

### **(A) Lesson Objectives**

- a. Review basic function notation & work with simple exponential equations using function notation
- b. Solve Exponential – Exponential Systems using multiple representation strategies
- c. Solve Exponential – Constant Systems using multiple representation strategies
- d. Solve Exponential – Linear Systems using multiple representation strategies
- e. Apply Exponential Equations/Systems to real world applications

### **(B) Opening 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. How do you determine a company's PROFITS?
- iv. What is the company's profitability in the fifth year of operation?
- v. What is the company's profitability in the 7<sup>th</sup> year of operation?
- vi. What do the intersection points represent?
- vii. What ASSUMPTION are you making as you analyze my brother's company's profitability?

## (C) Concept Connections – Exponential Functions & Working with Function Notation

Evaluate  $f(3)$  if  $f(x) = \frac{1}{3} \cdot 2^{x-1}$

Evaluate  $f(-2)$  if  $f(x) = 5 \cdot 3^{x+1} - 1$

Evaluate  $f^{-1}(16)$  if  $f(x) = 2^{x-1}$

Solve  $6 = f(x)$  if  $f(x) = 2^{x/2} - 2$

Solve  $6 = f^{-1}(x)$  if  $f(x) = 2^{x/2} - 2$

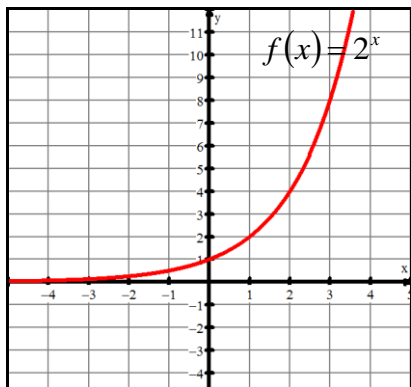
Solve  $3 = f(x)$  if  $f^{-1}(x) = 3^{1-x}$

## (D) Exponential – Exponential Systems

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

### Graphic Solution

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



### Numeric Solution

| x | f(x) | g(x) |
|---|------|------|
|   |      |      |
|   |      |      |
|   |      |      |

### Algebraic Solution

KEY CONCEPT →

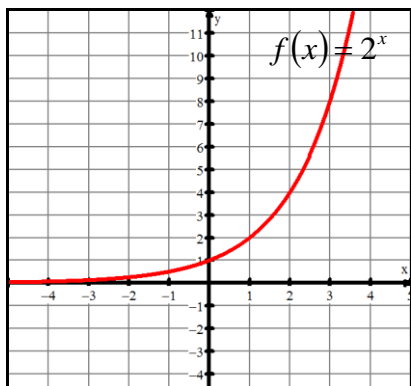
Verification:

# Solving Exponential Equations → Systems Revisited Lesson 15

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

**Graphic Solution**

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



**Numeric Solution**

| x | f(x) | g(x) |
|---|------|------|
|   |      |      |
|   |      |      |
|   |      |      |

**Algebraic Solution**

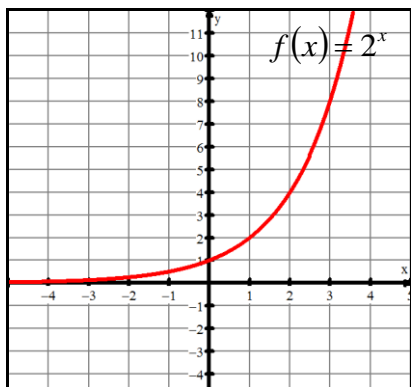
KEY CONCEPT →

Verification:

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

**Graphic Solution**

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



**Numeric Solution**

| x | f(x) | g(x) |
|---|------|------|
|   |      |      |
|   |      |      |
|   |      |      |

**Algebraic Solution**

KEY CONCEPT →

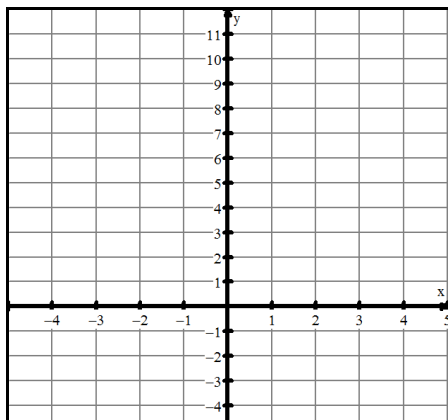
Verification:

