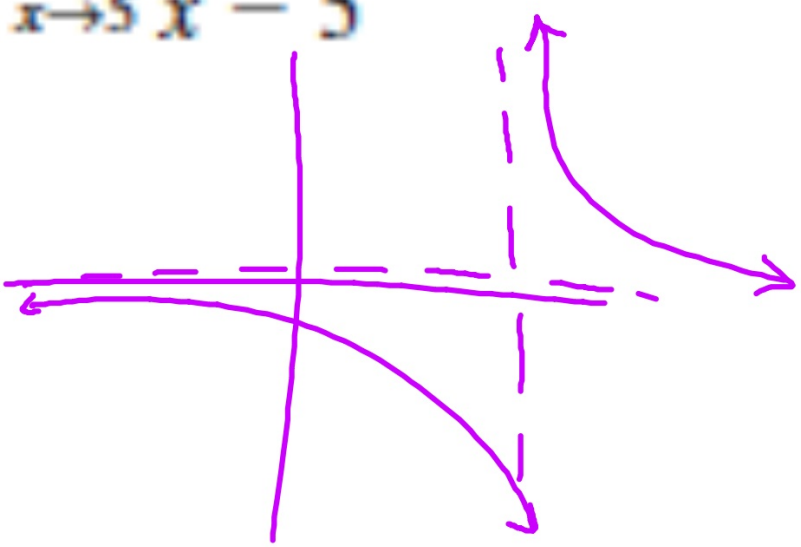
| $x$ | −0.1 | −0.01 | −0.001 | 0.001 | 0.01 | 0.1 |
|---|---|---|---|---|---|---|
| $f(x)$ | .544 | .506 | -.827 | .827 | -.506 | .544 |

$\lim_{x \to 0} \sin\frac{1}{x}$ dne

DNE Type #3

$$\lim_{x \to 5} \frac{2}{x - 5}$$

dne



(a) $f(-2)$ undefined

(b) $\lim_{x \to -2} f(x)$ dne

(c) $f(0) = 4$

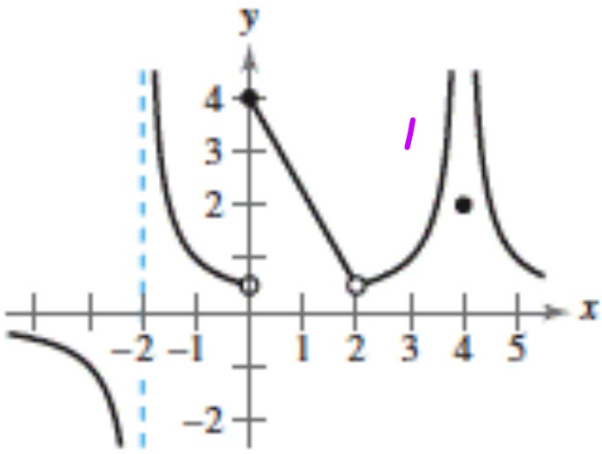
(d) $\lim_{x \to 0} f(x)$ dne

(e) $f(2)$ und.

(f) $\lim_{x \to 2} f(x)$ 1/2

(g) $f(4) = 2$

(h) $\lim_{x \to 4} f(x)$ $\infty$ or dne



# Sketching Piecewise functions

---

Sketch the graph of the following piecewise function.

$$g(x)=\begin{cases}-x^2+4 & \text{if } x<1\\ 2x-1 & \text{if } x\geq 1\end{cases}$$

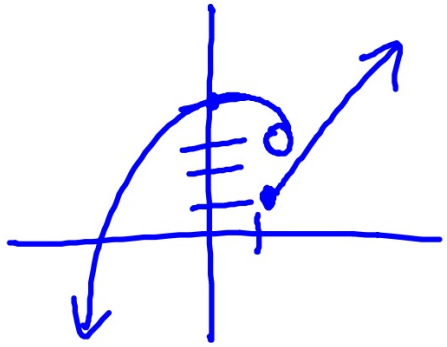
$-(1)^2+4$

$2(1)-1$

$\lim_{x\to 1} g(x)$

dne

$\lim_{x\to 1^-} g(x) \neq \lim_{x\to 1^+} g(x)$



Sketch the graph of the following piecewise function.

$$h(x)=\begin{cases} x+3 & \text{if } x<-2 \\ x^2 & \text{if } -2\le x<1 \\ -x+2 & \text{if } x\ge 1 \end{cases}$$

**Sketch a graph of a function f that satisfies the given values. (There are many correct answers)**

$f(-2) = 0$

$f(2) = 0$

$\lim_{x \to -2} f(x) = 0$

$\lim_{x \to 2} f(x)$ does not exist.

(a) If $f(2) = 4$, can you conclude anything about the limit of $f(x)$ as $x$ approaches 2? Explain your reasoning.

(b) If the limit of $f(x)$ as $x$ approaches 2 is 4, can you conclude anything about $f(2)$? Explain your reasoning.

- Notation

$$\lim_{x \to 5} f(x) = 17$$

$$\lim_{x \to -\infty} e^x = 0$$

$$\lim_{x \to 7} = 8$$

# 1.3: Evaluating limits Analytically (Direct Substitution)

**Ex 1**

$$\lim_{x \to 2} \frac{\sqrt{x+2}}{x-4}$$

$\frac{\sqrt{4}}{-2}$

$-1$

**Ex 2**

$$\lim_{x \to 7} \sec\left(\frac{\pi x}{6}\right)$$

$-\frac{2}{\sqrt{3}}$ or $-\frac{2\sqrt{3}}{3}$

Ex 3

$$\lim_{x \to 5\pi/3} \cos x$$

$$\lim_{x \to c} f(x) = \frac{3}{2}$$

$$\lim_{x \to c} g(x) = \frac{1}{2}$$

(a) $\lim_{x \to c} [4f(x)]$ $= 4 \cdot \frac{3}{2} = 6$

(b) $\lim_{x \to c} [f(x) + g(x)]$ $= 2$

(c) $\lim_{x \to c} [f(x)g(x)]$ $= 3/4$

(d) $\lim_{x \to c} \frac{f(x)}{g(x)}$ $= 3$