Mon 25 Jan

- comp.uark.edu/~ashleykw/Cal1Spring2016/cal1spr16.html
  Course website. All information is here, including a link to MLP, lecture slides, administrative information, etc. You should have already seen the **syllabus** by now.
- MyLabsPlus (MLP) has the graded homework. Solutions to Quizzes and Drill exercises will be posted there, under "Menu → Course Tools → Document Sharing".

Mon 25 Jan (cont.)

- Lecture slides are available on the course website. I'll try to have the week's slides posted in advance but the individual lectures might not be posted until right before class. **Don't try to take notes from the slides.** Instead, print out the slides beforehand or else follow along on your tablet/phone/laptop. You should, however, take notes when we do exercises during lecture. Suggestion: When printing the slides, put more than one slide per page and print double-sided.

Mon 25 Jan (cont.)

- For old Calculus materials, see the parent page `comp.uark.edu/~ashleykw` and look for links under "Previous Semesters".
- GET YOUR CLICKER
- Note: There is no Blackboard for this course.
- Stay on top of the MLP! First deadline is coming up. Don't wait till the last minute.
- MLP issues...
- Quiz 1 is due in drill tomorrow. See MLP for a copy.

Additional (Algebra) Techniques

When direct substitution (a.k.a. plugging in a) fails try using algebra:

- Factor and see if the denominator cancels out.

Example

$$\lim_{t \to 2} \frac{3t^2 - 7t + 2}{2 - t}$$

- Look for a common denominator.

Example

$$\lim_{h \to 0} \frac{\frac{1}{5+h} - \frac{1}{5}}{h}$$

Exercise

Evaluate $\lim_{s \to 3} \dfrac{\sqrt{3s+16}-5}{s-3}$.

Another Technique: Squeeze Theorem

This method for evaluating limits uses the relationship of functions with each other.

Theorem (Squeeze Theorem)

Assume $f(x) \leq g(x) \leq h(x)$ *for all values of* x *near* a*, except possibly at* a*, and suppose*

$$\lim_{x \to a} f(x) = \lim_{x \to a} h(x) = L.$$

Then since g *is always between* f *and* h *for* x*-values close enough to* a*, we must have*

$$\lim_{x \to a} g(x) = L.$$

Example

(a) Draw a graph of the inequality

$$-|x| \leq x^2 \ln\left(x^2\right) \leq |x|.$$

(b) Compute $\lim_{x \to 0} x^2 \ln\left(x^2\right)$.

2.3 Book Problems

12-30 (every 3rd problem), 33, 39-51 (odds), 55, 57, 61-67 (odds)

In general, review your algebra techniques, since they can save you some headache.

§2.4 Infinite Limits

We have examined a number of laws and methods to evaluate limits.

Question

Consider the following limit:

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

How would you evaluate this limit?

In the next two sections, we examine limit scenarios involving infinity. The two situations are:

- **Infinite limits:** as x (i.e., the independent variable) approaches a finite number, y (i.e., the dependent variable) becomes arbitrarily large or small

$$\text{looks like: } \lim_{x \to \text{number}} f(x) = \pm\infty$$

- **Limits at infinity:** as x approaches an arbitrarily large or small number, y approaches a finite number

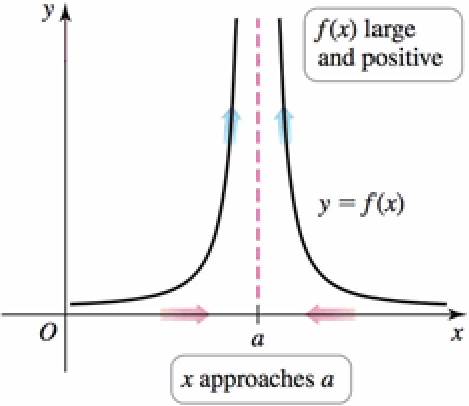
$$\text{looks like: } \lim_{x \to \pm\infty} f(x) = \text{number}$$

Definition (positively infinite limit)

Suppose f is defined for all x near a. If $f(x)$ grows arbitrarily large for all x sufficiently close (but not equal) to a, we write

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

and say **the limit of** $f(x)$ **as** x **approaches** a **is infinity**.

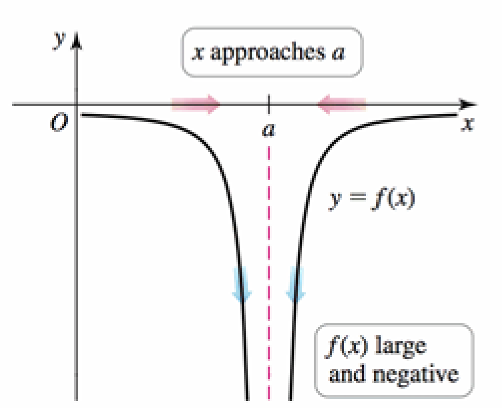

y
f(x) large
and positive
y = f(x)
O
a
x
x approaches a

Definition (negatively infinite limit)

Suppose f is defined for all x near a. If $f(x)$ is negative and grows arbitrarily large in magnitude for all x sufficiently close (but not equal) to a, we write

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

and say **the limit of** $f(x)$ **as** x **approaches** a **is negative infinity**.


y
x approaches a
O
a
x
y = f(x)
f(x) large
and negative

The definitions work for one-sided limits, too.

Exercise

Using a graph and a table of values, given $f(x) = \dfrac{1}{x^2 - x}$, determine:

(a) $\lim\limits_{x \to 0^+} f(x)$

(b) $\lim\limits_{x \to 0^-} f(x)$

(c) $\lim\limits_{x \to 1^+} f(x)$

(d) $\lim\limits_{x \to 1^-} f(x)$

Definition

Suppose a function f satisfies at least one of the following:

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

Then the line $x = a$ is called a **vertical asymptote** of f.

Exercise

Given $f(x) = \dfrac{3x-4}{x+1}$, determine, analytically (meaning using "number sense" and without a table or a graph),

(a) $\lim\limits_{x \to -1^+} f(x)$

(b) $\lim\limits_{x \to -1^-} f(x)$

Here is a common way you can summarize your solutions involving limits:

"Since the numerator approaches (#) and the denominator approaches 0, and is (positive/negative), and since (analyze signs here), (insert limit problem)=($+\infty$ / $-\infty$)."

Remember to check for factoring –

Exercise

(a) What is/are the vertical asymptotes of

$$f(x) = \frac{3x^2 - 48}{x + 4}?$$

(b) What is $\lim_{x \to -4} f(x)$? Does that correspond to your earlier answer?

2.4 Book Problems

7-10, 15, 17-23, 31-34, 44-45