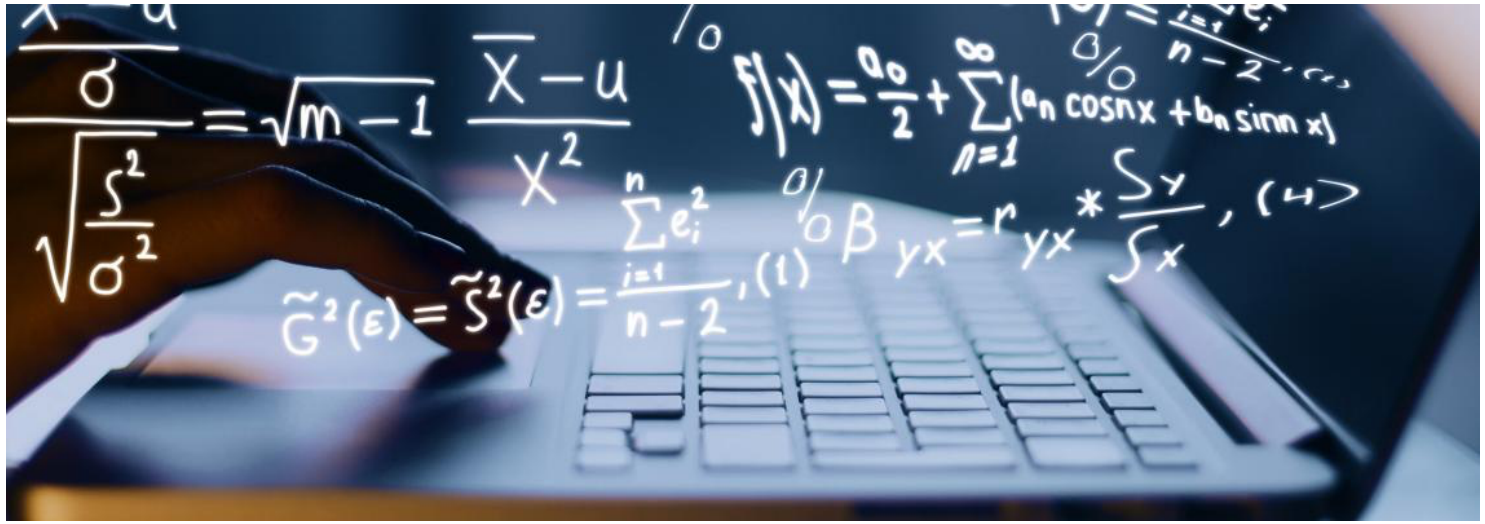
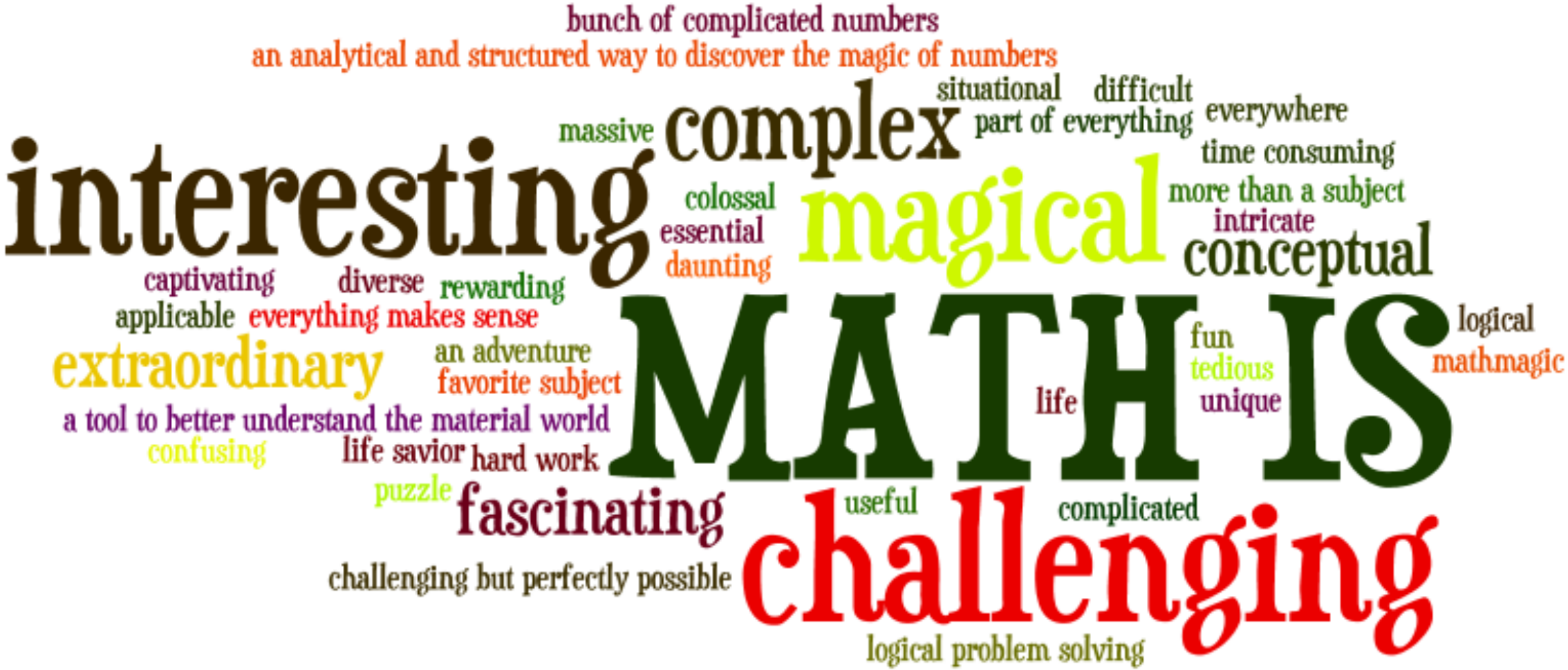
Teaching Mathematics using OER, ZTC, and Technology

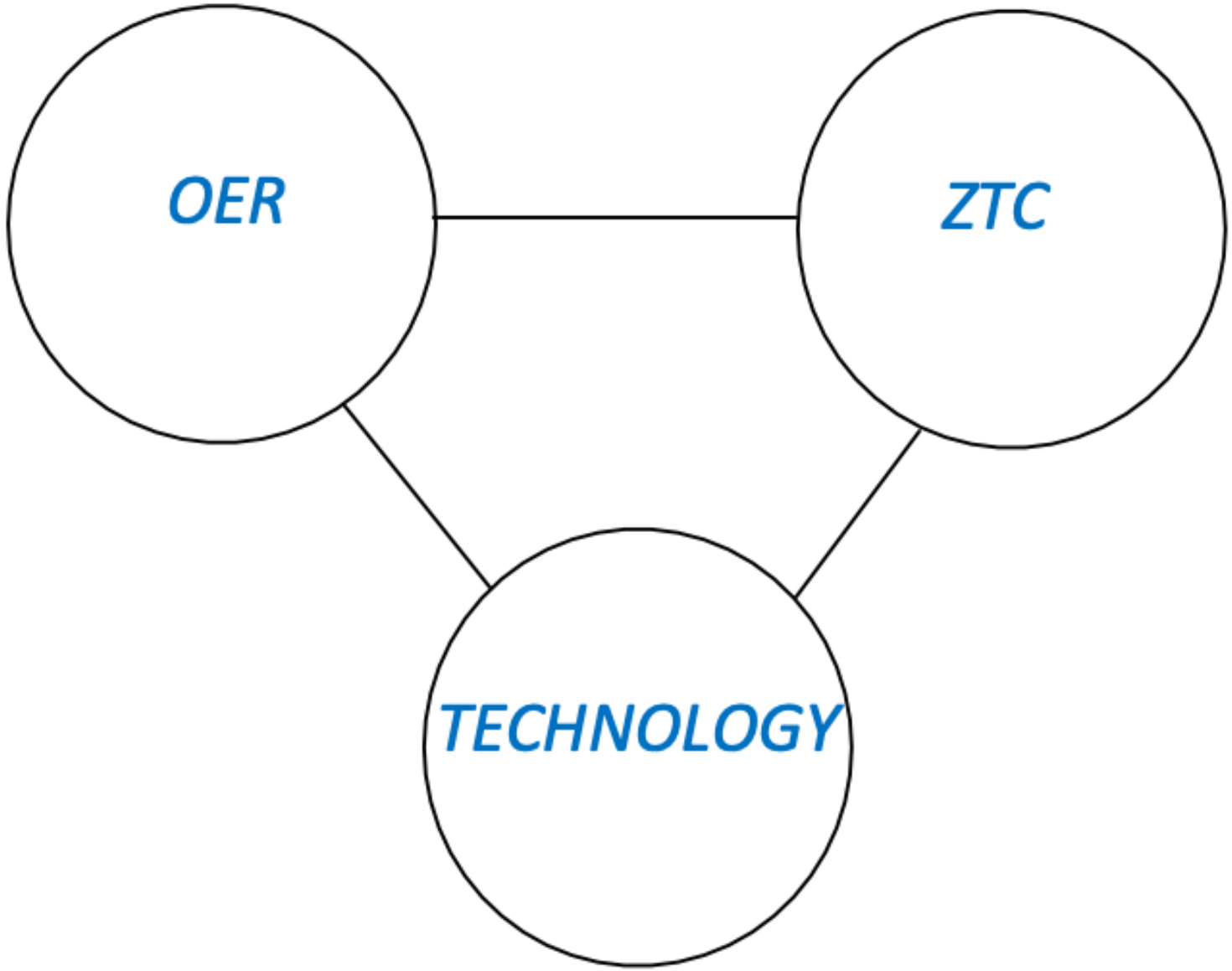


Now we can!

