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math instruction

Lesson 2.05 Writing Exponential Growth and Decay Functions

Students will be able to:

- __Content Objective:__ Write and interpret exponential growth and decay functions. This includes identifying the percent growth and decay.

- __Language Objective:__ Explain the relationship between the initial value of a quantity and its graph.

Warm Up

a. Write the equation of an exponential function $f(x)$ passing through the points $(0,-3)$ and $(4,-48)$ for an exponential function $f(x)$.
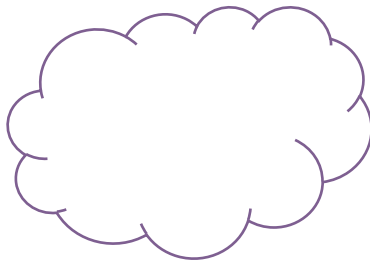
b. Determine the value of $f(7)$.

Vocabulary Review

__Exponential Growth__: A quantity that
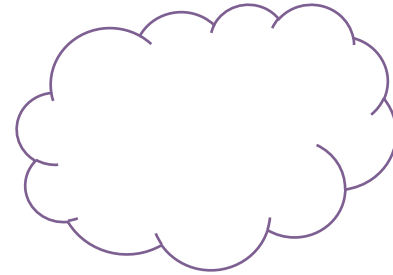
_____ by a fixed percent % over an

interval

| What other words can we use for growth? |

__Exponential Decay:__ A quantity that

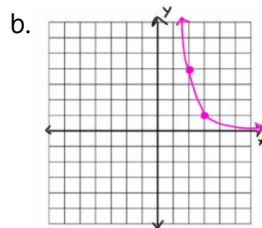_____ by a fixed percent % over an

interval

| What other words can we use for decay? |

Skill 1: Growth vs Decay

For each of the following below, determine whether it represents growth or decay. Then identify the y-intercept.

a. $y = 2(1.85)^x$

b.

c. $y = 3\left(\frac{1}{3}\right)^x$

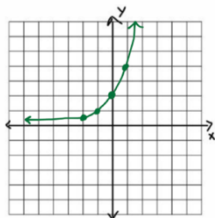d. You deposit $1000 into a savings account that earns 5% interest each year.

Exercise 1: Growth vs. Decay

For each of the following below, determine whether it represents growth or decay. Then identify the y-intercept.

a. $y = \frac{5}{2}(0.25)^x$

b.

c. A car that was bought for $15,000 depreciates by 10% each year.

d. $y = 1.2\left(\frac{7}{3}\right)^x$

Skill 2: Exponential Growth & Decay Word Problems

An 8- year lease for office space states that the annual rent is $92,000 for the first year and will increase by 4% each additional year of the lease.

a. Write an equation that represents the total rent expense, $r(x)$ after x years.

b. What will the total rent expense be for the entire 8-year lease?

Exercise 2: Exponential Growth & Decay Word Problems

A tennis ball is dropped from a height of 45 feet. It bounces and rebounds 80% of the height from which it was falling.

a. Write an equation that represents the total height of the tennis ball, $h(x)$ after x bounces.

b. What is the total downward distance, in feet, the ball traveled on the 10th bounce?

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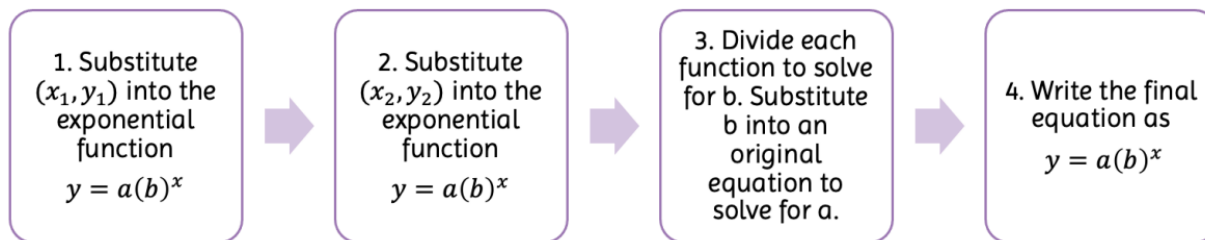
Skill 3: Exponential Equations from Two Points

Manatees, an aquatic animal, also known as sea cows, are found in shallow bodies of water, especially on the coasts of Florida, where they migrate for the winter. Unfortunately, due to climate change, manatees are declining at a rapid rate. In 2017, there were an estimated 6,620 manatees in Florida's waters. In 2019, there were an estimated 5,733 manatees. Given that y represents the population of manatees and x represents the number of years since 2017, do the following:

a. Determine the two coordinate points described in the description above.

b. Determine an exponential function in the form $y = a(b)^x$ to represent the decline of manatees over the given time frame. Round values to the nearest hundredth.

c. If the manatees continue to decline at this rate, determine how many manatees will be estimated in the year 2023.

Recap of writing exponential equations from two points:

Writing the equation of an Exponential Function

1. Substitute (x_1, y_1) into the exponential function $y = a(b)^x$	2. Substitute (x_2, y_2) into the exponential function $y = a(b)^x$	3. Divide each function to solve for b. Substitute b into an original equation to solve for a.	4. Write the final equation as $y = a(b)^x$

Exercise 3: Exponential Equations from Two Points

A fitness center has grown rapidly in population since it opened. The gym had 30 members after 1 month of being open and 270 members after 3 months of being open.

a. Determine an exponential function in the form $y = a(b)^x$ to model the fitness center's population where y represents the total members after x months.

b. What was the initial amount of people that joined the fitness center at the sign up? Explain what this represents in terms of the graph of the function you wrote in part a.

c. What is the growth factor?

Check Point

A baseball card has an initial trading value of $1200. The value of the card increases at a rate of 3.5% per year. What will the baseball card be worth after 12 years?

2.05- Problem Set

Name: _____

Multiple Choice

1. Given the exponential function $y = 4700(1.059)^x$, determine the percentage rate of increase or decrease.

   a. 59% *increase*   b. 5.9% *increase*   c. 105.9% *increase*   d. 1059% *increase*

2. Given the exponential function $y = 60(0.97)^x$, determine the percentage rate of increase or decrease.

   a. 97% *increase*   b. 97% *decrease*   c. 3% *increase*   d. 3% *decrease*

3. Given the equation $f(x) = 20(0.83)^x$

   I.   Choose one: Growth or Decay

   II. Which of the following is the initial value?

   a. 83   b. 20   c. 0.83   d. 17

   III. Which of the following is the rate of growth or decay?

   a. 83%   b. 20%   c. 0.83%   d. 17%

   IV. Determine the value of $f(3)$

4. A total of 400 contestants participate in a competition where the players are eliminated at a rate of 10% each day.

   I.   Choose one: Growth or Decay

   II. Which of the following is the equation that models this scenario?

   a. $y = 400(10)^x$ b. $y = 400(.10)^x$ c. $y = 400(0.9)^x$ d. $y = 400(1.10)^x$

   III. How many contestants are left at the end of the week?

   a. 40   b. 83   c. 320   d. 191