Warm-up

Simplify. Your answer should contain only positive exponents.

1) $\frac{2^4 \cdot 2^3}{2^2}$ $\quad \frac{2^7}{2^2} = 2^5$

$\frac{\cancel{2}\cdot\cancel{2}\cdot 2\cdot 2\cdot 2\cdot 2\cdot 2}{\cancel{2}\cdot\cancel{2}}$

2) $\frac{2^{-1} \cdot 2^4}{2^4}$ $\quad \frac{2^3}{2^4} = \frac{1}{2}$

3) $\frac{2}{\left(2^{-1}\right)^0 \cdot 2^0}$ $\quad = 2$

4) $\frac{2^2}{2^3 \cdot 2^4}$ $\quad = \frac{2^2}{2^7} = \frac{1}{2^5}$

Jan 4-10:29 AM

Exponential Laws	Examples
$a^1 = a$	$5^1 = 5$ $\quad x^1 = x$ $\quad \pi^1 = \pi$
$a^0 = 1$	$5^0 = 1$ $\quad x^0 = 1$ $\quad \pi^0 = 1$
$a^{-1} = \frac{1}{a}$	$3^{-1} = \frac{1}{3}$, $\frac{1}{4^{-1}} = 4$, $\left(\frac{x}{y}\right)^{-1} = \frac{y}{x}$
$a^m a^n = a^{m+n}$	$2^4 \cdot 2^3 = 2\cdot2\cdot2\cdot2\cdot2\cdot2\cdot2 = 2^7$
$\frac{a^m}{a^n} = a^{m-n}$	$\frac{5^3}{5^5} = \frac{5\cdot5\cdot5}{5\cdot5\cdot5\cdot5\cdot5} = \frac{1}{5^2}$, $\frac{3^4}{3^2} = \frac{3\cdot3\cdot3\cdot3}{3\cdot3} = 3^2$
$\left(a^m\right)^n = a^{mn}$	$\left(4^2\right)^4 = 4^2\cdot4^2\cdot4^2\cdot4^2 = 4^8$
$(ab)^n = a^n b^n$	$(3x)^3 = 3x\cdot3x\cdot3x = 3^3x^3$
$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$	$\left(\frac{4}{z}\right)^3 = \frac{4}{z}\cdot\frac{4}{z}\cdot\frac{4}{z} = \frac{4^3}{z^3}$
$a^{-n} = \frac{1}{a^n}$	$3^{-2} = \frac{1}{3^2}$, $\frac{1}{x^{-5}} = x^5$, $\left(\frac{z}{3}\right)^{-7} = \frac{3^7}{z^7}$
$a^{m/n} = \sqrt[n]{x^m}$	$5^{7/2} = \sqrt{5^7}$ $\quad x^{3/7} = \sqrt[7]{x^3}$
$= \left(\sqrt[n]{x}\right)^m$	$= \left(\sqrt{5}\right)^7$ $\quad = \left(\sqrt[7]{x}\right)^3$

power → $5^{7/2}$ ← root

Jan 4-11:28 AM

SOLVING QUADRATIC & OTHER EQUATIONS- 3.1

3.1 The In-Betweeners

A Develop Understanding Task

Now that you've seen that there are contexts for continuous exponential functions, it's a good idea to start thinking about the numbers that fill in between the values like 2^2 and 2^3 in an exponential function. These numbers are actually pretty interesting, so we're going to do some exploring in this task to see what we can find out about these "in-betweeners".

Let's begin in a familiar place:

1. Complete the following table.

x	0	1	2	3	4
$f(x) = 4 \cdot 2^x$	4	8	16	32	64

$4 \cdot 2$ $\quad 4 \cdot 2^2$ $\quad 4 \cdot 2^3$ $\quad 4 \cdot 2^4$

2. Plot these points on the graph at the end of this task, and sketch the graph of $f(x)$.

Oct 16-4:34 PM

Let's say we want to create a table with more entries, maybe with a point halfway between each of the points in the table above. There are a couple of ways that we might think about it. We'll begin by letting our friend Travis explain his method.

Travis makes the following claim:

"If the function doubles each time x goes up by 1, then half that growth occurs between 0 and ½ and the other half occurs between ½ and 1. So for example, we can find the output at x = ½ by finding the average of the outputs at x = 0 and x = 1." → true? picture the graph →

3. Fill in the parts of the table below that you've already computed, and then decide how you might use Travis' strategy to fill in the missing data. Also plot Travis' data on the graph at the end of the task.

