

# Lesson 6: Solving Exponential Equations – Day 2 | Unit 4 – Exponential Functions

## (A) Lesson Context

BIG PICTURE of this UNIT:	<ul style="list-style-type: none"> <li>• How can I analyze growth or decay patterns in data sets &amp; contextual problems?</li> <li>• How can I algebraically &amp; graphically summarize growth or decay patterns?</li> <li>• How can I compare &amp; contrast linear and exponential models for growth and decay problems.</li> </ul>		
CONTEXT of this LESSON:	<p>Where we've been</p> <p>In Lessons 3 &amp; 4, you looked at how exponential equations can be used to model real world scenarios</p>	<p>Where we are</p> <p>How can we solve exponential equations that arise when we model growth &amp; decay patterns</p>	<p>Where we are heading</p> <p>How can I use algebra, data tables, graphs &amp; equations to make predictions about scenarios which feature exponential growth &amp; decay?</p>

## (A) Lesson Objectives

- Review and apply one key exponent law → if  $b^x = b^y$ , then  $x = y$  in the context of exponential equations
- Use algebraic strategies to solve Exponential – Exponential Systems & Exponential – Constant Systems using multiple representation strategies
- Use multiple representations to verify algebraic solutions
- Solve Exponential – Linear Systems using multiple representation strategies
- Apply Exponential Equations/Systems to real world applications

## (B) Exponential Equations – Opening Example: Investigation #1

- Use ALGEBRAIC METHODS to solve and verify these equations. Finally, use your TI-84 to graphically verify.

(a) Solve and verify $2^{3-x} = 2^4$	(b) Solve and verify $2^{x-3} = 2^{3x+1}$
(c) Solve and verify $2^{2x+3} = 16$	(d) Solve and verify $8^x = 16^{x-1}$

**(C) Exponential – Constant Systems**

**EXPLORATORY EXAMPLE #1** → Solve the equation  $2^{1-2x} = 8$ . Verify your solution.

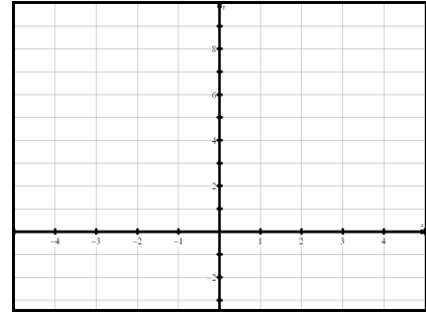
Algebraic Solution

Verification:

Graphic Solution (from TI-84)

KEY CONCEPT →

Let  $y_1 =$             and let  $y_2 =$



**EXPLORATORY EXAMPLE #2** → Solve the equation  $4^{1+x} = 2$ . Verify your solution.

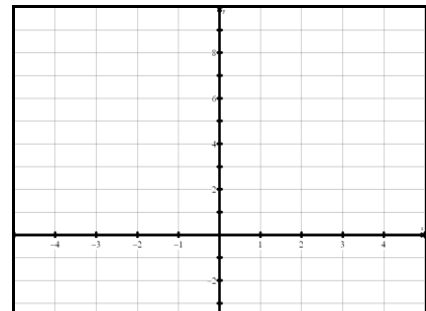
Algebraic Solution

Verification:

Graphic Solution (from TI-84)

KEY CONCEPT →

Let  $y_1 =$             and let  $y_2 =$



**(D) Exponential – Constant Systems**

**EXPLORATORY EXAMPLE #3** → Solve the equation  $3^{x+2} = \frac{1}{9}$ . Verify your solution.

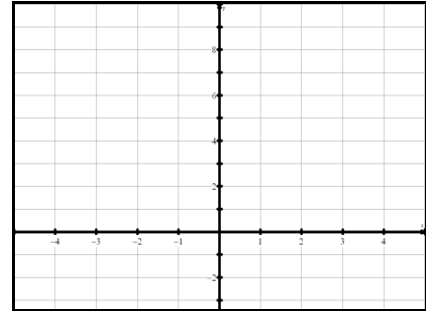
Algebraic Solution

Verification:

Graphic Solution (from TI-84)

