HW1 $\ln\left(\frac{e^4}{\sqrt[5]{y^3}}\right) = \ln(e^4) - \ln(\sqrt[5]{y^3})$

$\sqrt[n]{x} = x^{1/n}$

$= \ln(e^4) - \ln(y^{3/5})$

$= 4\ln e - \frac{3}{5}\ln y$

$= 4 - \frac{3}{5}\ln y$

Lesson 2: finding limits numerically / graphically

What is a limit?

$f(x)$ $\lim_{x \to c} f(x)$ is the limit of f as x approaches c

Numerically

1) $f(x) = 4x+1$, $\lim_{x \to 2} f(x) = 9$

x	1.9	1.99	1.999	2	2.001	2.01
$f(x)$	8.6	8.96	8.996	9	9.004	9.04

2) $f(x) = \frac{-5}{x-1}$, $\lim_{x \to 1} f(x) = \text{DNE}$

x	.9	.99	.999	1	1.001	1.01
$f(x)$	50.1	500	5000		-5000	-500

3) $f(x) = \begin{cases} x^2 & \text{if } x \neq 0 \\ 1 & \text{if } x = 0 \end{cases}$, $\lim_{x \to 0} f(x)$

x	$-.1$	$-.01$	0	$.01$	$.1$
$f(x)$	$.01$	$.0001$		$.0001$	$.01$

$\longrightarrow 0 \qquad 0 \longleftarrow$

then $\lim_{x \to 0} f(x) = 0$, but $f(0) = 1$

One-sided limits

"from the left" $= \lim_{x \to c^-} f(x)$

"from the right" $= \lim_{x \to c^+} f(x)$

$\lim_{x \to c} f(x)$ exists, when $\lim_{x \to c^-} f(x) = \lim_{x \to c^+} f(x)$

we let $\lim_{x \to c} f(x) := \lim_{x \to c^-} f(x)$

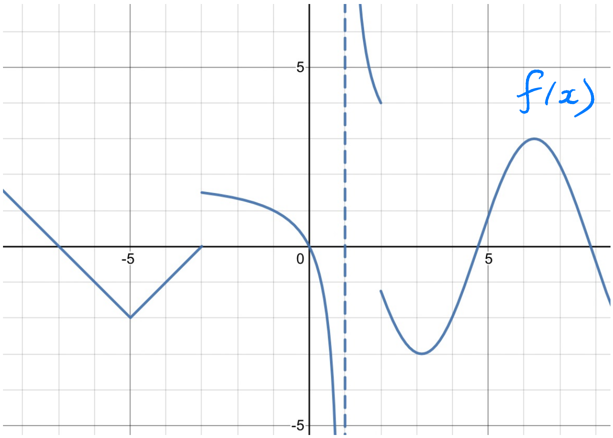
(4) $f(x) = \dfrac{\sin x}{x}$, $\lim_{x \to 0} f(x)$

