Calculus I - Lecture 1

Dr. Adam Larios

University of Nebraska-Lincoln

Monday, August 21, 2017

Getting Ready

- Read the syllabus and course policies and let us know (instructor or TA) if you have any questions

Getting Ready

- Read the syllabus and course policies and let us know (instructor or TA) if you have any questions
- Complete your to-do list: 1) canvas, 2) webwork, 3) clickers.

Getting Ready

- Read the syllabus and course policies and let us know (instructor or TA) if you have any questions
- Complete your to-do list: 1) canvas, 2) webwork, 3) clickers.
- Read the section of the textbook before each class

Getting Ready

- Read the syllabus and course policies and let us know (instructor or TA) if you have any questions
- Complete your to-do list: 1) canvas, 2) webwork, 3) clickers.
- Read the section of the textbook before each class
- We will cover and discuss most of the concepts in lecture, but we will not have time for everything. **It is your responsibility to read the entire section in the book**, unless you are advised otherwise.

Getting Ready

- Read the syllabus and course policies and let us know (instructor or TA) if you have any questions
- Complete your to-do list: 1) canvas, 2) webwork, 3) clickers.
- Read the section of the textbook before each class
- We will cover and discuss most of the concepts in lecture, but we will not have time for everything. **It is your responsibility to read the entire section in the book**, unless you are advised otherwise.
- **Form study groups.** Exchange contact information (email, phone number, facebook info, favorite coffee shop or study place, etc...). Meet with your study group on a regular basis. Take 1 minute **now**.

Getting Ready

- Read the syllabus and course policies and let us know (instructor or TA) if you have any questions
- Complete your to-do list: 1) canvas, 2) webwork, 3) clickers.
- Read the section of the textbook before each class
- We will cover and discuss most of the concepts in lecture, but we will not have time for everything. **It is your responsibility to read the entire section in the book**, unless you are advised otherwise.
- **Form study groups.** Exchange contact information (email, phone number, facebook info, favorite coffee shop or study place, etc...). Meet with your study group on a regular basis. Take 1 minute **now**.
- Plan to spend several hours a week in this course; as with everything make sure that you have a great support system along the way! (me, TA, MRC, peers, web resources, etc.)

Why all this work? Goals for the course

- The main goal for the course is for YOU to achieve a high proficiency in Calculus techniques which are widely used in applications ranging from engineering to biology to finance; really **everywhere**. Achieving this goal will be reflected in high success rate in passing the class!!!
- My personal goal is to help you have an enjoyable and meaningful experience in this course; to use the class time efficiently and effectively. Please contact me if you have any comments or suggestions, I really appreciate your feedback.

Grading

CRA	30 points
Gateway	70 points
Online Homework	120 points
Clickers	50 points
Regular Exams	300 points (100 points each)
Recitation participation	30 points
Online recitation problems	40 points
Quizzes	60 points (drop lowest 2)
Final	200 points
Total	900 points

Calculators

A graphing calculator can be useful for this course; models such as the TI-83, TI-84 and TI-86 have the range of functions that can help in exploring several concepts from the class. However, calculators **will not be permitted** during the CRA or Gateway exam. These exams will be designed so that a calculator will not be needed.

Cell Phones

As a courtesy to others, please turn off your cell phones, laptops, and similar devices when you come to class. Should you need to use your cell-phone you are welcome to step-out of the classroom.

Mathematics Resource Center

You are encouraged to visit with your instructors when you have questions about the material or the course and to use the Mathematics Resource Center (MRC) in Avery 13 as a meeting place for the course and as a resource for assistance. The hours for the MRC are MTWR 12:30–8:30 pm, Fri 12:30–2:30 pm, and Sun 1:00-5:00 pm.

Calculus Readiness Activity (CRA):

There is a mastery exam given on paper on **Wednesday, August 23** in recitation. This exam covers prerequisite material essential to your success in the course. There are 15 questions and if you have a score of 13 or better, you get full points for the CRA. If you do not pass on paper, then you can take it again online in the Learning Commons up to once per day until **September 6**. No calculators or cell-phones are permitted on the calculus readiness activity.