KEY CONCEPT →

Let  $y_1 =$             and let  $y_2 =$



**EXPLORATORY EXAMPLE #4** → Solve the equation  $4^{2-x} = 5$ . Verify your solution.

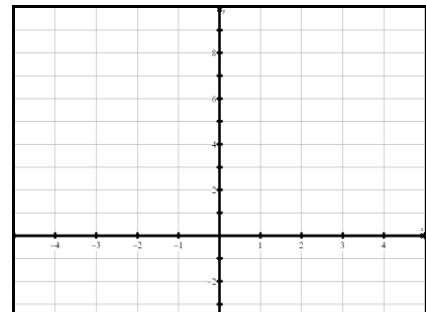
Algebraic Solution

Verification:

Graphic Solution (from TI-84)

KEY CONCEPT →

Let  $y_1 =$             and let  $y_2 =$



**(E) Exponential – Exponential Systems**

**EXPLORATORY EXAMPLE #1** → Solve the equation  $2^{3-2x} = 2^x$ . Verify your solution.

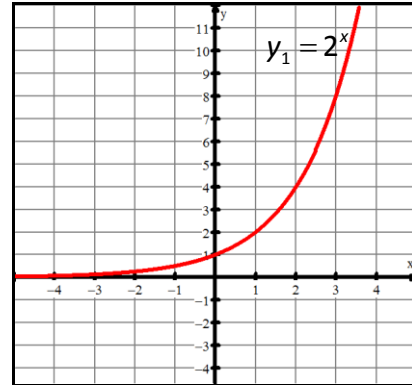
Algebraic Solution

Verification:

Graphic Solution (from TI-84)

KEY CONCEPT →

Let  $y_1 =$             and let  $y_2 =$



**EXPLORATORY EXAMPLE #1** → Solve the equation  $4^{x-1} = 2^x$ . Verify your solution.

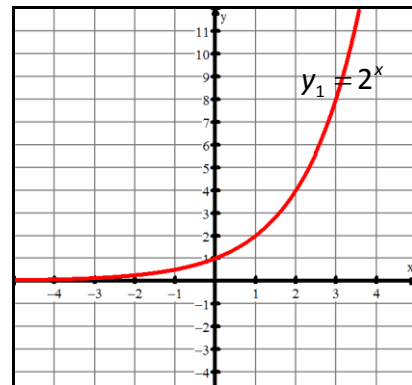
Algebraic Solution

Verification:

Graphic Solution (from TI-84)

KEY CONCEPT →

Let  $y_1 =$             and let  $y_2 =$



**(F) Exponential – Exponential Systems**

**EXPLORATORY EXAMPLE #1** → Solve the equation  $\left(\frac{1}{4}\right)^{2x+1} = \left(\frac{1}{8}\right)^{3-x}$ . Verify your solution.

**Algebraic Solution**

**Verification:**

**Graphic Solution (from TI-84)**

KEY CONCEPT →

Let  $y_1 =$             and let  $y_2 =$

**EXPLORATORY EXAMPLE #3** → Solve the equation  $3^{2x-2} = 2^x$ . Verify your solution.

**Graphic Solution**

Let  $f(x) =$             and let  $g(x) =$



**Algebraic Solution**

KEY CONCEPT →

Verification:

**(G)Closing Investigation**

My brother works as an electrician and runs his own company. In the first year of running his business, he earned total revenues of \$250,000 and he now estimates that his annual revenue has been increasing at a rate of 30% of the previous year's revenues. He also realizes that his business has expenses, which he estimated at \$100,000 for his first year of running his business. However his expenses have been increasing at a constant, fixed amount of \$55,000 every year. You will analyze the profitability of his business using appropriate mathematical modeling.

- i. Write an equation for his company's REVENUES. Graph this equation on your TI-84. (Window settings  $x \rightarrow 0-25$  and  $y \rightarrow 0 - 1,000,000$ )
- ii. Write an equation for his company's EXPENSES. Graph this equation on the same axes as (i).
- iii. If you know a company's revenues and expenses, how do you determine its PROFITS?
- iv. Write an equation that will model the company's PROFITS.
- v. What is the company's profitability in the fifth year of operation?
- vi. What is the company's profitability in the 7<sup>th</sup> year of operation?
- vii. What do the intersection points represent?
- viii. What ASSUMPTION are you making as you analyze my brother's company's profitability?