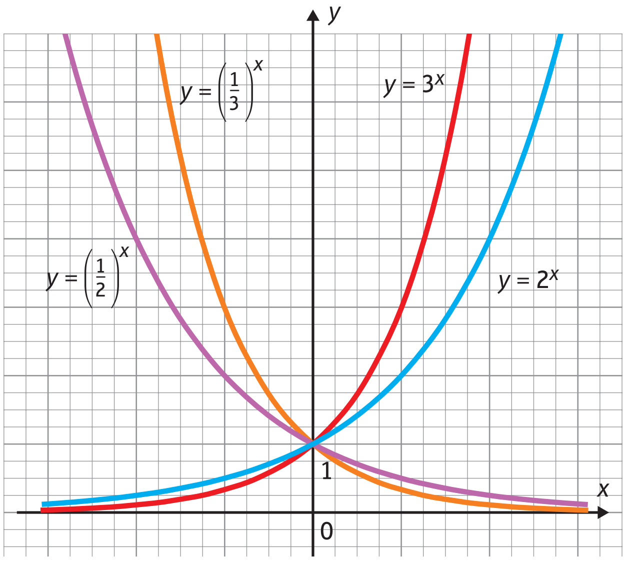
NAME: ______________________ PERIOD: ____________ DATE: ____________

Homework Problem Set

Use the image below for Problems 1–3.



Source: Nat White, University of Wisconsin-Milwaukee

1. What do you notice about these four exponential functions? List at least three similarities or differences.

   - All functions go through (0,1)
   - Functions w/ a BASE < 1 Model EXPONENTIAL DECAY
   - Functions w/a BASE >1 MODEL EXPONENTIAL GROWTH

2. Write an exponential function that would fall between $y = 3^x$ and $y = 2^x$. How do you know?

   $y = 2.75^x$

3. Write an exponential function that would fall between $y = \left(\frac{1}{2}\right)^x$ and $y = \left(\frac{1}{3}\right)^x$. How do you know?

   $y = \left(\frac{5}{12}\right)^x$

Pay It Forward and Exponential Growth

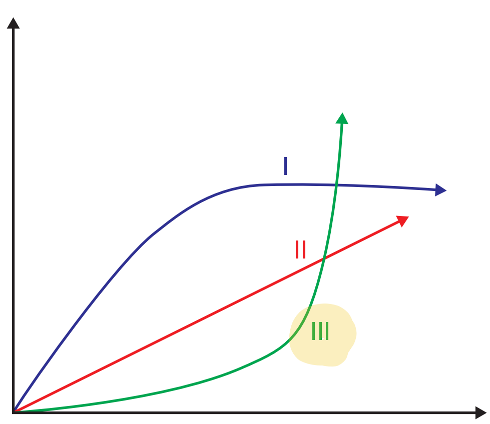
In the popular book and movie, *Pay It Forward*, 12-year-old Trevor McKinney gets a challenging assignment from his social studies teacher. *Think of an idea for world change, and put it into practice!* Trevor came up with an idea that fascinated his mother, his teacher, and his classmates.

He suggested that he would do something really good for three people. Then when they would ask how they can pay him back for the good deeds, he would tell them to "pay it forward"— each doing something good for three other people.

Trevor figured that those three people would do something good for a total of nine others. Those nine would do something good for 27 others, and so on. He was sure that before long there would be good things happening to billions of people all around the world.

Source: Emily Burkett on Algebra 4 All

4. Which of the graphs below do you think is most likely to represent the pattern by which the number of people receiving Pay It Forward good deeds increase as the process continues over time? Explain your choice.



GRAPH III → It's an Exponential GROWTH MODEL

5. Use the table below to look for patterns in the number of good deeds done and the total number of good deeds done.

Set of People	Number of good deeds done by this set of people	Total number of good deeds done
1st set—Trevor alone	3	3
2nd set—People Trevor helped	9	12 (3 from Trevor and 9 from the 2nd set of people)
3rd set	27	12 + 27 = 39
4th set	81	39 + 81 = 120
5th set	243	120 + 243 = 363
6th set	729	363 + 729 = 1092

6. Use Trevor's idea to create an equation to show how many good deeds would occur for each set of people (not the total number of good deeds).

$$f(x) = 3^x$$

7. Using your equation from Problem 6, how many good deeds would be done by the fourth set of people? Does your answer agree with the values in the table?

$$f(x) = 3^x$$
$$f(4) = 3^4 = 81$$

8. How many sets of people would be needed to get to 1,000,000 good deeds? Explain your thinking.

Guess & Check

$f(x) = 3^x$
$f(12) = 3^{12}$
$f(12) = 531{,}441$ people

$f(x) = 3^x$
$f(13) = 3^{13}$
$f(13) = 1{,}594{,}323$ people

Between 12 and 13 sets

9. Elaine came up with the formula below to find the **total** number of good deeds. Use Elaine's formula to see if it agrees with your values in the table.

$$f(x) = \frac{3^{x+1} - 3}{2}, \text{ where } x \text{ is the set number}$$

10. Determine how many sets of people it would take for 1,000,000 **total** good deeds to be achieved.

11. Trevor says it wouldn't take long to reach a billion people. Do you agree with Trevor? Suppose each good deed takes at least a week to complete, how long would it take to complete a billion good deeds?