Gateway Exam:

This exam consists of 8 questions in which you are asked to find the derivative without using calculators, notes, or tables. You must get at least 7 questions completely right to pass, with no partial credit and no points awarded for less than a passing mark. You may repeat the exam up to once a day during the exam period. The Gateway exam will be given once in recitation during the week of **October 3**. Retakes will be given in the learning commons (student ID required) from **October 4** through **October 24**. No calculators or cell-phones are permitted on the gateway exam.

Exams:

Mid-term exams will be given on **September 21**, 6:30-8:00pm, **October 26**, 6:30-8:00pm, and **November 30**. The Final Exam will be given on **December 13** from 6pm to 8pm, at locations TBA. You are expected to take these exams at the scheduled time, with exceptions made for students who have a conflict with another scheduled exam or who have three or more finals on one day. Makeups should be arranged with Lori Mueller in Avery 203 as soon as possible. Under no circumstances will exams be given early. **You are not allowed to have on your person during exams any device that can access the internet or communicate in any way. Cellphones, smart watches, etc. should be put away in backpacks/purses.**

Clickers

- We will be using clickers for this class. If you have not purchased a clicker visit the bookstore today and pick one up.
- We will begin using clickers today in class. However, clicker grades will not be counted today, and I will also drop your lowest few scores.

Email:

Please, use email to contact me whenever you have a question. During regular business hours, I will respond as soon as I can, at most within 24 hours. However, I will respond to no email after 5:00 p.m. on weekdays, no email after noon on Saturday, and no email on Sunday.

Recitation

Recitation will be a time for you to work with your peers on specially designed problems aimed at helping you to deepen your understanding of the material you learn in class. Recitation is required and counts toward your grade. Should you need to miss a recitation you are expected to contact your recitation TA and let them know when and why you will be missing class. We expect you to spend the time in recitation talking about mathematics, working with your group-mates and deepening your understanding of the material. There is always more to learn, **don't be content to merely answer the question. Let your curiosity guide you, dig deep into the mathematics.** To encourage participation in recitation, your TA will assign participation points. *Should you miss recitation for any reason you will be expected to complete the worksheet on your own as well as handing the first five suggested problems from the textbook to the recitation TA within 72 hours of the scheduled recitation.*

Review of functions

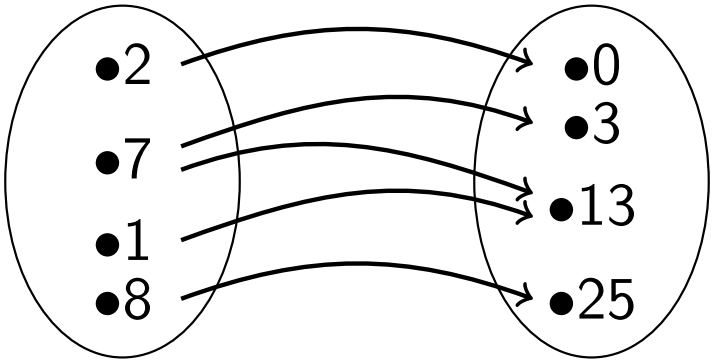
- The material of the course starts in Chapter 1 of the textbook. Today we will cover sections 1.1 and 1.3.
- **Definition.** A function is a relationship between an independent variable (input) and a dependent variable (output).

$$f(x) = \frac{1}{\sqrt{x+1}} \quad \text{OR :} \quad x \text{ (input)} \to x^2 + 5 \text{ output}$$

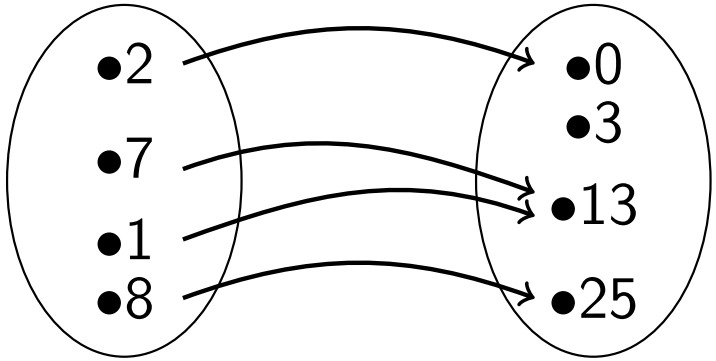
Domain = set of all valid inputs. For f the domain is $(-1, \infty)$.
Range = set of all possible outputs. For f the range is $(0, \infty)$.

