Unit 6 Day 9

Warm-Up:

1. Simplify $(3x^4y^{-6})(5x^{-2}y^9)^{-2}$

$$\frac{3x^4y^{-6}}{(5x^{-2}y^9)^2} = \frac{3xy^{-6}}{25x^{-4}y^{18}} = \frac{3xx^4}{25y^{18}y^6} = \boxed{\frac{3x^5}{25y^{24}}}$$

2. Find the x- and y-intercepts of $2x-3y=18$.

(9,0) (0,-6) $2x=18$ $-3y=18$

$x=9$ $y=-6$

3. Are the following lines parallel, perpendicular, or neither:

$$y=\frac{1}{6}x+8$$

$$-2x+12y=-11$$

$12y=2x-11$

$y=\frac{1}{6}x-\frac{11}{12}$

parallel

Linear VS Exponential Investigation

Linear Function	Exponential Function
$f(x) = mx + b$	$f(x) = a \cdot b^x$
b is the *starting value*, m is the *rate* or the *slope*. m is positive for growth, negative for decay.	a is the *starting value*, b is the *base* or the *multiplier*. $b > 1$ for growth, $0 < b < 1$ for decay. See below for ways to find the base b.
Arithmetic Sequences model Linear functions which means there is a **common difference** being added or subtracted to the y values.	Geometric Sequences model Exponential functions which means the y values are being multiplied by a **common ratio**.

PRACTICE

1. **Decide whether the word problem represents a linear or exponential function. Circle either linear or exponential. Then, write the function formula.**

a. "A library has 8000 books, and is adding 500 more books each year."

(Linear) or exponential? $y =$ 8000 + 500x.

b. "A gym's customers must pay $50 for a membership, plus $3 for each time they use the gym."

(Linear) or exponential? $y =$ 50 + 3x.

c. "A bank account starts with $10. Every month, the amount of money in the account is tripled."

Linear or (exponential)? $y =$ $10(3)^x$.

d. "At the start of a carnival, you have 50 ride tickets. Each time you ride the roller coaster, you have to pay 6 tickets."

(Linear) or exponential? $y =$ 50 - 6x.

e. "There are 20,000 owls in the wild. Every decade, the number of owls is halved."

Linear or (exponential)? $y =$ $20{,}000(1/2)^x$.

2. Decide whether the table represents a linear or exponential function. Circle either linear or exponential. Then, write the function formula.

a.

x	0	1	2	3	4	5	6	7
y	2	5	8	11	14	17	20	23

+ 3

Linear or exponential? $y =$ $3x + 2$.

b.

x	0	1	2	3	4	5	6	7
y	3	6	12	24	48	96	192	384

• 2

Linear or exponential? $y =$ $3(2)^x$.

c.

x	0	1	2	3	4	5	6	7
y	10	5	2.5	1.25	.625	.3125	.15625	.078125

÷ 2

Linear or exponential? $y =$ $10(1/2)^x$.

d.

x	0	1	2	3	4	5	6	7
y	12	8	4	0	-4	-8	-12	-16

- 4

Linear or exponential? $y =$ $12 - 4x$

e.

x	0	1	2	3	4	5	6	7
y	50	35	24.5	17.15	12.005	8.4035	5.88245	4.117715

• 0.70

Linear or exponential? $y =$ $50(.70)^x$

f.

x	0	1	2	3	4	5	6	7
y	40	35	30	25	20	15	10	5

- 5

Linear or exponential? $y =$ $40 - 5x$

g.

x	0	1	2	3	4	5	6	7
y	.4	.6	.9	1.35	2.025	3.0375	4.55625	6.834375

Linear or exponential? $y =$ $0.4(1.5)^x$

3. **Without a calculator**, make a table for $f(x) = \frac{1}{2}x + 8$ and for $f(x) = 8 \cdot (\frac{1}{2})^x$.