By Ivan Retamoso Ph.D. BMCC



How can we teach Mathematics such that all students are given a fair chance to learn regardless of their financial status?


OER
ZTC
TECHNOLOGY

Why do I use OER/ZTC and Technology?

- My students have access to all course materials from day one.
- OER/ZTC are, partly or totally, adaptable and customizable. I can share, remix, transform, and build upon the content.
- As a professor, I have free access to faculty resources, such as Test-Banks, assignments, solutions to homework problems, etc.
- The data is recorded and can be used for future data analysis.
- OER/ZTC lead to increase financial and academic student success.

Zero Cost TEXTBOOK FROM Openstax

www.Openstax.org

Math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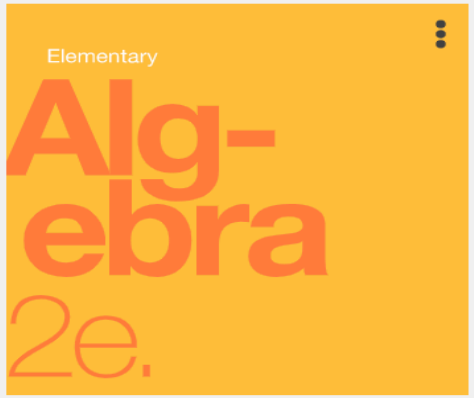
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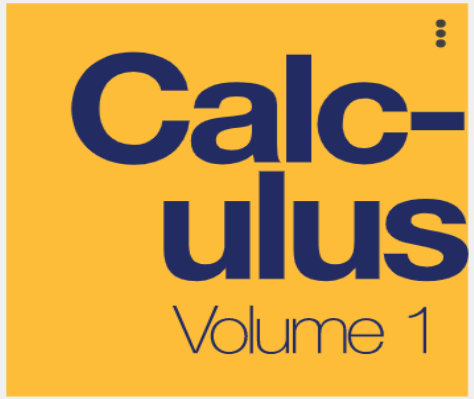
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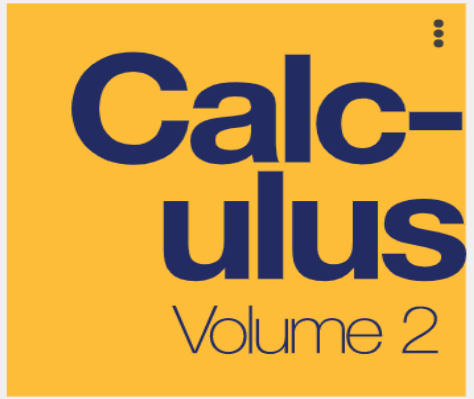
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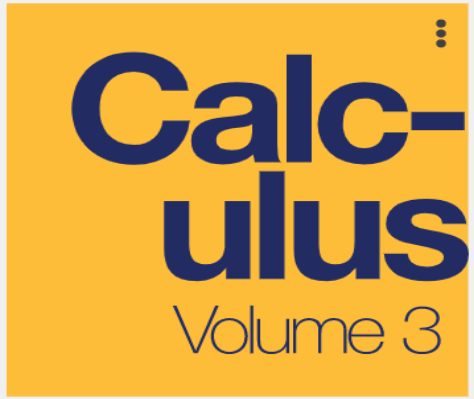
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Introductory
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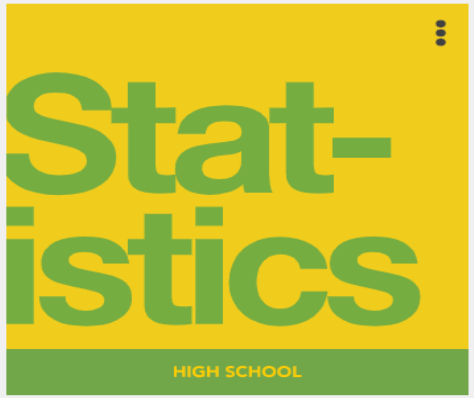
Stat-
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College
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with Corequisite
Support

Calculus

Volume 1

Book details | Instructor resources | Student resources

Academic freedom. No catch.

Access free resources integrated with your book. Sign up for an account to access locked content.

Resources for taking your course online

Canvas Course Cartridge

The California Community Colleges' Online Education Initiative created a course cartridge for this title to integrate your OpenStax books and resources into the Canvas learning management system. Download your cartridge from the Canvas Commons and work with your campus administrator to add to your course.

Go

Blackboard Course Cartridge

San Jacinto College created a course cartridge for this title to integrate your OpenStax books into the Blackboard learning management system. Download this file and work with your campus Blackboard administrator to add to your course.

Download

OPENSTAX TEXBOOK IMPORTED TO BLACKBOARD

OpenStax - Calculus Volume 1 Full Textbook

- **Preface**
- **Functions and Graphs**
- **Limits**
- **Derivatives**
- **Applications of Derivatives**
- **Integration**

2020 Fall Term (1) Analytic Geometry and Calculus I MAT 301 0516[66450] (Borough of Manhattan CC)

- Announcements
- Course Information
- Course Content and Assignments (start here)
- MAPLE Lab Assignments
- Discussion Board
- Collaborate
- Contact Professor
- E-learning Orientation
- Help and Resources
- Course Dashboard
- Tools
- CALCULUS I TEXTBOOK
- WEBWORK (Homework)
- OUR WEBSITE
- LECTURE NOTES
- RECORDED LECTURES
- Free BMCC Online Tutoring
- Reviews for Exams
- EXAMS
- DESMOS Activities

Derivatives

- **Introduction**
- **Key Terms**
- **Defining the Derivative**
- **The Derivative as a Function**
- **Differentiation Rules**
- **Derivatives as Rates of Change**
- **Derivatives of Trigonometric Functions**

EXAMPLE 4.32

Maximizing the Area of a Garden

A rectangular garden is to be constructed using a rock wall as one side of the garden and wire fencing for the other three sides (Figure 4.62). Given 100 ft of wire fencing, determine the dimensions that would create a garden of maximum area. What is the maximum area?

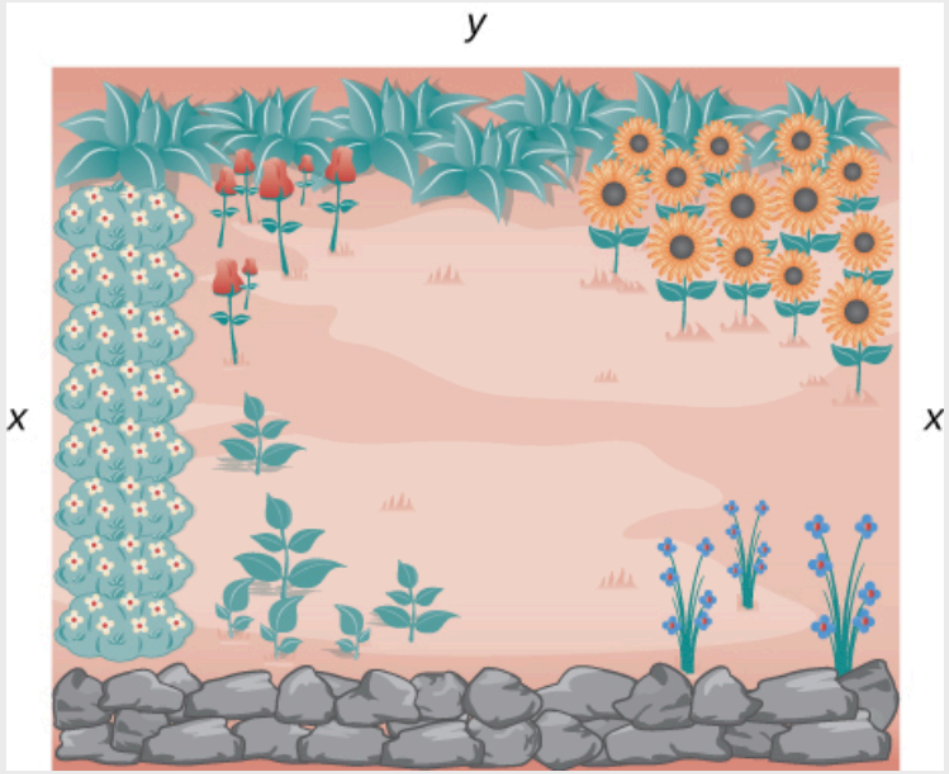


Figure 4.62 We want to determine the measurements x and y that will create a garden with a maximum area using 100 ft of fencing.