x	$-.1$	$-.01$	0	$.01$	$.1$
$f(x)$	$.998$	$.999$		$.999$	$.998$

$\lim_{x \to 0^-} f(x) = 1$, $\lim_{x \to 0^+} f(x) = 1$

$\Longrightarrow \lim_{x \to 0} f(x) = 1$, but $f(0) = \text{DNE}$

Evaluating limits graphically



$\lim_{x \to c} f(x) = L$

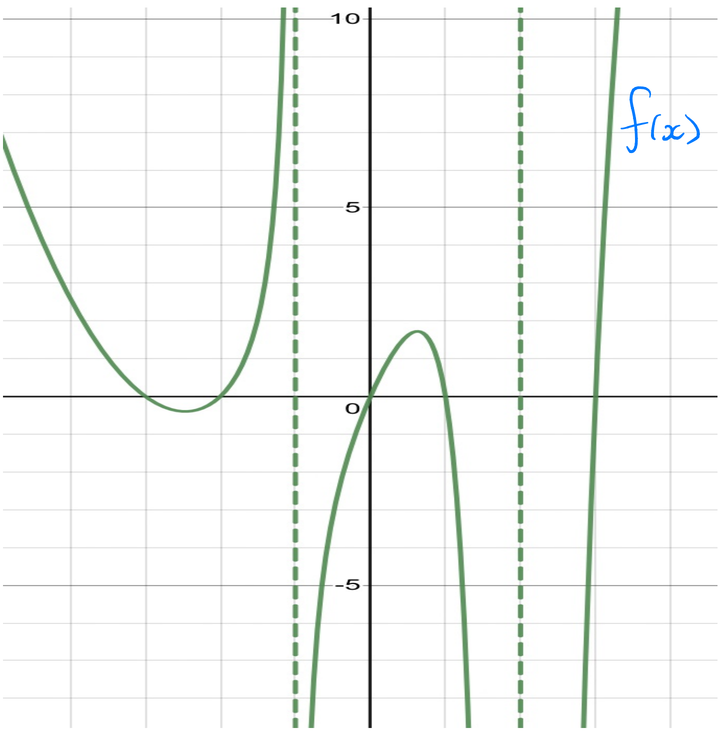
$\lim_{x \to c^-} f(x) = L_-$

$\lim_{x \to c^+} f(x) = L_+$

$c = -5 \; : \; L = -2$

$c = -3, \quad L_- = 0, \quad L_+ = 1.5, \quad L = DNE$

$c = 1, \quad L_- = -\infty, \quad L_+ = +\infty, \quad L = DNE$



$c = 2$

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

$\lim_{x \to 2^+} f(x) = -\infty$

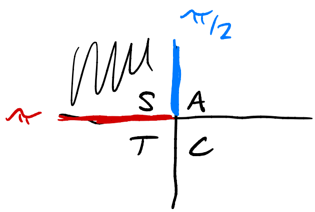
$\lim_{x \to 2} f(x) = -\infty$

$f(2) = DNE$!

Office Hours. WTHR 313 (This is chemistry building)
I will be there MW: 3:30 – 4:30 pm

HW 1 #6 $\csc\theta = 5$, $\frac{\pi}{2} < \theta < \pi$, find $\cos\theta$

$\csc\theta = \frac{1}{\sin\theta} = 5$, then $\sin\theta = 1/5$



$\sin^2\theta + \cos^2\theta = 1$

$$(1/5)^2 + \cos^2\theta = 1$$

$$\cos^2\theta = 1 - 1/25$$

$$= 24/25$$

$$\cos\theta = \pm \sqrt{24}/5 \qquad \cos\theta = -\sqrt{24}/5$$

Lesson 2: find limits numerically / graphically and One-sided limits.

What is a limit?

Consider a function $f(x)$

$\lim\limits_{x \to c} f(x)$ = the limit of $f(x)$ as x approaches c

Numerically

① $f(x) = 4x + 1, \quad \lim_{x \to 2} f(x)$

x	1.9	1.99	2	2.01	2.1
$f(x)$	8.6	8.96		9.04	9.4

$\longrightarrow 9 \qquad 9 \longleftarrow$

$$\lim_{x \to 2} f(x) = 9$$

② $f(x) = \dfrac{-5}{x-1}, \quad \lim_{x \to 1} f(x)$

x	.9	.99	.999	1	1.001	1.01	1.1
$f(x)$	50	500	5000		-5000	-500	-50

$\longrightarrow \infty \neq -\infty \longleftarrow$

$$\lim_{x \to 1} f(x) = \text{DNE}$$

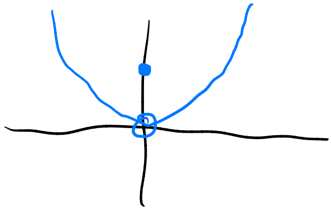
③ $f(x) = \begin{cases} x^2 & \text{if } x \neq 0 \\ 1 & \text{if } x = 0 \end{cases}, \quad \lim_{x \to 0} f(x)$