Functions in abstract

This is not a function because the number 2 is sent to two different numbers in the range.

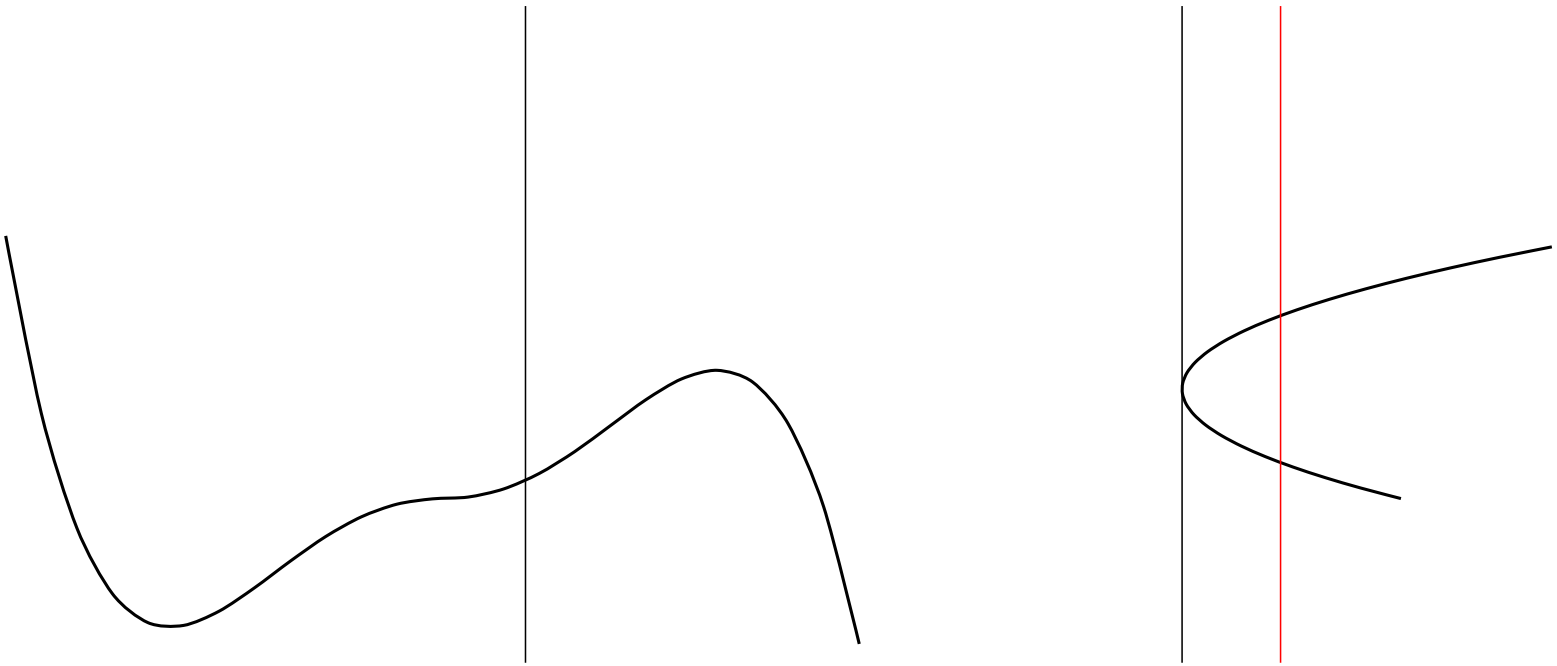


This is a function because each number is sent to only one number in the range.