[Show Solution]

Rule: The Chain Rule

Let f and g be functions. For all x in the domain of g for which g is differentiable at x and f is differentiable at $g(x)$, the derivative of the composite function

$$h(x) = (f \circ g)(x) = f(g(x))$$

is given by

$$h'(x) = f'(g(x))\, g'(x). \tag{3.17}$$

Alternatively, if y is a function of u, and u is a function of x, then

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}.$$

Note: The Chain Rule

Rule: Power Rule for Composition of Functions

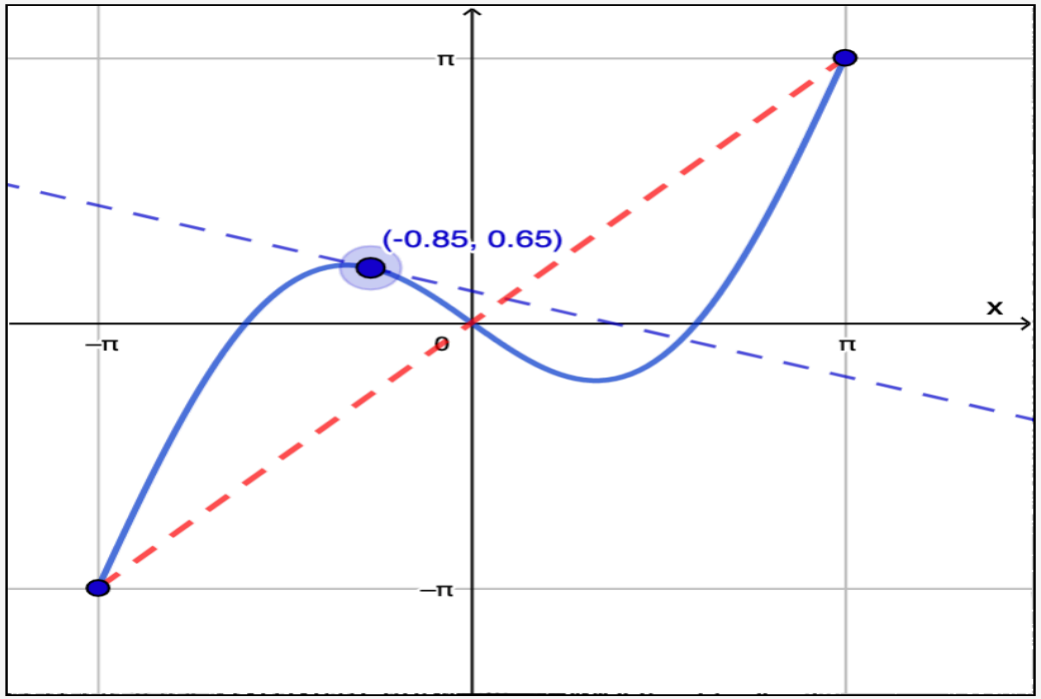
For all values of x for which the derivative is defined, if

$$h(x) = (g(x))^n.$$

Zero cost Homework System: WEBWORK

http://webwork.bmcc.cuny.edu/webwork2/2020_Fall_MAT206_0511_Retamoso/

http://webwork.bmcc.cuny.edu/webwork2/2020_Fall_MAT301_0516_Retamoso/



return this question to its initial state

Consider the applet above.

The blue graph shows the function f that is continuous on $[-\pi, \pi]$ and differentiable on $(-\pi, \pi)$.

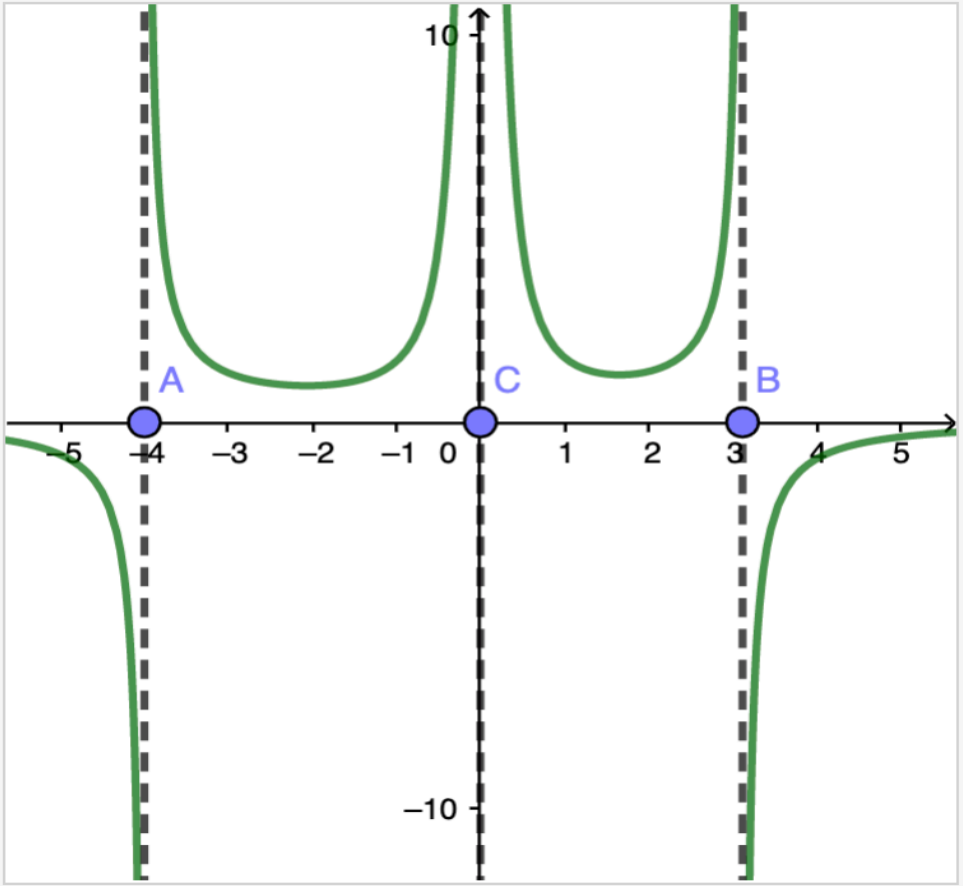
Let $a = -\pi$ and $b = \pi$.

Move the point along the graph to find all the numbers c between a and b so that

$$f'(c) = \frac{f(b) - f(a)}{b - a}$$

List your answers:

WEBWORK Question using "Applet" Related to The Mean Value Theorem

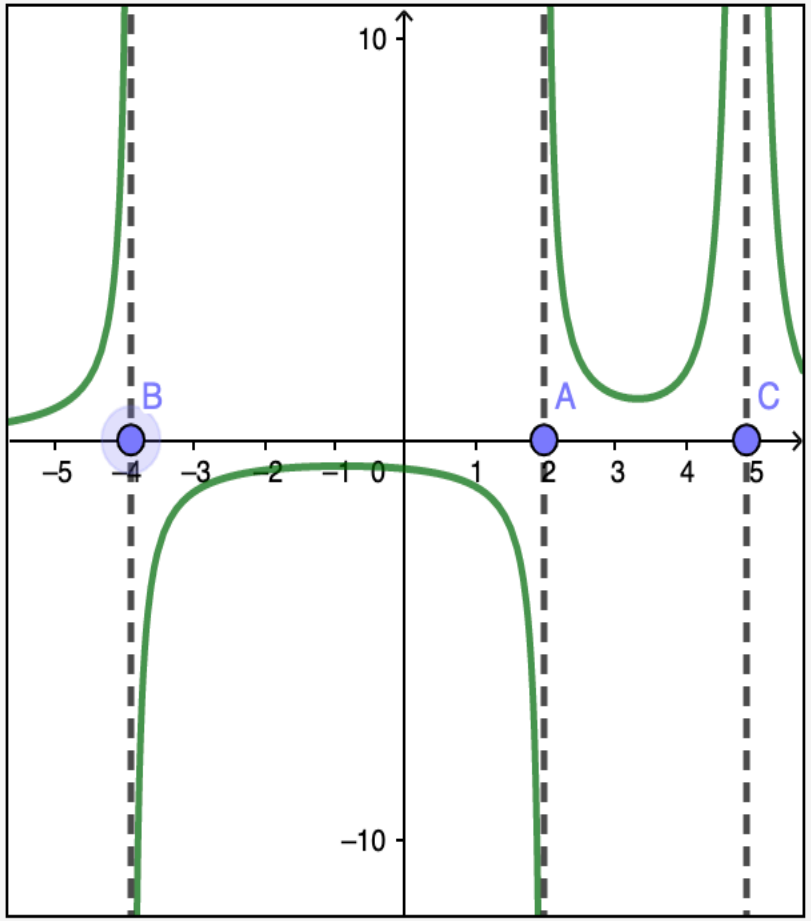


return this question to its initial state

Move the points A, B and C to construct the graph of the function below.

$$f(x) = \frac{1}{x-2} - \frac{1}{x+4} + \frac{1}{(x-5)^2}$$

Click the submit answers button when you are done.