$f(0) = 1$

x	-.1	-.01	0	.01	.1
$f(x)$	.01	.0001		.0001	.01

$\longrightarrow 0 \qquad 0 \longleftarrow$

$$\lim_{x \to 0} f(x) = 0 \quad , \quad \text{but } f(0) = 1$$



One - sided limits

"from the left" $= \lim_{x \to c^-} f(x)$

"from the right" $= \lim_{x \to c^+} f(x)$

we say if $\lim_{x \to c^-} f(x) = \lim_{x \to c^+} f(x)$,

then $\lim_{x \to c} f(x)$ exists and is equal to the one-sided limits

(4) $f(x) = \dfrac{\sin x}{x}$, $\lim_{x \to 0} f(x)$

$f(0) = \text{DNE}$,

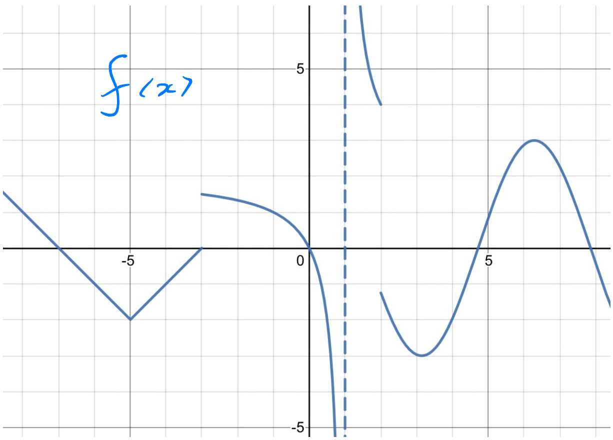
x	$-.1$	$-.01$	0	$.01$	$.1$
$f(x)$	$.998$	$.999$		$.999$	$.998$

$\lim_{x \to 0^-} f(x) = 1$, $\lim_{x \to 0^+} f(x) = 1$

So $\lim_{x \to 0} f(x) = \underline{1}$

Very important limit

find limits Graphically



$\lim_{x \to -5} f(x) = -2$

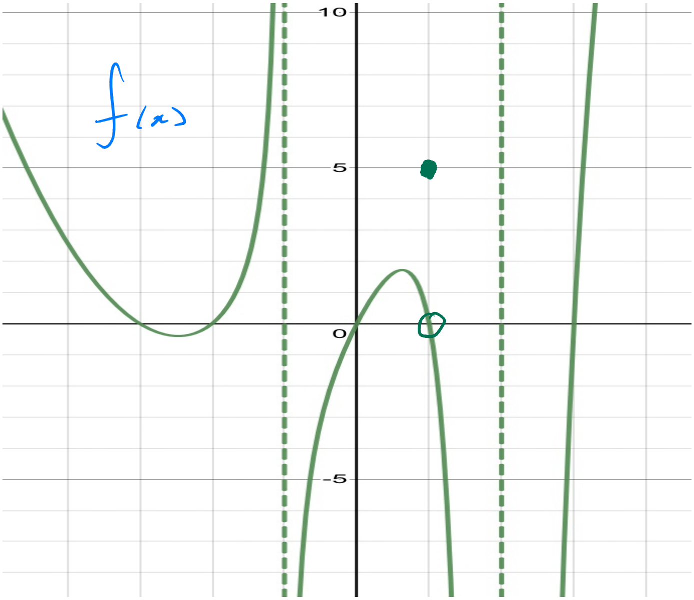
$\lim_{x \to -3^-} f(x) = 0$

$\lim_{x \to -3^+} f(x) = 1.5$

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

$\lim_{x \to 1^-} f(x) = -\infty$, $\lim_{x \to 1^+} f(x) = +\infty$

$\lim_{x \to 1} f(x) = DNE$



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

$$\lim_{x \to 2^+} f(x) = -\infty$$

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

$f(1) = 5$, but

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