The vertical line test

- to one value of x it should correspond only one value of $y = f(x)$
- a vertical line should intersect the graph of f exactly once over the domain of f

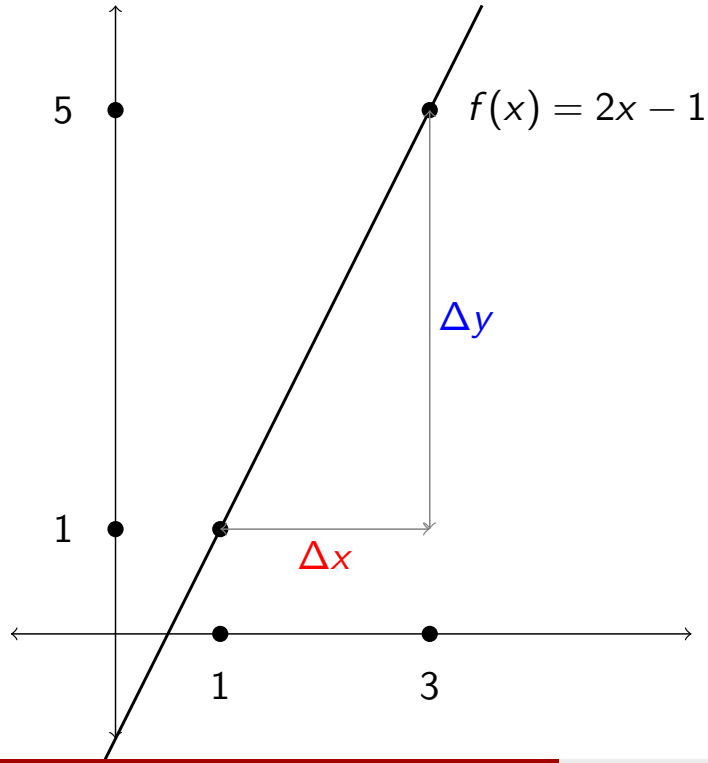


Linear functions

- All linear functions have the algebraic form:

$$f(x) = mx + b, \quad m, b \in \mathbb{R}.$$

The parameter m =slope of the line; b =vertical intercept. Indeed, all graphs of linear functions are ... lines.



$$\begin{aligned}
\text{Slope} &= \frac{\text{rise}}{\text{run}} \\
&= \frac{\Delta y}{\Delta x} \\
&= \frac{f(3) - f(1)}{3 - 1} \\
&= \frac{5 - 1}{3 - 1} \\
&= 2 \\
&= \text{ coefficient of } x \text{ in the equation.}
\end{aligned}$$

Clicker Question

Which of the following tables could represent linear functions?

a)

x	$f(x)$
1	1
2	2
3	4
4	8

b)

x	$f(x)$
1	-12
2	-9
3	-6
4	-3

c)

x	$f(x)$
1	10
2	9
3	6
4	3

d)

x	$f(x)$
1	12
2	14
3	16
4	18

Function Properties

(if we have time)

Monotonicity

- f is increasing if its values $f(x)$ increase as x increases
- f is decreasing if its values $f(x)$ decrease as x increases
- f is monotone if it is either increasing or decreasing

Examples:

$$f(x) = \sin x, \quad x \in [0, \tfrac{\pi}{2}]$$

$$g(x) = e^x, \quad h(x) = x^3 \quad \text{on } \mathbb{R}$$

Clicker Question

Which of the following functions is *not* increasing?

a) The elevation of a river as a function of distance from its mouth.

b) The length of a single strand of hair as a function of time.

c) The height of a person from age 0 to 80.

d) The height of a redwood tree as a function of time.

Concavity

- f is concave up (convex) if its graph is bent upwards ("holding water")
- f is concave down if its graph is bent downwards ("shedding water")

Examples

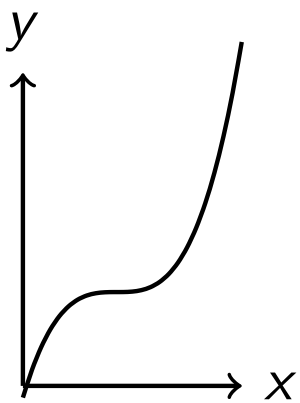
$$f(x) = \sin x \text{ is concave down on } [0, \tfrac{\pi}{2}]$$

$$g(x) = e^x \text{ is concave up on } \mathbb{R}.$$

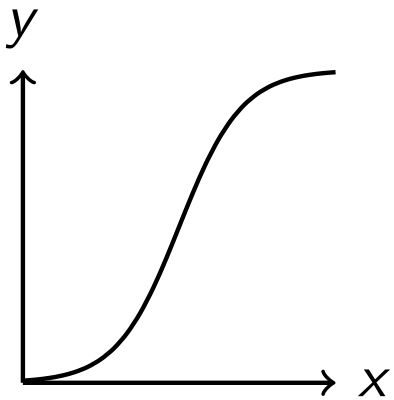
Clicker Question

Which of the graphs represents the position of an object that is speeding up and then slowing down?