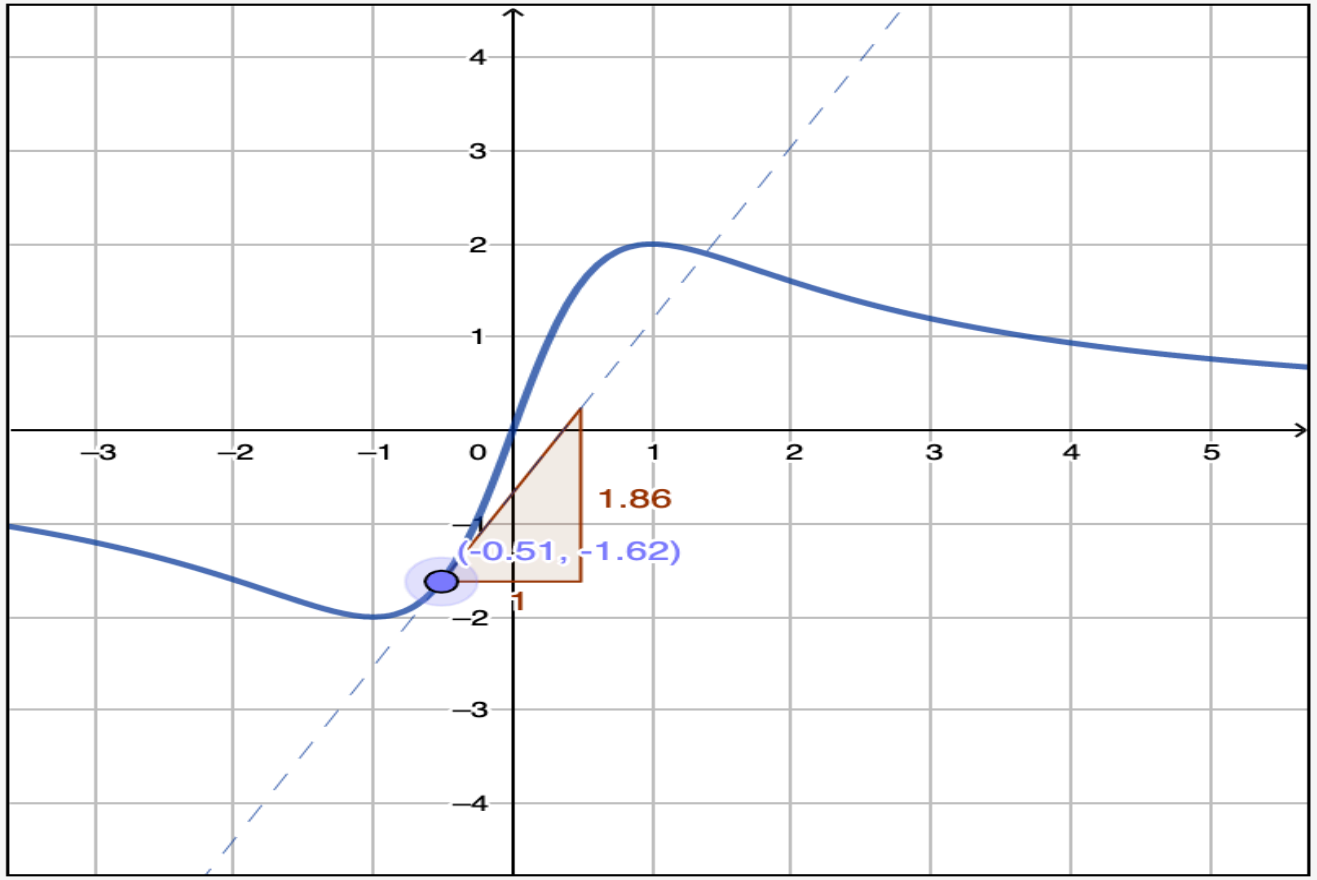


return this question to its initial state

Move the points A, B and C to construct the graph of the func

$$f(x) = \frac{1}{x-2} - \frac{1}{x+4} + \frac{1}{(x-5)^2}$$

Click the submit answers button when you are done. run SetC



return this question to its initial state

Consider the applet above.

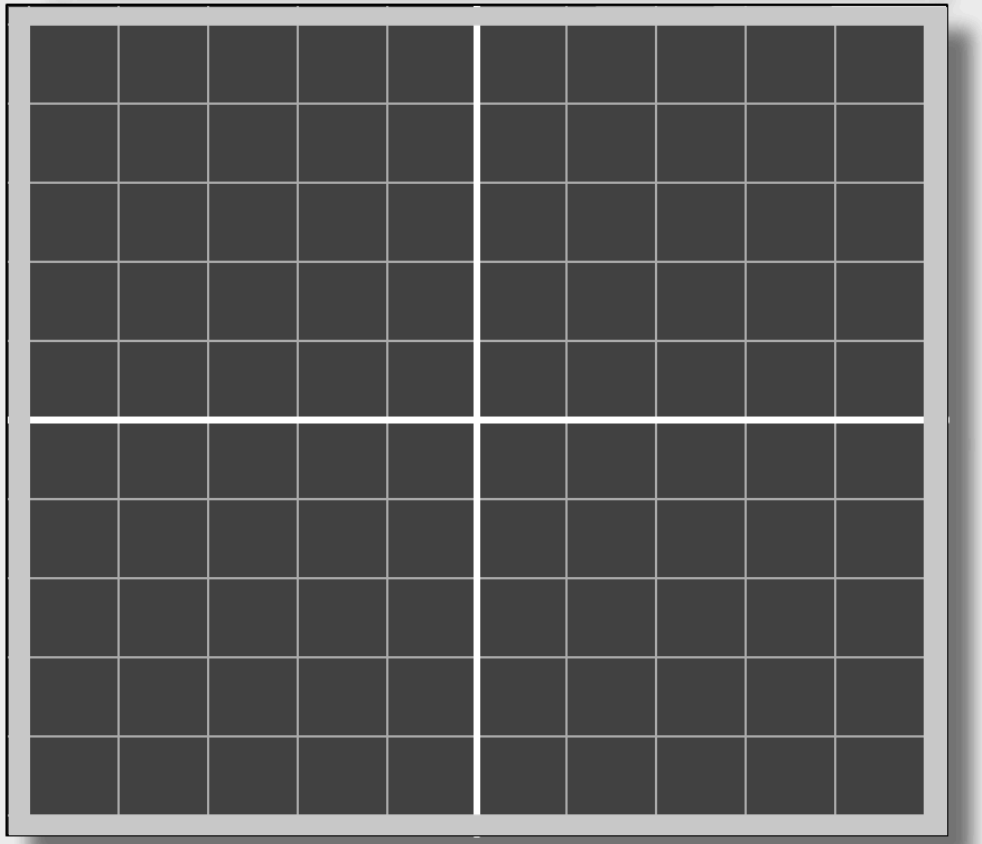
The grapgh of $y = f(x)$ is in blue.

Move the point along the graph to compute the slope of the graph.

List all the points-of-inflection.

WEBWORK Question using "Applet" Related to Inflection Points

Draw from left to right across the board. Sketch a positive function with a negative derivative.



ERASE

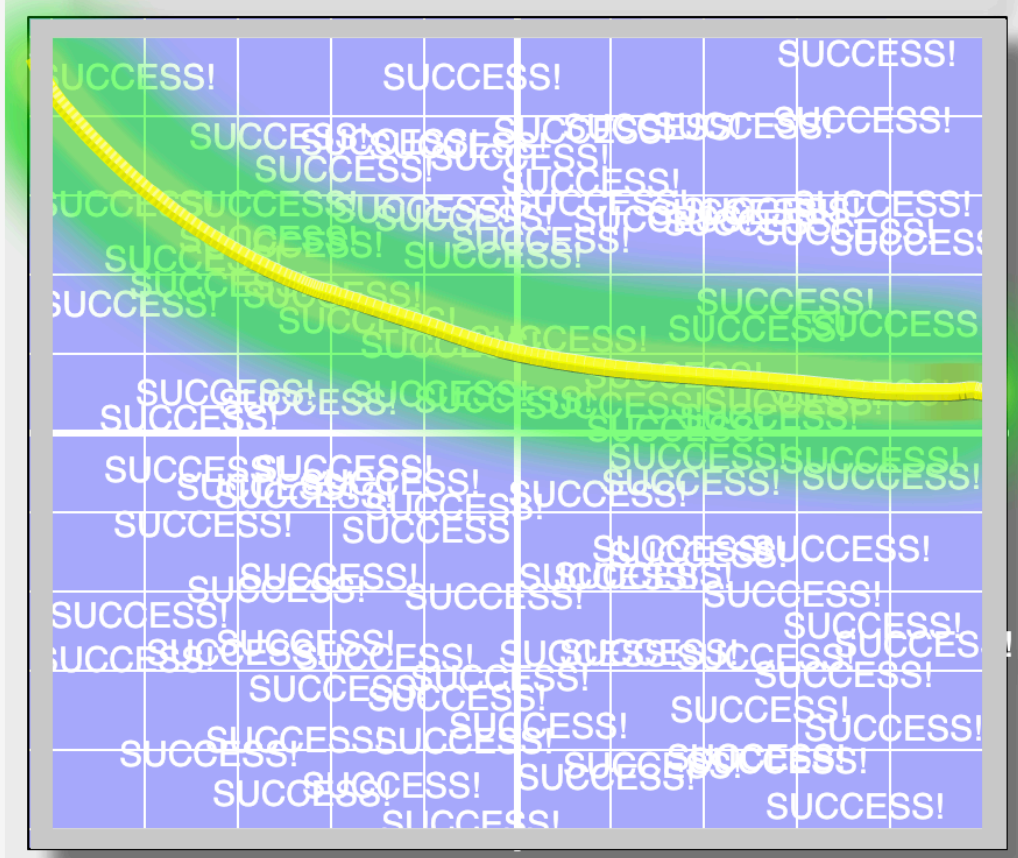
SCORE

SMOOTH

This applet makes use of graphing classes developed by B. Kaskosz and D.Ensley, published at flashandmath.com.
This work was supported in part by the National Science Foundation under grant DUE-0941388.

Sketch a positive function with a negative derivative.
Press 'score' to check your work. When it is correct, press 'submit answers'.
If your graph is close to correct (not much marked red) pressing the 'SMOOTH' butto

Place the cursor over an item to see context sensitive instructions.



