CC Algebra II - Regents Review

Unit #4: Exponential and Logarithmic Functions Video 1/2

Video by Mr. Williamson
Newfield Senior High School

Based on Kirk Weiler's emathinstruction lessons

Unit 4: Video Overview

- Video 1/2:
  - Lesson Overview
  - CCLS Associated with Unit 4 (3 slides)
  - Definition of Exponential and Logarithmic Functions
  - Converting Between Exponential and Logarithmic Form
  - The Laws of Exponents and Logarithms
  - Negative and Fractional Exponents
  - Graphing Exponential and Logarithmic Functions
- Video 2/2:
  - Writing Equations of Exponential Functions
  - Newton's Law of Cooling
  - Solving Exponential and Logarithmic Equations
  - Compound Interest Problems
  - Percent Manipulations
  - Lesson Summary

Unit 4: Lesson Overview

- 4.1 Integer Exponents
- 4.2 Rational Exponents
- 4.3 Exponential Function Basics
- 4.4 Finding Equations of Exponentials
- 4.5 The Method of Common Bases
- 4.6 Exponential Modeling with Percent Growth and Decay
- 4.7 Mindful Percent Manipulations
- 4.8 Introduction to Logarithms
- 4.9 Graphs of Logarithms
- 4.10 Logarithm Laws
- 4.11 Solving Exponential Equations Using Logarithms
- 4.12 The Number e and the Natural Logarithm
- 4.13 Compound Interest
- 4.14 Newton's Law of Cooling

CCLS Associated with Unit 4 (Slide 1/3)

- N.RN.1 - Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
- N.RN.2 - Rewrite expressions involving radicals and rational exponents using the properties of exponents.

- A.CED.1 - Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. Tasks are limited to exponential equations with rational or real exponents or rational functions
- A.CED.2 - Create equations in two or more variables to represent relationships between quantities; graph equations on the coordinate axes and with labels and scales

CCLS Associated with Unit 4 (Slide 2/3)

- F.IF.4 - For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* Tasks may involve polynomial, exponential, logarithmic, and trigonometric functions.

- F.IF.7e - Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

- F.IF.8 - Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. Use the properties of exponents to interpret expressions for exponential functions.

CCLS Associated with Unit 4 (Slide 3/3)

- F.LE.2 - Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table) Tasks will involve solving multi-step problems by constructing linear and exponential functions.
- F.LE.4 - For exponential models, express as a logarithm the solution to $ab^{(ct)} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.
- F.LE.5 - Interpret the parameters in a linear or exponential function in terms of a context. Tasks are limited to exponential functions with domains not in the integers.

- F.BF.1 - Write a function that describes a relationship between two quantities. A) Determine an explicit expression, a recursive process, or steps for calculation from a context. Tasks may involve linear functions, quadratic functions, or exponential functions. B) Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

Definition of Exponential and Logarithmic Functions

- Exponential Functions

  The input variable is an exponent.

- Logarithmic Functions

  Inverse of an exponential.

  Logarithms are essentially Exponents!