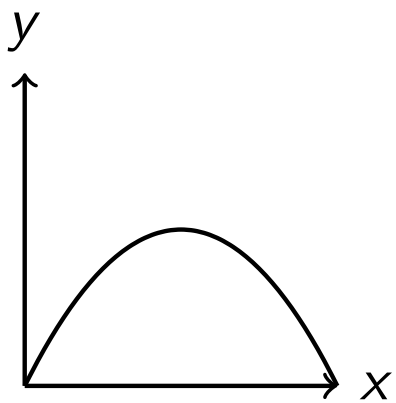
a)



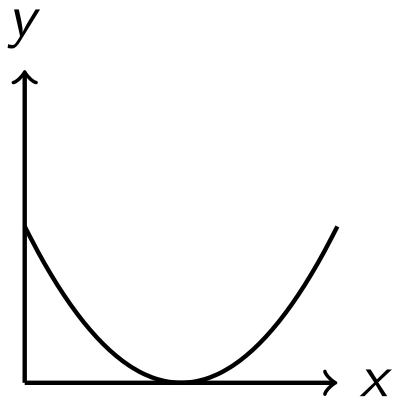
b)



c)



d)



Proportionality

Directly Proportional

We say y is directly proportional to x if there is a nonzero constant k such that, $y = kx$. This k is called the constant of proportionality.

Inversely Proportional

We say that y is inversely proportional to x if y is proportional to the reciprocal of x, that is, $y = k/x$ for a nonzero constant k.

Inverses

Invertible

A function has an inverse if (and only if) its graph intersects any horizontal line at most once. If a function has an inverse, we say it is invertible.

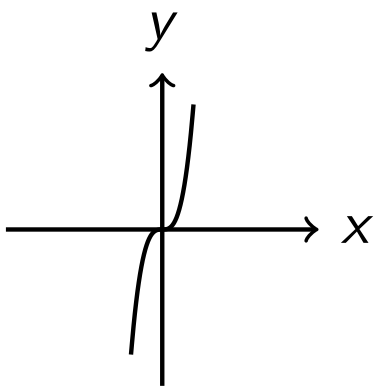
Inverse Function

If the function f is invertible, its inverse is defined as follows $f^{-1}(y) = x$ means $y = f(x)$.

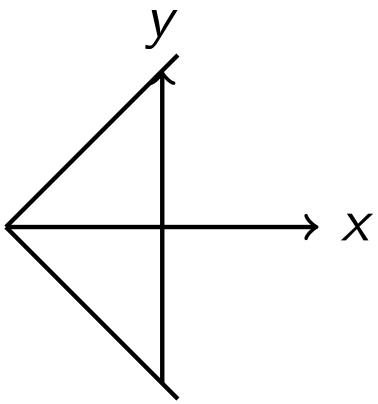
Clicker Question

Which of the following could be graphs of functions that have inverses?

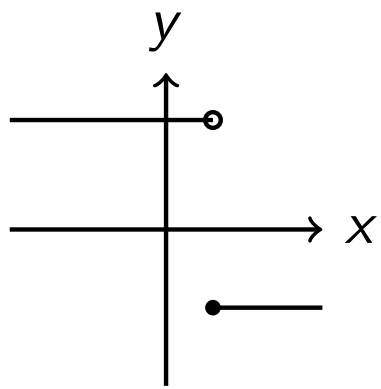
a)



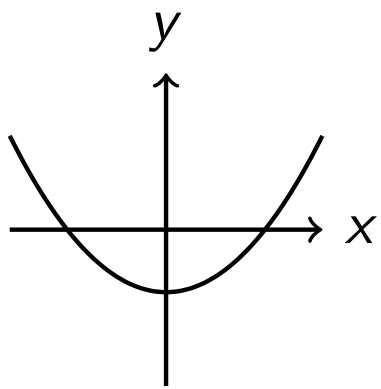
b)



c)



d)



Clicker Question

Given the values in the table evaluate $f(g(1))$.