ERASE

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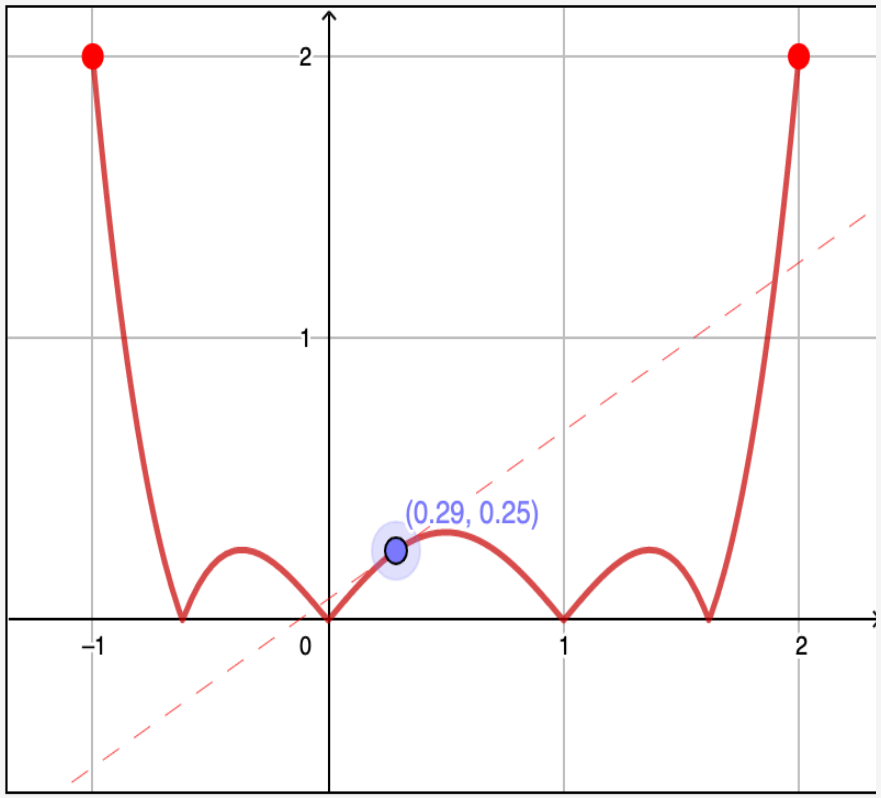


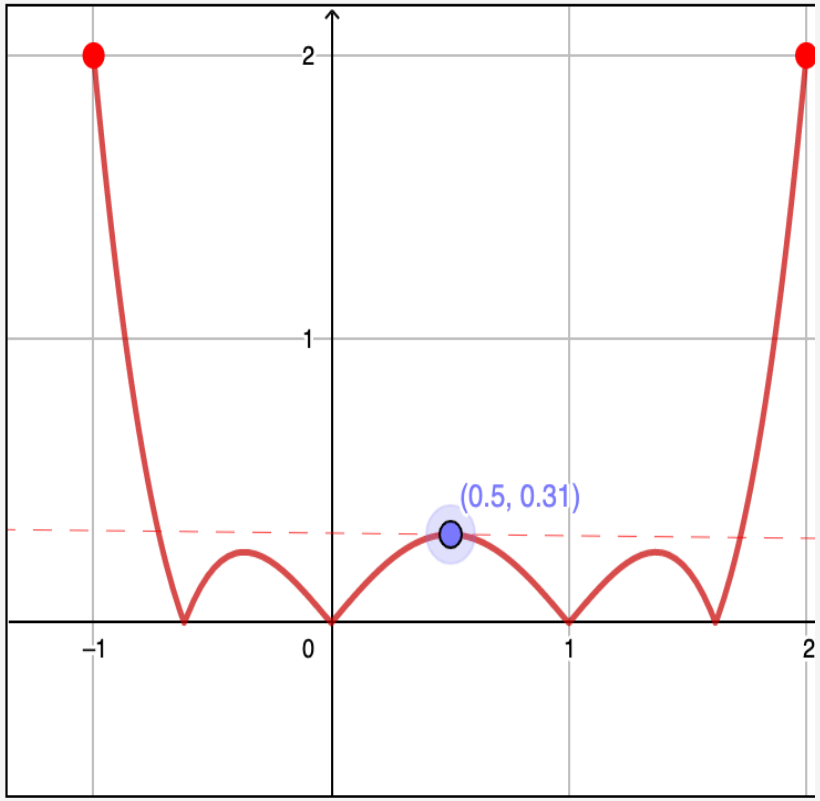
return this question to its initial state

Consider the applet above.

The graph shown is a continuous function on the interval [-1,2].

Move the point along the graph to find all the critical numbers.

List all the critical numbers:



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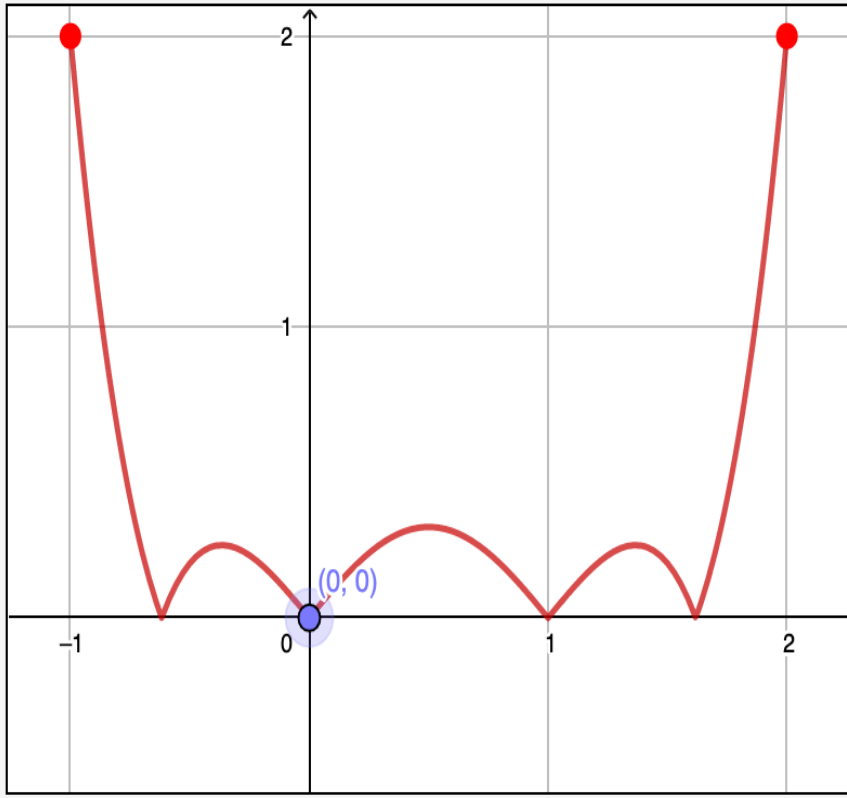
Move the point along the graph to find all the critical numb

List all the critical numbers:



return this question to its initial state

Consider the applet above.

The graph shown is a continuous function on the interval [-1,2]

Move the point along the graph to find all the critical numbers.

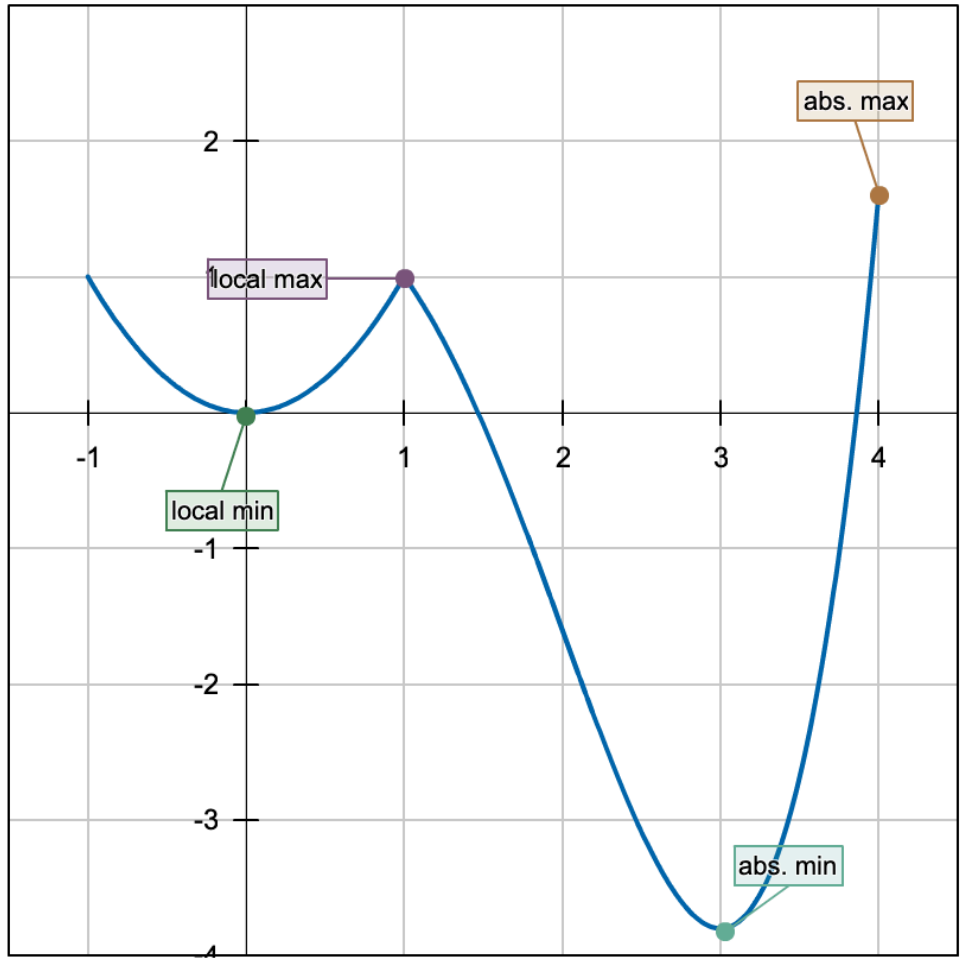
List all the critical numbers:

4.3 Increasing and Decreasing and the First Derivative Test: Problem 18

Previous Problem | Problem List | Next Problem

This set is **visible to students.**

(1 point) **local/Label/appletDemonstrationProblems/LabelingPointsCustom.pg**



drag point | delete point

label critical points

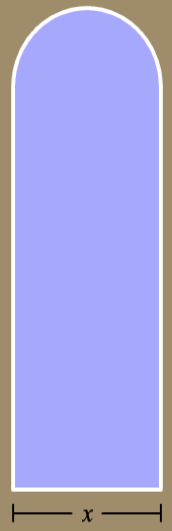
label local minima

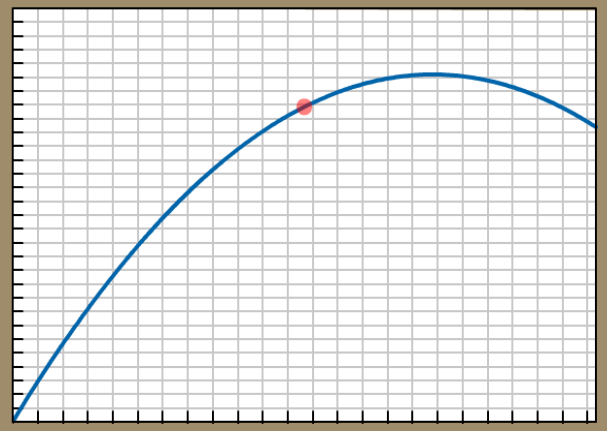
label local maxima

label absolute maximum

label absolute minimum

A Norman window has the shape of a rectangle surmounted by a semicircle. Suppose the outer perimeter of such a window must be 600 cm. Use the slider below to adjust the base length x. The plot below shows how the area depends on this value.





r = 116.70

A = 22852.00

A Norman window has the shape of a rectangle surmounted by a semicircle. Suppose the outer perimeter of such a window must be 600 cm maximize the area of such a window. The applet above shows a plot of the area function. Use the slider to visualize how the area changes fo estimate the optimal radius. Then use calculus to find an exact answer. (Correction: In the figure "r" should be "x").

When the base length is zero, the area of the window will be zero. There is also a limit on how large x can be: when x is large enough, the re height. What is the **exact** largest value of x when this occurs?

largest x: cm.

Determine a function $A(x)$ which gives the area of the window in terms of the parameter x (this is the function plotted above):

$A(x) =$ cm^2.

Now find the **exact** base length x which maximizes this area:

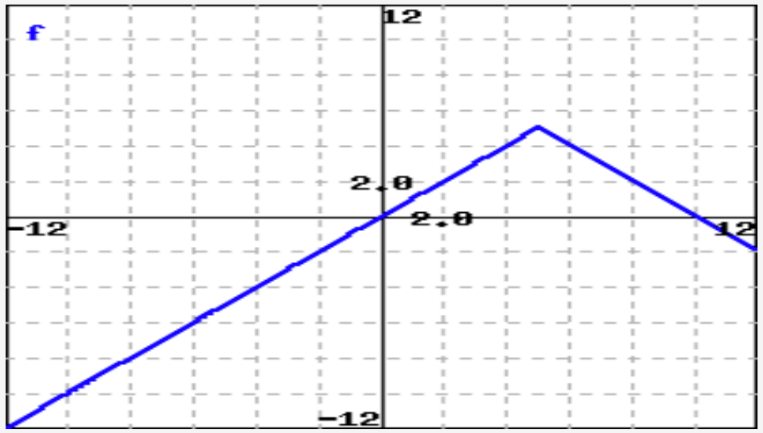
$x =$ cm.

Interactive optimization problem

Embedding your own video in WEBWORK

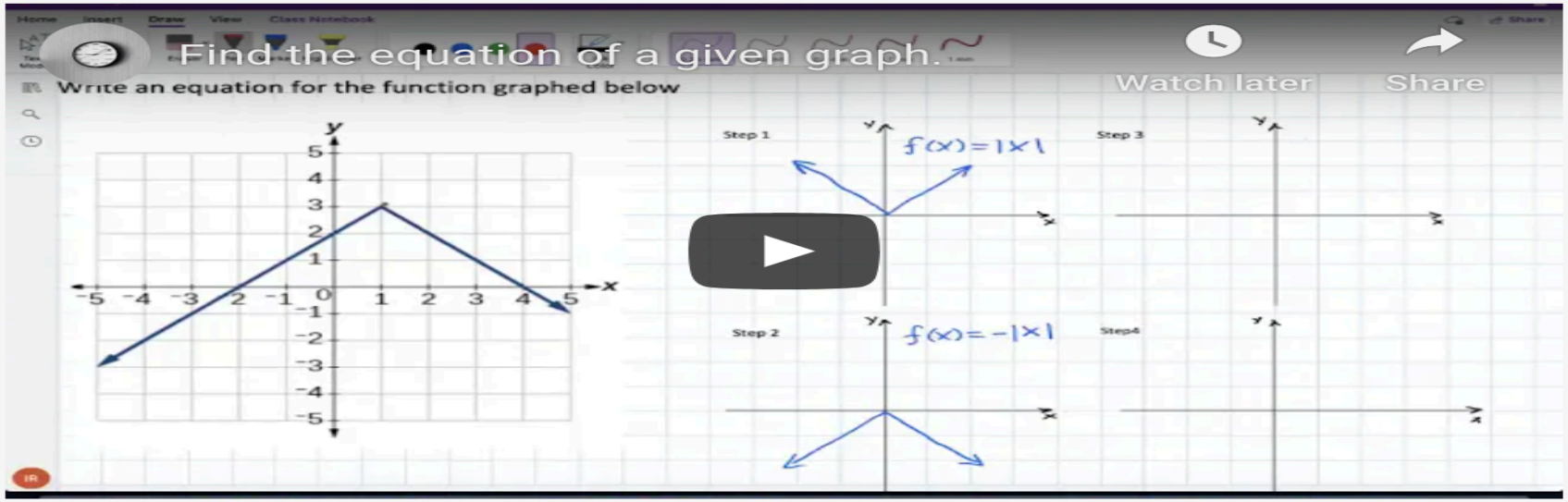
Previous Problem | Problem List | Next Problem

(1 point) **local/Library/NAU/setFunctionBasicGraphs/Abs.pg**



Find the formula for f.

$f(x) =$ ☐



If the video does not work, click here to go to YouTube directly.

Embedding your own video in WEBWORK

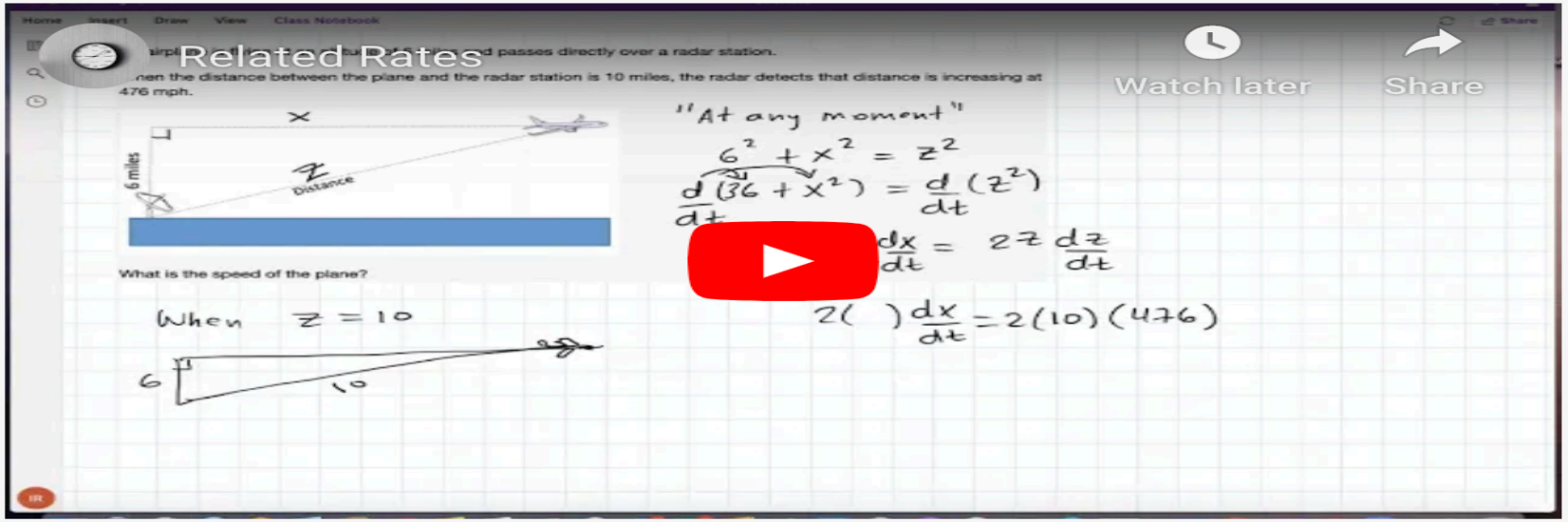
Previous Problem | Problem List | Next Problem

(1 point) **localSCF/CALC1/RelatedRates/05.pg**
An airplane is flying at an altitude of 6 miles and passes directly over a radar station.

When the distance between the plane and the radar station is 10 miles, the radar detects that distance is increasing at 476 mph.

What is the speed of the plane?

Answer: | $\frac{\text{miles}}{\text{hour}}$

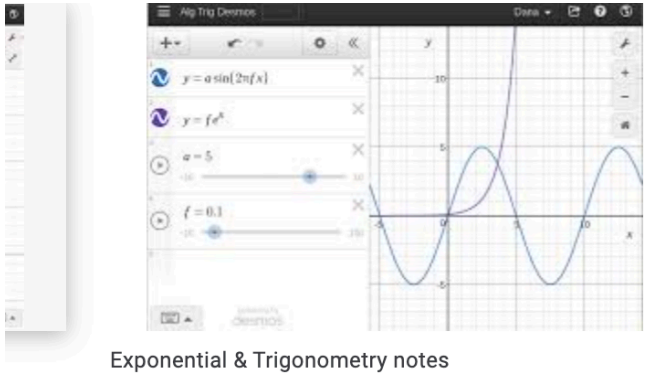


If the video does not work, click here to go to YouTube directly.