Express answers as fractions

x	$f(x) = \frac{1}{2}x + 8$
0	8
1	8.5
2	9
3	9.5
4	10
5	10.5
6	11

x	$f(x) = 8 \cdot (\frac{1}{2})^x$ in fractions
0	8
1	4
2	2
3	1
4	1/2
5	1/4
6	1/8

4. Compare and Contrast the two tables above

table 1
increasing by 1/2 (add)

table 2
decreasing by a factor of 1/2 (divide)

5. A science experiment involves periodically measuring the number of mold cells present on a piece of bread. At the start of the experiment, there are 50 mold cells. Each time a periodic observation is made, the number of mold cells triples. For example, at observation #1, there are 150 mold cells.

   a. Write a function formula equation ($y = \cdots$) for the number of mold cells present, where x stands for the observation number.

$$y = 50(3)^x$$

   b. Fill in the missing outputs of this table.

x = observation number	0	1	2	3	4	5
y = mold cell count	50	150	450	1350	4050	12150

   c. Suppose that the mold begins to be visible as green coloration when the mold cell count exceeds 100,000. On which observation will this happen?

3

   d. What will be the mold cell count on the 20th observation? When you find the answer on your calculator, it will be so large that it displays in scientific notation (E notation). Rewrite the answer as an ordinary big number.

$50(3)^{20} = 1.743392201\ E11$

174,000,000,000

6. Julie gets a pre-paid cell phone. Initially she has a $40.00 balance on the phone. Each minute of talking costs $0.15.

Let x stand for the amount of time in minutes that Julie has talked on the phone, and let $f(x)$ stand for the remaining dollar value of the phone.

a. Is $f(x)$ a linear function or an exponential function? Explain how you know.

subtract 15¢ per min.

b. Find a function formula equation $f(x) =$ $40 - .15x$

c. Find the value of $f(0)$ and explain its meaning in terms of the cell phone.

$f(0) = \$40$ the initial balance on the phone

d. Find the value of $f(100)$ and explain its meaning in terms of the cell phone.

$f(100) = \$25$ the value of the phone after 100 min.

e. Find the value of x that makes $f(x) = 10$, and explain its meaning in terms of the cell phone.

$10 = 40 - .15x$ $x = 200$ the phone's value is $10 after 200 minutes

f. Find the value of x that makes $f(x) = 0$, and explain its meaning in terms of the cell phone.

$x = 266.\overline{6}$ the max. amt. of min. is 266

Sketch a graph of the function $y = 3 \cdot 2^x$ on the axes below. **Be sure to label the y-intercept.**

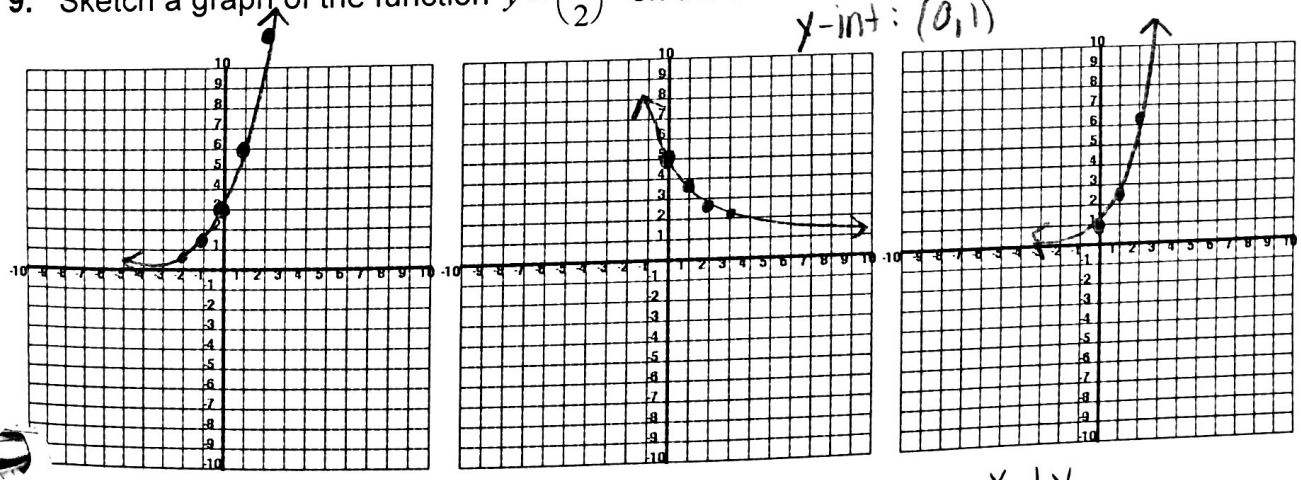
Hint: the y-intercept is the starting amount y-int: (0, 3)