**(E) Exponential – Constant Systems**

**EXPLORATORY EXAMPLE #4** → Solve the equation  $2^{1-2x} = 8$ . Verify your solution.

**Graphic Solution**

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



**Numeric Solution**

| x | f(x) | g(x) |
|---|------|------|
|   |      |      |
|   |      |      |
|   |      |      |

**Algebraic Solution**

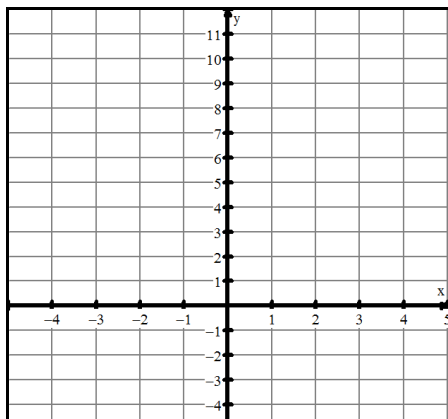
KEY CONCEPT →

Verification:

**EXPLORATORY EXAMPLE #5** → Solve the equation  $(\frac{1}{2})^{3-2x} = 5$ . Verify your solution.

**Graphic Solution**

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



**Numeric Solution**

| x | f(x) | g(x) |
|---|------|------|
|   |      |      |
|   |      |      |
|   |      |      |

**Algebraic Solution**

KEY CONCEPT →

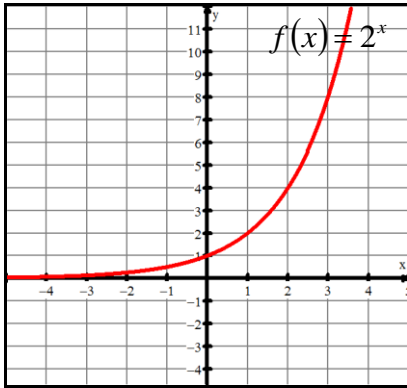
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## (F) Exponential – Linear Systems

**EXPLORATORY EXAMPLE #6** → Solve the equation  $2^x = 3x$ . Verify your solution.

### Graphic Solution

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



### Numeric Solution

| x | f(x) | g(x) |
|---|------|------|
|   |      |      |
|   |      |      |
|   |      |      |

### Algebraic Solution

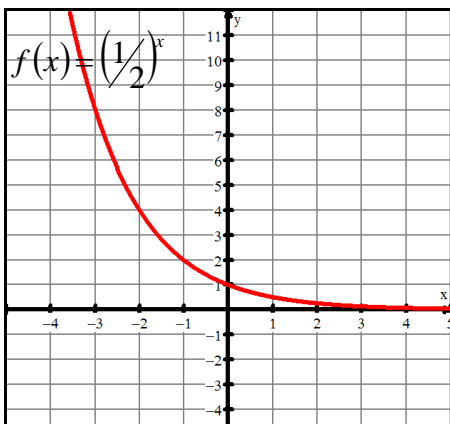
KEY CONCEPT →

Verification:

**EXPLORATORY EXAMPLE #7** → Solve the equation  $(\frac{1}{2})^x = \frac{x}{2} + 5$ . Verify your solution.

### Graphic Solution

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



### Numeric Solution

| x | f(x) | g(x) |
|---|------|------|
|   |      |      |
|   |      |      |
|   |      |      |

### Algebraic Solution

KEY CONCEPT →

Verification:

### (G) **Applications of Exponential Equations & Systems**

Mr. S has to make a decision about two different education savings plans for his children. Investment option #1 requires that I first deposit \$10,000, compounded annually at 8% (meaning it will grow at a rate of 8% every year.) Investment option requires an initial deposit of \$12,500 which will be compounded annually at 6.5%. Use an appropriate mathematical model and multiple representations to offer advice to Mr. S on which investment option is better.