Travis' way:

x	0	$\frac{1}{2}$	1	$\frac{3}{2}$	2	$\frac{5}{2}$	3	$\frac{7}{2}$	4
$f(x)$	4	6	8	12	16	24	32	48	64

middle #

Oct 16-4:35 PM

4. Comment on Travis' idea. How does it compare to the table generated in problem 1? For what kind of function would this reasoning work?

Miriam suggests they should fill in the data in the table in the following way:

"I noticed that the function increases by the same factor each time x goes up 1, and I think this is like what we did last year *Geometric Meanies*. To me it seems like this property should hold over each half- interval as well."

5. Fill in the parts of the table below that you've already computed in problem 1, and then decide how you might use Miriam's idea to fill in the missing data. As in the table in problem 1, each entry should be multiplied by some constant factor to get the next entry, and that factor should produce the same results as those already recorded in the table. Use this constant factor to complete the table. Also plot Miriam's data on the graph at the end of this task.

$\times 2$

x	0	$\frac{1}{2}$	1	$\frac{3}{2}$	2	$\frac{5}{2}$	3	$\frac{7}{2}$	4
$f(x)$	4	$4\sqrt{2}$	8	$4(\sqrt{2})^3$	16	$4(\sqrt{2})^5$	32	$4(\sqrt{2})^7$	64

$\sqrt{2}$ $\sqrt{2}$ $\sqrt{2}$ $\sqrt{2}$ $\sqrt{2}$

5.65 $4\cdot 2^{\frac{3}{2}}$ ~ 11.3137 $4\cdot 2^{\frac{5}{2}}$ ~ 22.6274 $4\cdot 2^{\frac{7}{2}}$ ~ 45.2548