8. Sketch a graph of the function $y = 5 \cdot \left(\frac{3}{4}\right)^x$ on the axes below. Be sure to label the y-intercept.

y-int: (0, 5)

9. Sketch a graph of the function $y = \left(\frac{5}{2}\right)^x$ on the axes below. Be sure to label the y-intercept.

y-int: (0, 1)



X	Y
0	5
1	3.75
2	2.8125
3	2.1094

X	Y
0	1
1	2.5
2	6.25
3	15.625

Day 9 Homework Worksheet

$a(1+r)^x$ $\quad y = a(1-r)^x$ $\quad A = P\left(1+\frac{r}{n}\right)^{nt}$

Show all work, including set up, ON A SEPARATE PIECE OF PAPER.

1. In 2000, the United States had a population of about 280 million, and a growth rate of about 0.85% per year. Write an equation to represent the population of the US since the year 2000. According to the equation, what will be the population of the US in 2011? .0085 307.32 million
2. The population of Johnson City in 1995 was 25, 000. Since then the population has increased at an average rate of 3.2% per year. Write an equation to represent the population of Johnson City since 1995. According to the equation, what will be the population of Johnson City in the year 2011? 41,382.35
3. During an economic recession, a charitable organization bound that its donations dropped by 1.1% per year. Before the recession, its donations were $390,000. Write an equation to represent the charity's donations since the beginning of the recession. Estimate the amount of donations 5 years after the start of the recession. $369,016.74
4. A computer valued at $6500 depreciates at the rate of 14.3% per year. Write a function that models the value of the computer and find the value of the computer after 3 years. $4,091.25
5. Suppose Karen has $1000 that she invests in an account that pays 3.5% interest compounded quarterly. How much does Karen have at the end of 5 years? $1,190.34
6. William wants to have a total of $4000 in two years so that he can put a hot tub on his deck. He finds an account that pays 5% interest compounded monthly. How much should William put into this account so he'll have $4000 at the end of two years? $3,620.10
7. A car is valued at $18,450 when brand new, but its value depreciates at an annual rate of 15.2%. What will the value of the car be after 6 years? $6,860.75
8. The population of a particular species of bird increases at 2.5% annually. If there are 246 of the birds living in a region, how many will there be after 10 years? (Round to the nearest whole number) 315
9. Kelly plans to put her graduation money into an account and leave it there for 4 years while she goes to college. She receives $750 in graduation money that she puts into an account that earns 4.25% interest compounded semi-annually. How much will be in Kelly's account at the end of four years? $887.46
10. A man invests $10,000 in an account that pays 8.5% interest per year, compounded quarterly. What is the amount of money that he'll have after 3 years? $12,870.19
11. A car is now worth $7,699.77 after 5 years. The value of the car depreciates at a rate of 13.5% each year. Find the original value of the car. 15,900
12. The population of a small town in North Carolina is currently 5,375. If the growth rate has been 3% over the past 10 years, what was the population 10 years ago? $3,999.50
13. A necklace is appraised at $6300. If the value of the necklace has increased at an annual rate of 7%, how much was it worth 15 years ago? $2,283.41
14. Suppose $2500 is invested at an annual rate of 6%. If the interest is compounded quarterly, find the value of the account after 5 years. $3,367.14
15. Find the amount Erica owes at the end of three years if $6000 is loaned to her at a rate of 8% compounded monthly. How much interest did she pay?

$7,621.42