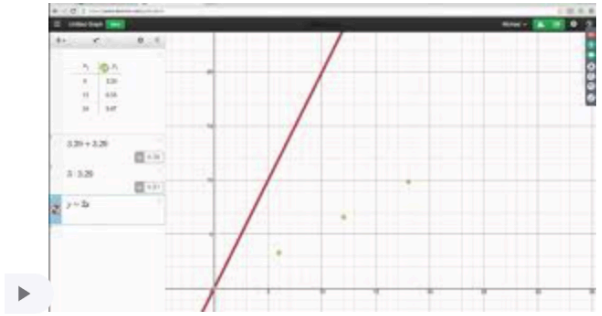
Code for embedding video in WEBWORK

```
$video = MODES(
HTML=>
'<iframe width="560" height="315" src="https://www.youtube.com/embed/aeyFb2eVH1c"
frameborder="0" allow="autoplay; encrypted-media" allowfullscreen></iframe>',
TeX =>
"An embedded YouTube video."
);



BEGIN_TEXT
${BCENTER}
$BR

$video
$BR
If the video does not work,
\{ htmlLink("https://www.youtube.com/embed/aeyFb2eVH1c",
"click here to go to YouTube directly.") \}
${ECENTER}
END_TEXT
```

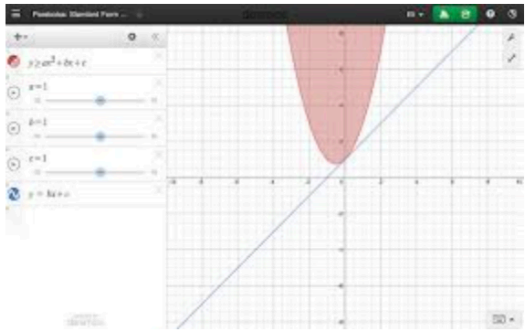
Free Interactive Activities from DESMOS



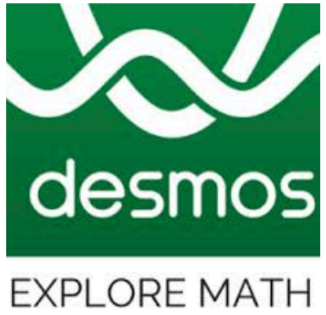
Exponential & Trigonometry notes
comfsm.fm



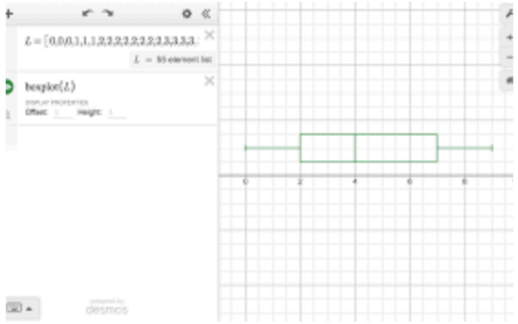
Desmos Graphing Calculator - YouTube
youtube.com



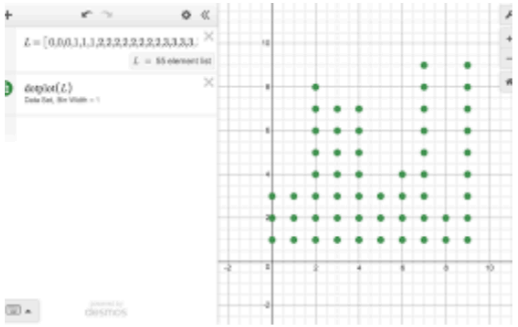
Desmos Graphing Calculator
chrome.google.com



AASL Recommended Apps: …
cmle.org



Data Visualizations – Desmos
support.desmos.com



Data Visualizations – Desmos
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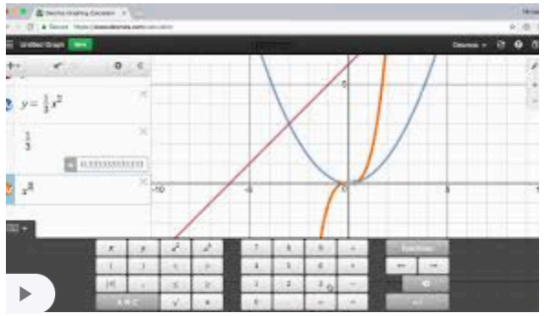
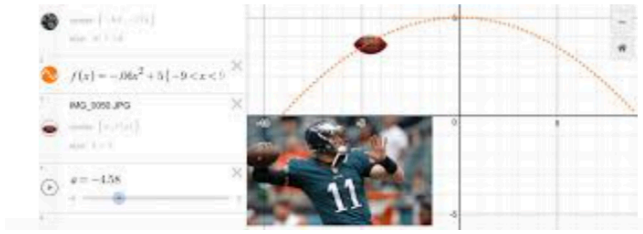
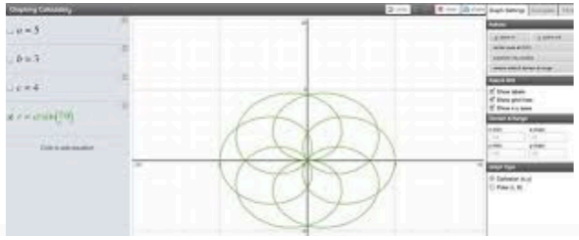
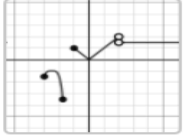


Introduction to the Desmos Graphing ...
youtube.com







Domain and Range Practice.

Teacher Guide

By Suzanne von Oy Precalculus

Mobile Tablet Laptop

Practice with domain and range

Activity Sessions

Assign

SESSIONS		STUDENTS	DATE	
YNQJYP	Expires Feb 15, 2021	34	Aug 19, 2020 at 10:35 pm	View Dashboard
XQRSMR	Expires Nov 21, 2020	20	May 25, 2020 at 8:07 pm	View Dashboard
Inactive Code	Reactivate	16	Feb 5, 2020 at 7:58 am	View Dashboard
Inactive Code	Reactivate	2	Jan 16, 2020 at 9:19 pm	View Dashboard

Screens

Student Preview

1 A function is graphed in black. Notice that it is a two-piece piecewise function. On the left piece, the orange shaded

2 The orange region has now been fixed for the piece to the right, and so in this case, the domain of the function can be

3 Practice writing the domain of the function as an inequality in f(x)

4 Domain Challenge #1

5 Domain Challenge #1 What did you get for the domain of the function on the previous f(x)

6 Domain Challenge #2

7 Domain Challenge #2 What did you get for the domain of the function on the previous f(x)

8 Domain Challenge #3

9 Domain Challenge #3 What did you get for the domain of the function on the previous f(x)

10 Domain Challenge #4

11 Now we will use the same functions, but will identify the range for each.

Notice: the range of this function is

12 Range Challenge #1

13 Range Challenge #1 What did you get for the range of the function on the previous f(x)

14 Range Challenge #2

15 Range Challenge #2 What did you get for the range of the function on the previous f(x)

16 Range Challenge #3

17 Range Challenge #3 What did you get for the range of the function on the previous f(x)

18 On the next page, there will not be any shaded regions you can play with. instead, YOU will write the inequalities that match the range, and the shaded regions should show up exactly showing the range of the function.

19 Range Challenge #4

20 Comprehension check #1 What is the domain and range of this function?

21 Comprehension check #2 What is the domain and range of this function?

22 Congratulations! You're done!

DESMOS Activity

Transforming Functions

Teacher Guide

By Desmos | 30-45 minutes | Practice Precalculus

Mobile Tablet Laptop

In this activity, students practice representing graphs of transformations using algebraic notation. The activity gives students timely feedback on their work, letting them see the effect of their algebraic transformations on the graph itself.

Translated by the Desmos localization team into:
French: https://teacher.desmos.com/activitybuilder/custom/5e8d1a0fc442eb0c0db03794
Spanish: https://teacher.desmos.com/activitybuilder/custom/5e8789aed2dcc20bcf9b636b
Russian: https://teacher.desmos.com/activitybuilder/custom/5e8fb6d993db0402f4b58d5a

Activity Sessions

Assign

SESSIONS	STUDENTS	DATE	
TM4JCM *Expires Feb 15, 2021*	24	Aug 19, 2020 at 10:39 pm	View Dashboard
Q6S6NG *Expires Nov 29, 2020*	10	Jun 2, 2020 at 5:32 pm	View Dashboard
Inactive Code Reactivate	12	Feb 12, 2020 at 11:57 pm	View Dashboard

Dashboards below are for earlier versions of this activity.

Screens

Student Preview

1 Verbal Transformation #1 — Describe in words how you'd transform the black function

2 Algebraic Transformati… — Use algebraic notation to describe how to transform the f(x)

3 Algebraic Transformati… — Use algebraic notation to describe how to transform the f(x)

4 Algebraic Transformati… — Use algebraic notation to describe how to transform the f(x)

5 Algebraic Transformati… — Use algebraic notation to describe how to transform the f(x)

6 Algebraic Transformati… — Use algebraic notation to describe how to transform the f(x)

7 Algebraic Transformati… — Use algebraic notation to describe how to transform the f(x)

8 Algebraic Transformati… — Use algebraic notation to describe how to transform the f(x)

9 Algebraic Transformati… — Use algebraic notation to describe how to transform the f(x)

10 Algebraic Transforma… — Use algebraic notation to describe how to transform the f(x)

11 Settle a Dispute — Paige and Sai are arguing about this transformation.

12 Card Sort

13 Difficult Transformations — Select which of these transformations is hardest for you to write using algebraic notation.