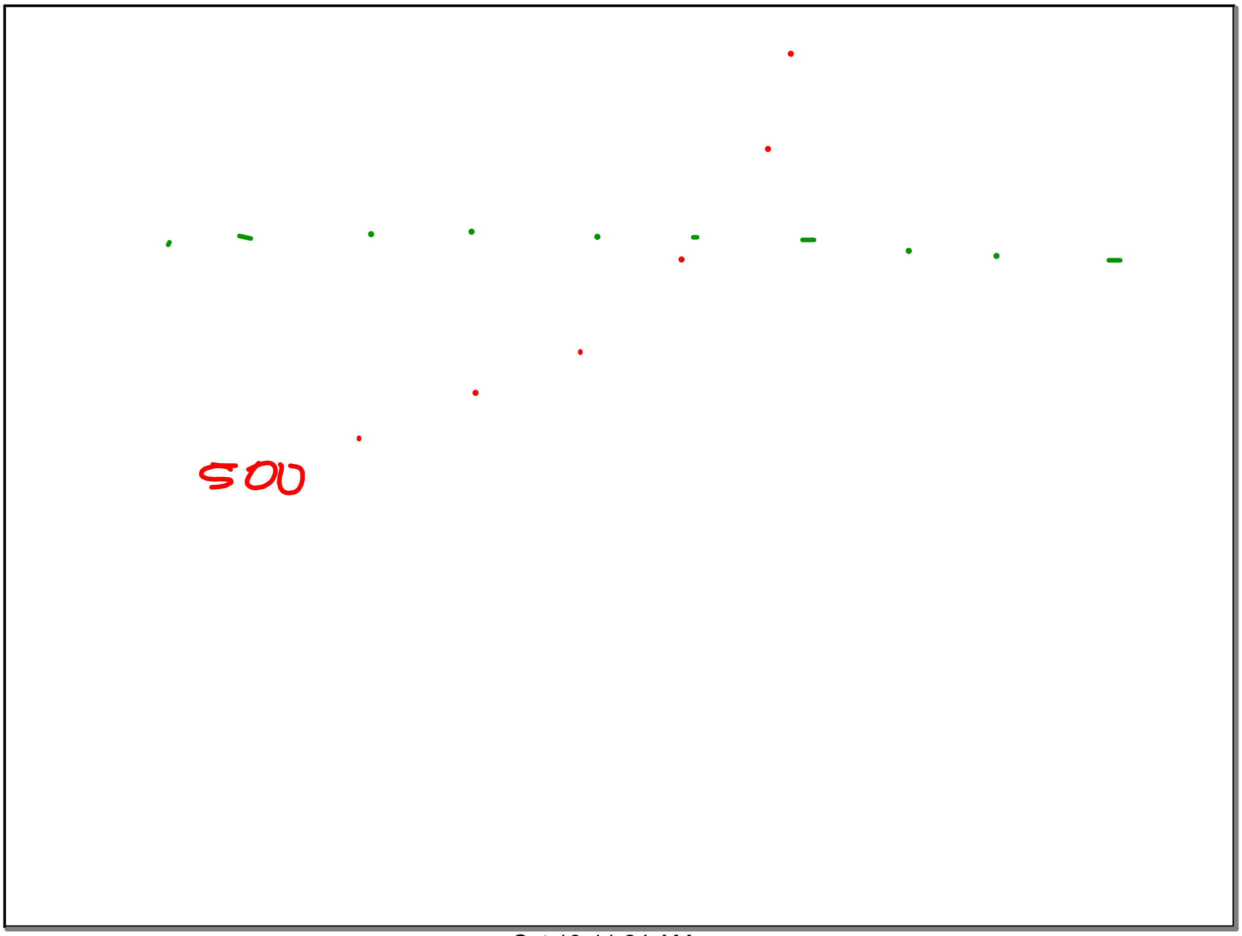
$\frac{4(x)^2}{4}=\frac{8}{4}$

$x^2=2$

$x=\pm\sqrt{2}$

but not negative situation so just use positive.

Oct 16-4:35 PM



Oct 18-11:24 AM

6. What if Miriam wanted to find values for the function every third of the interval instead of every half? What constant factor would she use to be consistent with the function doubling as x increases by 1. Use this multiplier to complete the following table.

x	0	$\frac{1}{3}$	$\frac{2}{3}$	1	$\frac{4}{3}$	$\frac{5}{3}$	2	$\frac{7}{3}$	$\frac{8}{3}$	3
$f(x)$	4	$4\cdot 2^{1/3}$	$4\cdot 2^{2/3}$	8 ($4\cdot 2^{3/3}$)	$4\cdot 2^{4/3}$	$4\cdot 2^{5/3}$	$4\cdot 2^{6/3}$ $4\cdot 2^{2}$ 16 ✓	$4\cdot 2^{7/3}$	$4\cdot 2^{8/3}$	$4\cdot 2^{9/3}$ $4\cdot 2^{3}$ 32 ✓

$4x^3=8$

$x^3=2 \quad x=\sqrt[3]{2}=2^{1/3}$

7. What number did you use as a constant factor to complete the table in problem 5?

$\sqrt{2}=2^{1/2}$

8. What number did you use as a constant factor to complete the table in problem 6?

$\sqrt[3]{2}=2^{1/3}$

9. Give a detailed description of how you would estimate the output value $f(x)$, for $x = \frac{5}{3}$.

power $\rightarrow$ 5

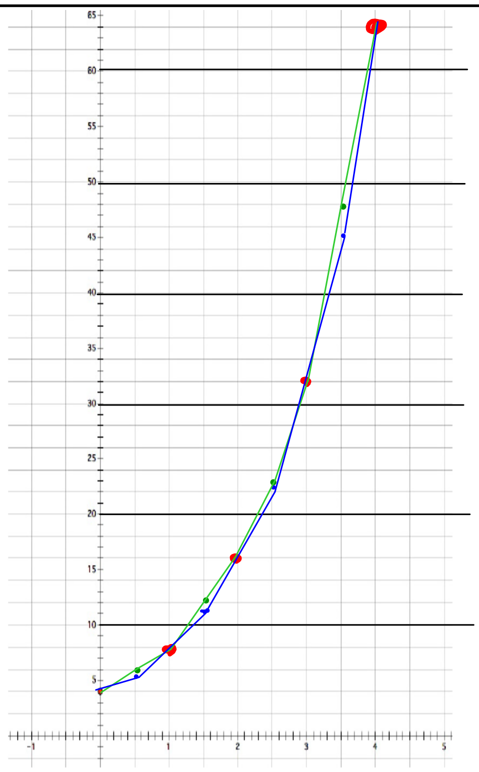
$x^{5/3}$ $\leftarrow$ root

$\underbrace{\sqrt[3]{x}\cdot\sqrt[3]{x}\cdot\sqrt[3]{x}\cdot\sqrt[3]{x}\cdot\sqrt[3]{x}}_{5} =$

or

$\sqrt[3]{\underbrace{x\cdot x\cdot x\cdot x\cdot x}_{5}}$

Oct 16-4:35 PM



Oct 16-4:39 PM

SECONDARY MATH II // MODULE 3
SOLVING QUADRATICS & OTHER EQUATIONS – 3.1

3.1

READY, SET, GO! Name Period Date

READY

Topic: Comparing Additive and Multiplicative Patterns

The sequences below exemplify either an additive (arithmetic) or a multiplicative (geometric) pattern. Identify the type of sequence, fill in the missing values on the table and write an equation.