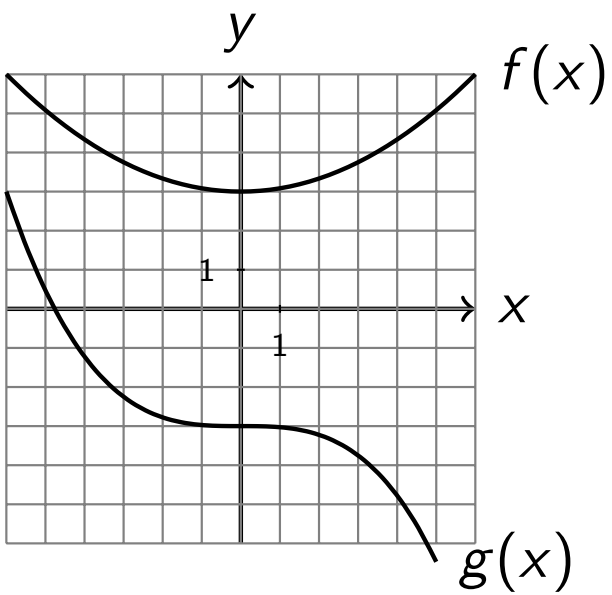
Table : Function Values

x	$f(x)$	$g(x)$
-2	1	-1
-1	2	1
0	-2	2
1	2	0
2	-1	-2

a) -2
b) -1
c) 0
d) 1
e) 2

Clicker Question

Given the values in the graph evaluate $g(f(0))$.



a) -3.6

b) -2.2

c) 0

d) 3.6

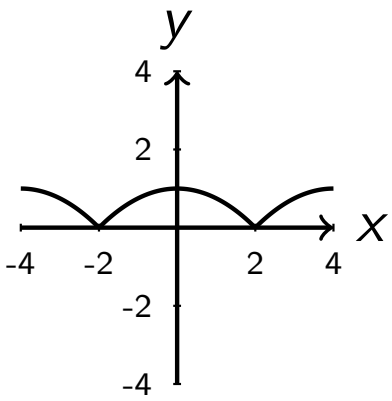
e) undefined

Shifts and Stretches

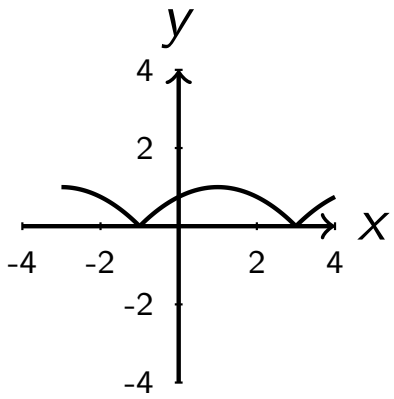
- Multiplying a function by a constant, c, stretches the graph vertically (if $c > 1$) or shrinks the graph vertically (if $0 < c < 1$)
- A negative sign (if $c < 0$) reflects the graph about the x-axis, in addition to shrinking or stretching.
- Replacing y by $(y\,k)$ moves a graph up by k (down if k is negative).
- Replacing x by $(x\,h)$ moves a graph to the right by h (to the left if h is negative).

Clicker Question

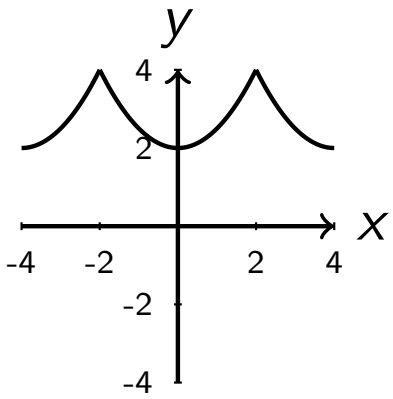
The graph given is that of $y = f(x)$. Which could be a graph of $cf(x)$?



