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Professional Development from Texas Instruments



# AP<sup>®</sup> Precalculus: Develop Procedural and Conceptual Fluency Using TI Technology

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 TEXAS INSTRUMENTS



Host

## Stacy Thiboeaux

T<sup>3</sup>™ National Instructor  
Lafayette, Louisiana  
@stacythib



Presenter

## Greg Foley

T<sup>3</sup>™ National Instructor  
Athens, Ohio  
foleyg@ohio.edu



Presenter

## Rachael Gorsuch

T<sup>3</sup>™ Regional Instructor  
Columbus, Ohio  
@rachaelhgorsuch



# Agenda

- Welcome & Introductions
- Solve equations, inequalities, and systems of equations
- Rewrite functions and equations in useful equivalent forms
- Build a function by transforming, composing, inverting, or regressing
- Learn where to get pre-created activities for TI 84 and TI-Nspire™ Technology
- Webinar drawing





## Expected Outcomes



**I CAN** use multiple representations to solve equations and inequalities.



**I CAN** write functions, equations, or expressions in equivalent forms.



**I CAN** build new functions using transformations, compositions, inverses or regressions.



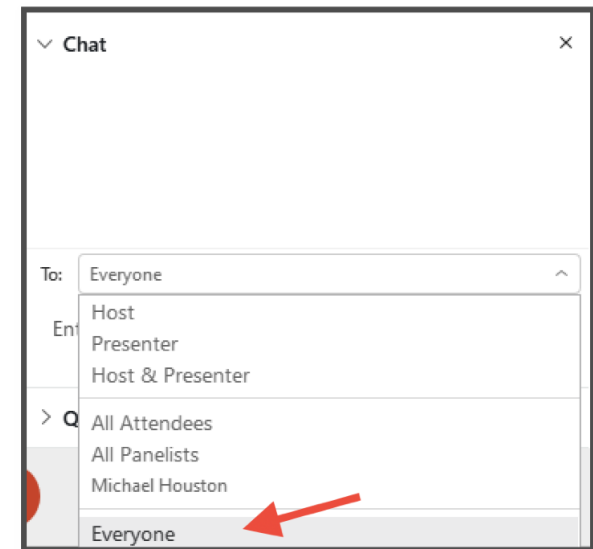
**I CAN** access the files from the webinar and other tech-based activities.





## WebEx Chat & Poll Features

- » Use the chat window to send general messages.
- » Open the chat with the messaging icon at the bottom of your screen
- » Send chat messages to “everyone”. Please feel free to ask questions during the presentation!
- » The Q&A and chat windows are located on the right side of your screen.
- » Later, we will use the poll feature, also found on the lower right side of your screen.





## From the **AP<sup>®</sup> Precalculus Course & Exam Description**

Throughout this course, students develop and hone symbolic manipulation skills, including solving equations and manipulating expressions, for the many function types. Students also learn that functions and their compositions, inverses, and transformations are understood through graphical, numerical, analytical, and verbal representations, which reveal different attributes of the functions and are useful for solving problems in mathematical and applied contexts. In turn, the skills learned in this course are widely applicable to situations that involve quantitative reasoning. (p. 6)

## Practice 1

### *Procedural and Symbolic Fluency* **1**

Algebraically manipulate functions, equations, and expressions.

## Practice 2

### *Multiple Representations* **2**

Translate mathematical information between representations.

## Practice 3

### *Communication and Reasoning* **3**

Communicate with precise language, and provide rationales for conclusions.

## SKILLS

**1.A** **Solve equations and inequalities** represented analytically, with and without technology.

**1.B** **Express** functions, equations, or expressions in analytically **equivalent forms** that are useful in a given mathematical or applied context.

**1.C** **Construct new functions**, using transformations, compositions, inverses, or regressions, that may be useful in modeling contexts, criteria, or data, with and without technology.

**2.A** **Identify information from** graphical, numerical, analytical, and verbal **representations** to answer a question or construct a model, with and without technology.

**2.B** **Construct equivalent** graphical, numerical, analytical, and verbal **representations** of functions that are useful in a given mathematical or applied context, with and without technology.

**3.A** **Describe** the **characteristics** of a function with varying levels of precision, depending on the function representation and available mathematical tools.