1.

Term	1st	2nd	3rd	4th	5th	6th	7th	8th
Value	2	4	8	16	32			

a. Type of Sequence: b. Equation:

2.

Term	1st	2nd	3rd	4th	5th	6th	7th	8th
Value	66	50	34	18				

a. Type of Sequence: b. Equation:

3.

Term 0	1st	2nd	3rd	4th	5th	6th	7th	8th
Value 1	-3	9	-27	81				

$\div -3$ $\times -3$

a. Type of Sequence: geo b. Equation: $y = 1(-3)^x$

4.

Term	1st	2nd	3rd	4th	5th	6th	7th	8th
Value	160	80	40	20				

a. Type of Sequence: b. Equation:

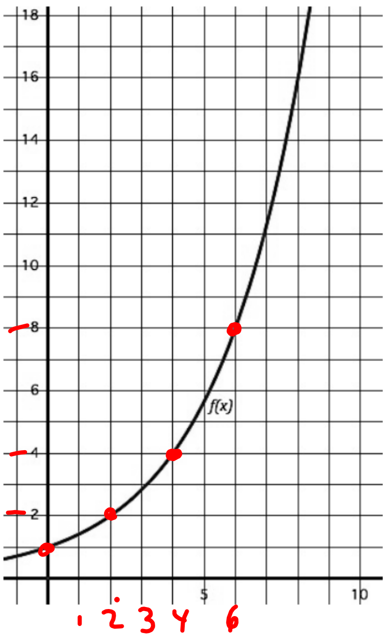
5.

Term	1st	2nd	3rd	4th	5th	6th	7th	8th
Value	-9	-2	5	12				

a. Type of Sequence: b. Equation:

Oct 16-4:36 PM

Use the graph of the function to find the desired values of the function. Also create an explicit equation for the function.



6. Find the value of *f(2)*

7. Find where *f(x) = 4*

8. Find the value of *f(6)*

9. Find where *f(x) = 16*

10. What do you notice about the way that inputs and outputs for this function relate? (Create an in-out table if you need to.)

x	y
0	1
1	
2	2
3	
4	4
5	
6	8

$\sqrt{2} = 2^{1/2}$
$\sqrt{2} = 2^{1/2}$
$\sqrt{2}$

11. What is the explicit equation for this function?

$y = 1(\sqrt{2})^x$

or $y = 1(2)^{\frac{x}{2}}$

Oct 16-4:37 PM

SET

Topic: Evaluate the Expressions with Rational Exponents

Fill in the missing values of the table based on the growth that is described.

$\sqrt{x} = x^{1/2}$

$\sqrt[3]{x} = x^{1/3}$

12. The growth in the table is triple at each whole year.

Years	0	½	1	3/2	2	5/2	3	7/2	4
bacteria	2	$2\cdot\sqrt{3}$	6	$6\cdot\sqrt{3}$	18	$2\cdot(\sqrt{3})^5$			

$x^2 = 3$

$x = \sqrt{3}$

$\times 3$

$2\cdot 3^{5/2}$

13. The growth in the table is triple at each whole year.

Years	0	⅓	⅔	1	4/3	5/3	2	7/3	8/3
bacteria	2	$2\cdot 3^{1/3}$	$2\cdot 3^{2/3}$	6					

$2\cdot 3^{3/3=1}$

$x^3 = 3$

$x = \sqrt[3]{3}$

$\sqrt[3]{3} = 3^{1/3}$

$(\sqrt[3]{3})^2 \quad (\sqrt[3]{3})^3$

$\times 3$

14. The values in the table grow by a factor of four at each whole year.

Years	0	½	1	3/2	2	5/2	3	7/2	4
bacteria	2		8						

$\times 2 \quad \times 2$

$\times 4$

Oct 16-4:37 PM

GO

Topic: Simplifying Exponents

Simplify the following expressions using exponent rules and relationships, write your answers in exponential form. (For example: $2^2 \cdot 2^5 = 2^7$)

15. $3^2 \cdot 3^5$

16. $\frac{5^3}{5^2}$

17. 2^{-5}

18. 17^0

19. $\frac{7^5}{7^2} \cdot \frac{7^3}{7^4}$

20. $\frac{3^{-2} \cdot 3^5}{3^7}$

Oct 16-4:38 PM