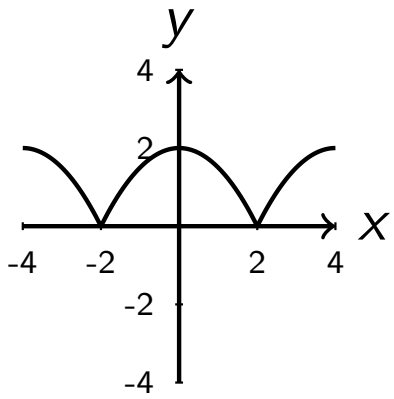
a)



b)

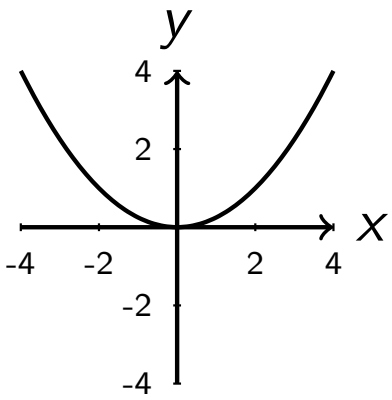


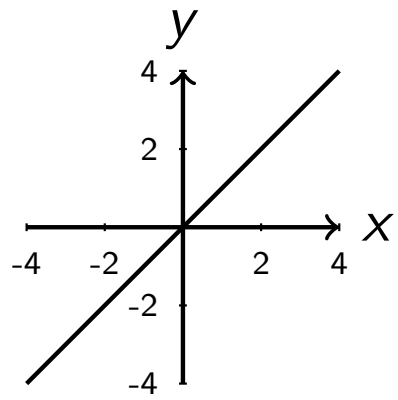
c)



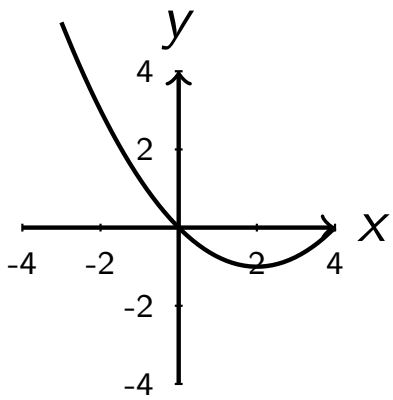
Clicker Question

Which of the following graphs might represent a function that is the sum of the functions represented in the graphs below?

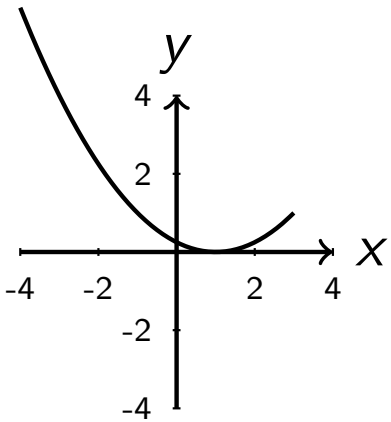




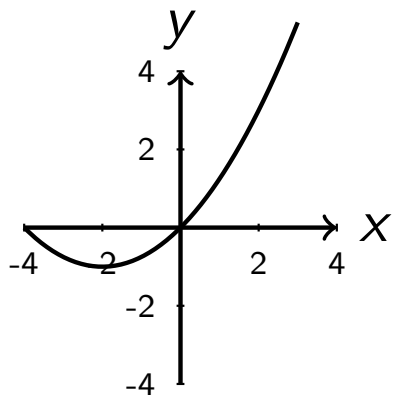
a)



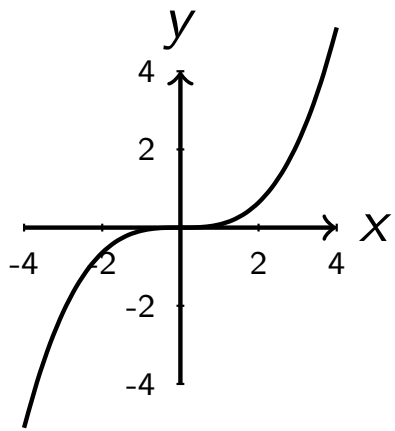
b)



c)



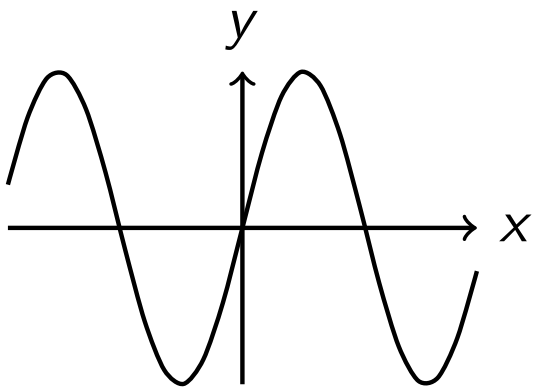
d)