Converting Between Exponential and Logarithmic Form

- Exponential to Logarithmic Form

- Logarithmic to Exponential Form

The Laws of Exponents and Logarithms

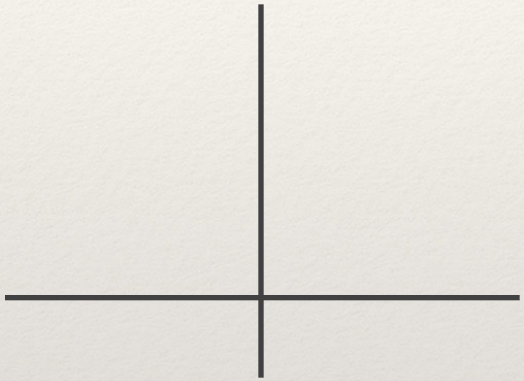
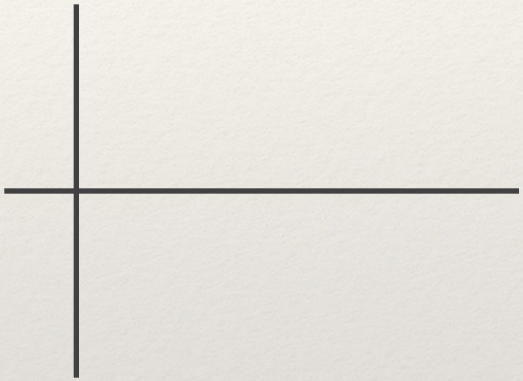
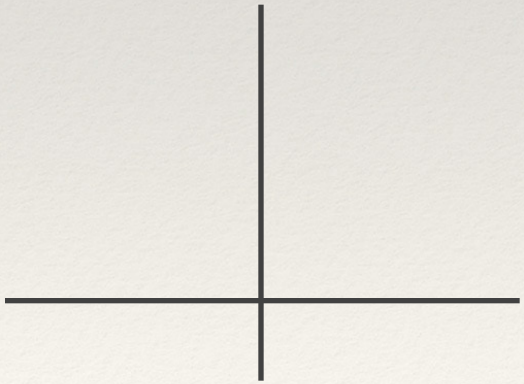
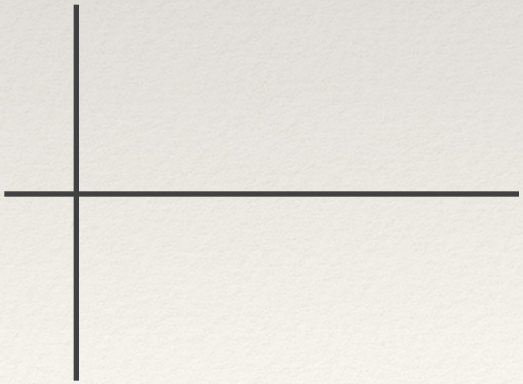
- Product Laws:
- Quotient Laws:
- Power Laws:

Negative and Fractional Exponents

- Negative Exponents

- Fractional Exponents

Graphs of Exponential and Logarithmic Functions

	Exponential	Logarithmic
Growth: $b > 1$		
Decay: $0 < b < 1$		

End of Video 1

- In the second review video, I will go over:
  - Writing the Equation of an Exponential Function
  - Newton's Law of Cooling
  - Solving Exponential and Logarithmic Equations
  - Compound Interest Formulas
  - Percent Manipulations
  - Unit 4 Summary of the Most Important Information

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Unit #4: Exponential and Logarithmic Functions Video 2/2

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Review from Video 1

- Just a quick recall of what we reviewed in the first video:
  - Lesson Overview and Common Core Standards
  - Definition of Exponential and Logarithmic Functions
  - Converting Between Exponential and Logarithmic Form
  - Laws of Exponents and Logarithms
  - Fractional and Negative Exponents
  - Graphs of Exponential and Logarithmic Functions

Review Material in this Video

- In this review video, I will go over:
  - Writing the Equation of an Exponential Function
  - Newton's Law of Cooling
  - Solving Exponential and Logarithmic Equations
  - Compound Interest Formulas
  - Percent Manipulations
  - Unit 4 Summary of the Most Important Information

Writing Equations of Exponential Functions

- Given Two Points (One Point is the y-intercept)

Find the exponential equation that contains that points (0, 6) and (3, 20.25).

- Given Two Points (Without knowing the y-intercept)

Find the exponential equation that contains that points (2, 144) and (4, 51.84).

Newton's Law of Cooling

- Function for Newton's Law of Cooling

- Interpreting the Parts of the Function
  - Initial Value (y-intercept):
  - Rate of decay:
  - Room Temperature:

Solving Exponential and Logarithmic Equations

- Method of Common Bases
- Using Logarithms
- Converting to Exponential Form

Compound Interest Formulas

- Compounded over Equal Intervals:

- Compounded Continuously:

- Nominal vs Effective Rates

Percent Manipulations

- Given a percent rate for a certain period of time, find the the percent rate for a different period of time.

  If after 6 years there is a 15% growth rate, what is the growth rate after 10 years?

  If after 6 years there is a 15% decay rate, what is the rate of decay after 10 years?

Summary of the Most Important Information

- Students should be able to:
  - Understand that exponential and logarithmic functions are inverses of each other.
  - Apply the properties of exponents and logarithms.
  - Convert expressions between exponential and logarithmic form.
  - Graph an exponential or logarithmic function, noting the domain, range, rate of growth or decay, y-intercept, and asymptote.
  - Find the equation of an exponential function, given any two points or its graph.
  - Solve an exponential or logarithmic equation.
  - Apply or use the compound interest formulas to find a missing variable.
  - Interpret and manipulate an exponential expression to find the rate for any amount of time, including finding the effective yearly rate.
  - Apply and interpret the equation for Newton's Law of Cooling