DESMOS Activity

Limits and Continuity

Teacher Guide

By Bryn Humberstone | 30-45 minutes | Introduction Calculus 1 Distance Learning – …

Mobile Tablet Laptop

In this activity, students consider left and right limits—as well as function values—in order to develop an informal and introductory understanding of continuity.

Looking for more activities like this?

Distance Learning – Calculus

By Desmos 4 Activities

The activities in this collection are designed for Calculus students, and are especially useful in distance learning settings.

Activity Sessions

Assign

SESSIONS		STUDENTS	DATE	
37H365	*Expires Feb 17, 2021*	18	Aug 21, 2020 at 4:10 pm	View Dashboard
5WM9J6	*Expires Dec 14, 2020*	40	Jun 17, 2020 at 9:39 pm	View Dashboard

Screens

Student Preview

1 Watch this dot as it m… — What y-value is the dot getting closer to as x approaches 1

2 Watch this dot as it m… — What y-value is the dot getting closer to as x approaches 1

3 Now look carefully at t… — What is the actual value of y when $x = 1$?

4 Language and Notation — Here's how mathematicians would describe what we saw on

5 Continuous? — If all three of these values... (1) … the limit

6 Limits — (a) What y-value is the function approaching as x approaches 3

7 Continuous? — Is the function shown here continuous at $x = 3$?

8 Make it continuous. — Change the graph (by dragging one of the movable points) to create a function that is continuous at $x = 3$

9 Sketch a function that … — (a) What y-value is it approaching from the left?

10 Sketch a function tha… — As x approaches 0, the left and right limits equal ?

11 Sketch a function tha…

12 Which of the followin…

DESMOS Activity

Card Sort: Derivative Match

Teacher Guide

By Desmos | 30-45 minutes | Development | Calculus 1

Mobile | Tablet | Laptop

In this activity, students match the graphs of functions with the graphs of their derivatives.

This activity was inspired by a blog post by David Petro:
http://engaging-math.blogspot.com/2016/06/derivative-matching-cards.html

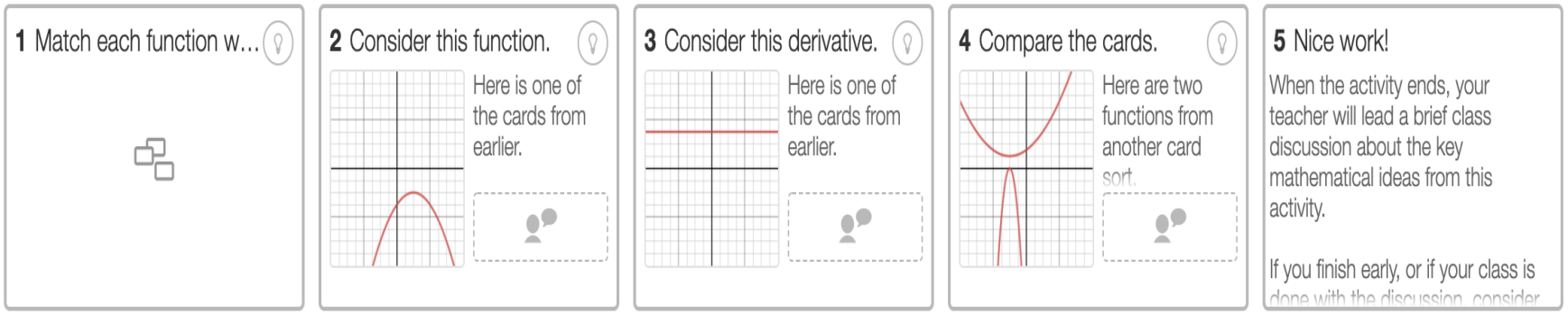
Activity Sessions

Assign

SESSIONS		STUDENTS	DATE	
W6MY23	*Expires Feb 17, 2021*	8	Aug 21, 2020 at 4:12 pm	View Dashboard
PTFX3Y	*Expires Jan 8, 2021*	39	Jul 12, 2020 at 11:57 pm	View Dashboard

Screens

Student Preview



DESMOS Activity

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MAT 301 | Calculus I | Sec. 0516 | Prof. Retamoso | Fall 2020

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OPEN

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MAT 206 I Precalculus | Sec. 0509 | Prof. Retamoso | Summer 6...

IVAN RETAMOSO

MATHEMATICS, A.S. | MAT 206 | **SUMMER 2020**

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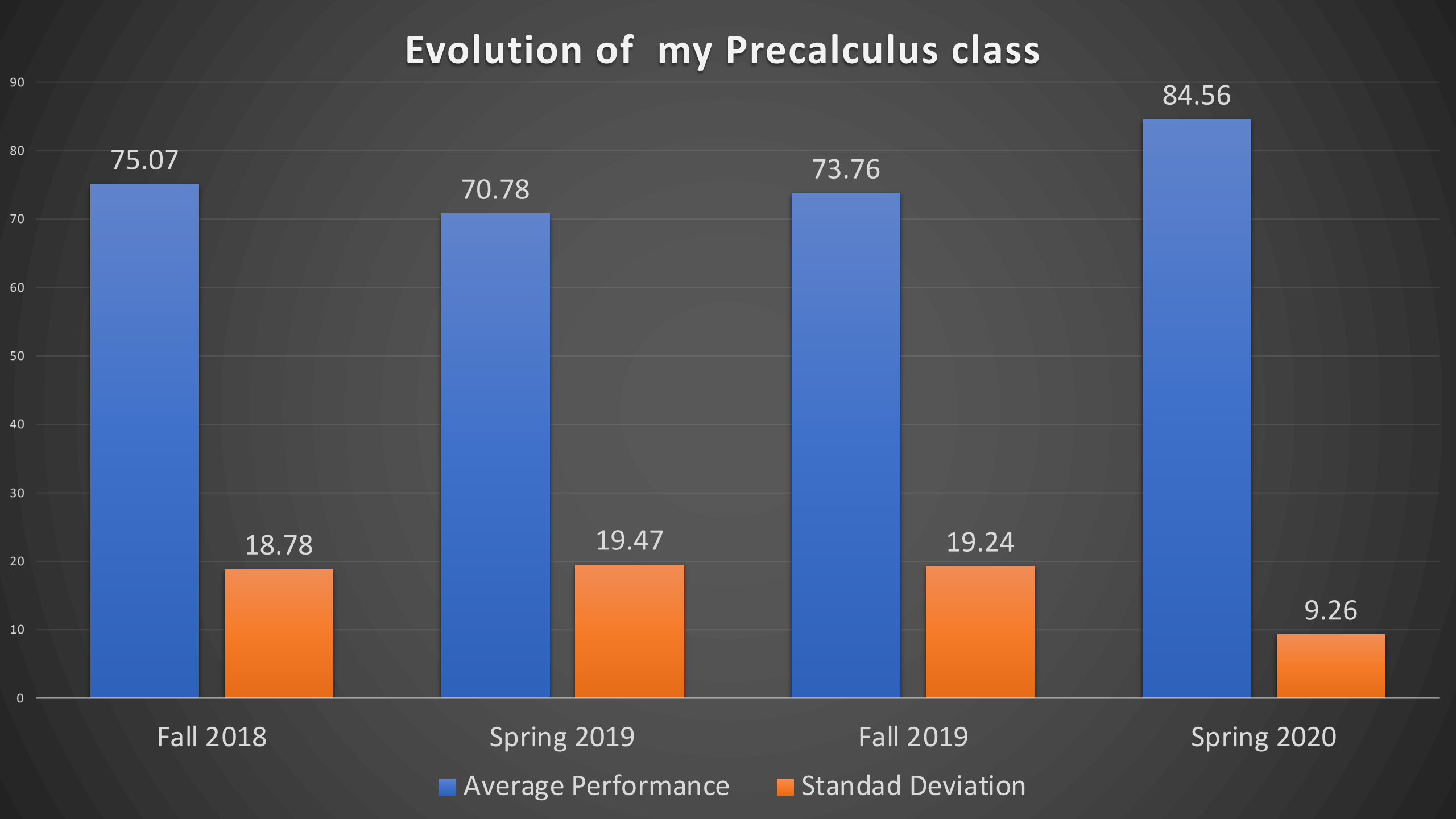
OPEN

WEBSITES FOR MY COURSES ARE CREATED AND STORED AT:

BMCC OPEN LAB

<<	Sep 2020			
Mon	Tue	Wed	Thu	Fri
31	1 • 1.2 Domain and Range • 1.3 Rates of Change and Behavior of Graphs	2	3 • DESMOS Activity 1 • 1.4 Composition of Functions	4 Virtual Office Hours
7	8 • 1.5 Transformation of Functions • 1.6 Absolute Value Functions	9	10 • 1.7 Inverse Functions • 2.1 Linear Functions	11 Virtual Office Hours
14	15 • DESMOS Activity 2 • 2.2 Graphs of Linear Functions	16	17 • 2.3 Modeling with Linear Functions	18 Virtual Office Hours

Calendar embedded in Website


Evolution of my Precalculus class
90
80
70
60
50
40
30
20
10
0
75.07
18.78
70.78
19.47
73.76
19.24
84.56
9.26
Fall 2018
Spring 2019
Fall 2019
Spring 2020
Average Performance
Standad Deviation