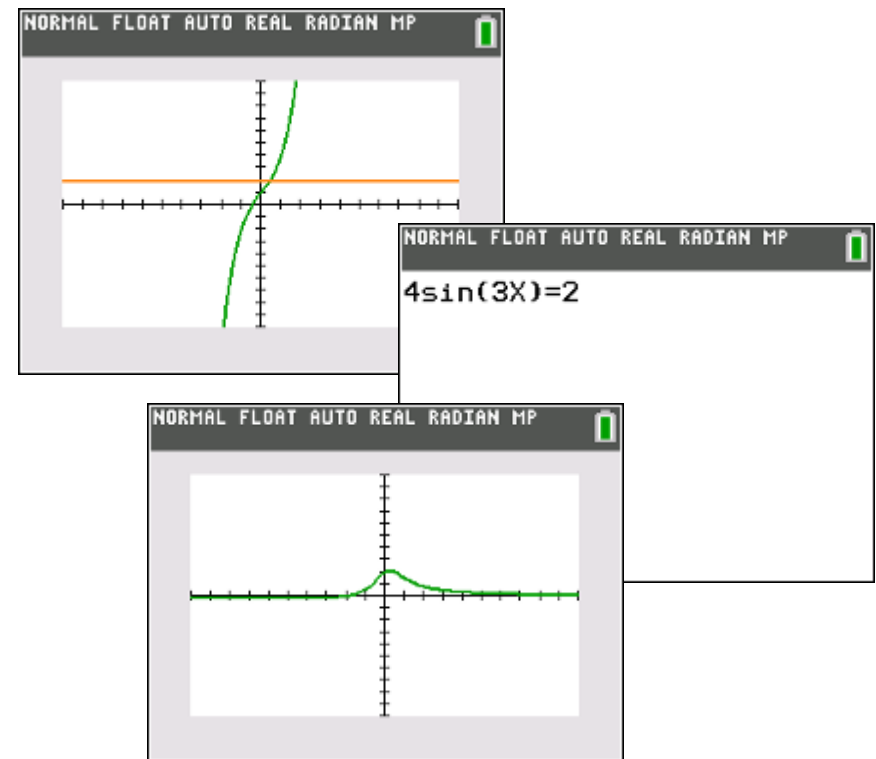
**3.B** **Apply** numerical **results** in a given mathematical or applied context.

**3.C** **Support conclusions** or choices with a logical rationale or appropriate data.

# Solving Polynomials, Rational, Exponential, Logarithmic, and Trigonometric Equations

## Ask yourself...

- » What methods or tools do you personally use to solve equations or inequalities?
- » What methods or tools do you teach your students to solve equations and inequalities?
- » Do your responses to the first 2 questions match? Why do you think that is?

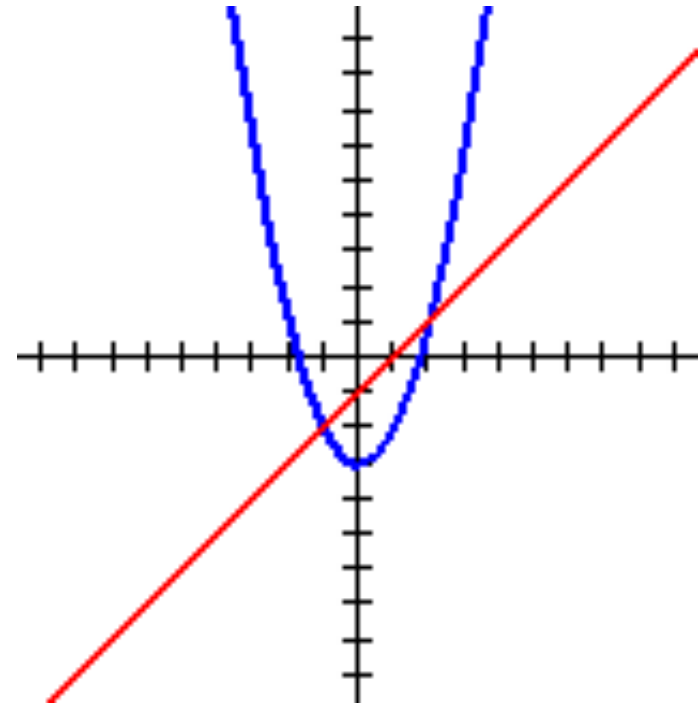




## Example 1 Solving a system of equations

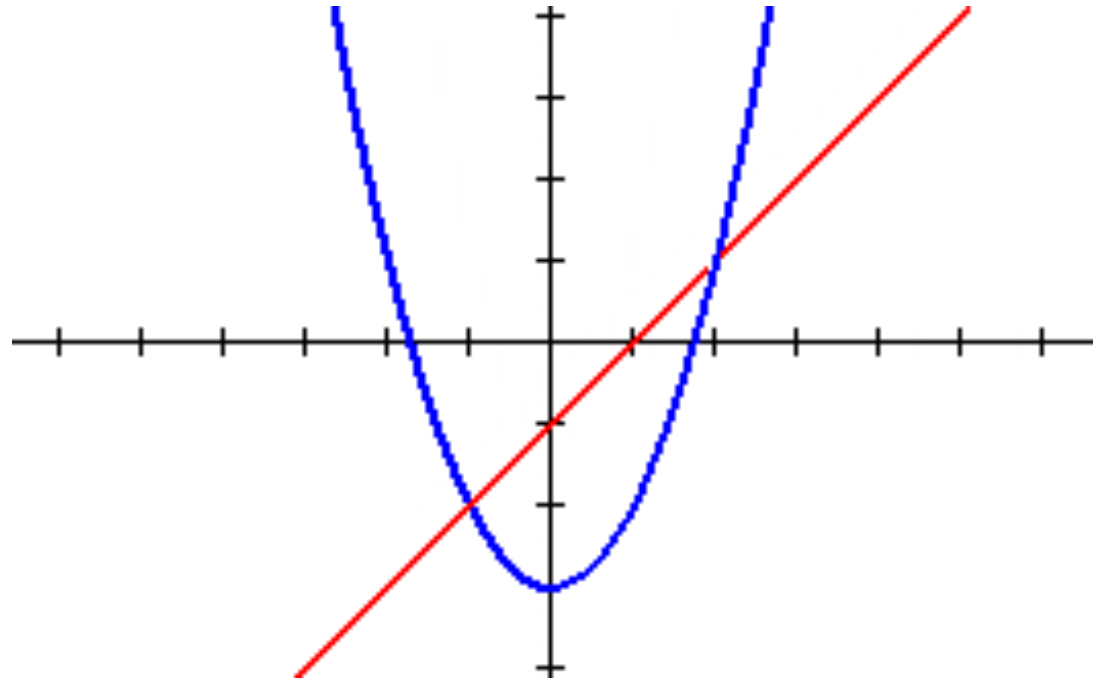
At right are the graphs of two functions. One is  $f(x) = x^2 - 3$ . The other,  $g$ , passes through the points  $(0, -1)$  and  $(1, 0)$ .