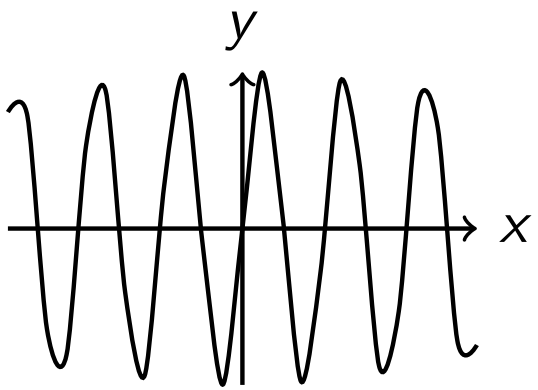
Clicker Question

Which of the graphs might represent the graph of $y = \sin(2x)$ given that the other functions represented are $y = \sin(x)$, $y = \sin(3x)$, $y = \cos(x)$?

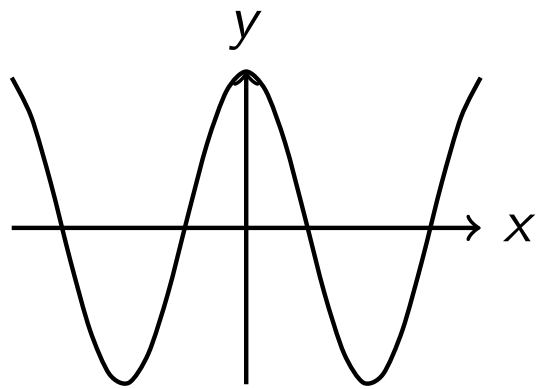
a)



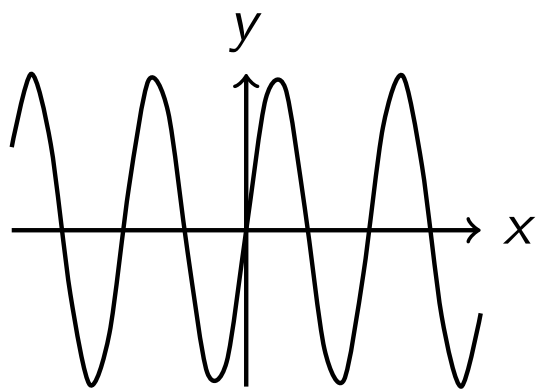
b)



c)



d)



Wrapping up

- What is a function? How do we test for it?

Wrapping up

- What is a function? How do we test for it?
- We reviewed linear functions, slope, and certain characteristics of functions:
  Monotonicity, Concavity, Proportionality, Inverses.

Wrapping up

- What is a function? How do we test for it?
- We reviewed linear functions, slope, and certain characteristics of functions:
  Monotonicity, Concavity, Proportionality, Inverses.
- Work on the suggested problems from section 1.1 (and 1.3) by Wednesday (from syllabus and webwork).

Wrapping up

- What is a function? How do we test for it?
- We reviewed linear functions, slope, and certain characteristics of functions:
  Monotonicity, Concavity, Proportionality, Inverses.
- Work on the suggested problems from section 1.1 (and 1.3) by Wednesday (from syllabus and webwork).
- Read sections 1.2 - 1.4 before lecture on Wednesday.

Wrapping up

- What is a function? How do we test for it?
- We reviewed linear functions, slope, and certain characteristics of functions:
  Monotonicity, Concavity, Proportionality, Inverses.
- Work on the suggested problems from section 1.1 (and 1.3) by Wednesday (from syllabus and webwork).
- Read sections 1.2 - 1.4 before lecture on Wednesday.
- Register and bring your clickers to lecture on Wednesday!

Wrapping up

- What is a function? How do we test for it?
- We reviewed linear functions, slope, and certain characteristics of functions:
  Monotonicity, Concavity, Proportionality, Inverses.
- Work on the suggested problems from section 1.1 (and 1.3) by Wednesday (from syllabus and webwork).
- Read sections 1.2 - 1.4 before lecture on Wednesday.
- Register and bring your clickers to lecture on Wednesday!

Don't stare at the sun, but do stare at your Calculus textbook!