What are the solutions of this system of equations?



## Example 2 Rewriting this system of equations

- (a) What equation is associated with this system?
- (b) How can you rewrite this equation?
- (c) What inequalities are associated with these equations?



## Example 3 Solving an equation

Solve  $\ln x = \sin x$ .

- (a) How would you get started in developing a plan to solve this equation?
- (b) What algebraic methods could you use?
- (c) What other methods are possible?

## Example 4 Solving an inequality

Solve  $\ln x > \sin x$ .

- (a) How would you write the solution?
- (b) What other related inequalities could you solve?

## Example 5 Using Parametric mode for inverses

Does  $f(x) = x^2 - 3$  have an inverse?

(a) If so, how could you graph its inverse?

(b) Does  $f(x) = x^2 - 3$  have an inverse function?

## Example 6 Graphing compositions of functions

What functions can we build by composing the functions we have explored so far?

## Example 7 Creating a function from a table

$x$	0	1	2	3	4
$f(x)$	3	4.5	6.75	10.125	15.1875

Let  $f$  be an increasing function defined for  $x \geq 0$ . The table gives values of  $f(x)$  at selected values of  $x$ .

- Use the table of values of  $f(x)$  to determine if  $f$  is best modeled by a linear, quadratic, exponential, or logarithmic function.
- Give a reason for your answer in part (a) based on the relationship between the change in the output values of  $f$  and the change in the input values of  $f$ .
- Give a reason for your answer in part (a) based on the residual plot of the regression.



# Resources Wrap-Up: education.ti.com > Activities

## TI-84

### Precalculus: You Can't Get There From Here

by Texas Instruments

#### Overview

Students will explore rational functions graphically and algebraically to identify singularities and asymptotes, both vertical and horizontal.

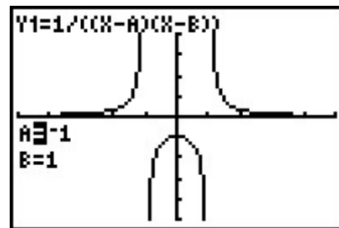
X	Y1
-3	ERROR
-2	-.2
-1	-.125
0	-.1111
1	-.125
2	-.2
3	ERROR

X = -3

#### Key Steps

Factoring is applied as a means to identify singularities and determine vertical asymptote locations.

Students will use the Transformation Graphing application to see the effects of different values on the graph of the function.



1 2 3

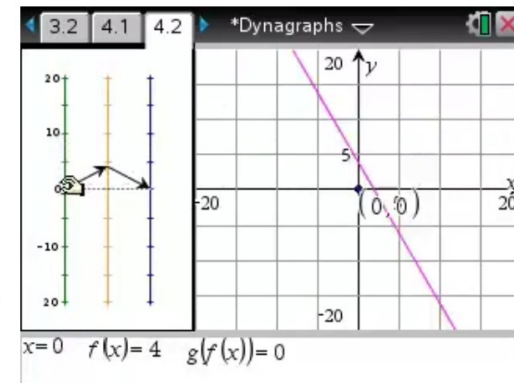
## TI-Nspire™ Technology

### Precalculus: Dynagraphs

by Texas Instruments

#### Objectives

- Students will utilize the input and output of a function to determine its rule.
- Students will discover conditions that would restrict a function's domain.
- Students will understand that a composition utilizes the output of the inside function as the input of the outside function.
- Students will understand the special relationship between two inverse functions and their composition.



Questions are included throughout the activity to help assess student understanding.





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# Webinar Drawing

One lucky winner receives a TI graphing calculator!

Choose from

- TI-84 Plus CE Python
- TI-84 Plus CE
- TI-Nspire™ CX II
- TI-Nspire™ CX II CAS

And the winner is ...





## Q&A

Questions on anything covered today?





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**AP® Precalculus: Develop Procedural and Conceptual Fluency Using TI Technology**

<https://bit.ly/3ZrJoVa>





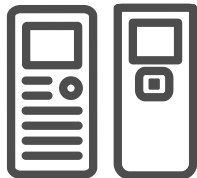
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Thank you