Word Problems using Exponential Growth and Decay

HW 9-7

Questions 1 and 2: See next slide for solutions

3. 2

4. Reflection over the x-axis, Right 3, Down 2

5. Left 3, Up 10

6. $y = (27.2025)(1.1509)^x$

6. $x^{\frac{7}{4}}$

7. $11^{\frac{3}{7}}$

8. $27x^6$

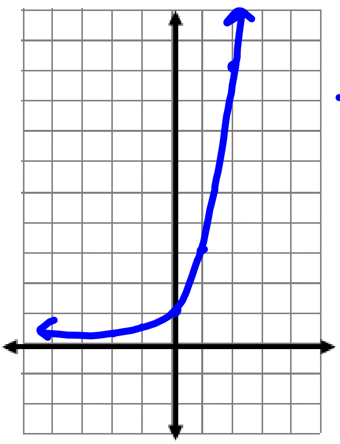
9. $a^{\frac{1}{4}}$

10. 3

Name________________________________ Alg 2 HW9-7

1. Graph $y = 3^x$

Show a table of values.



x	y
-2	1/9
-1	1/3
0	1
1	3
2	9

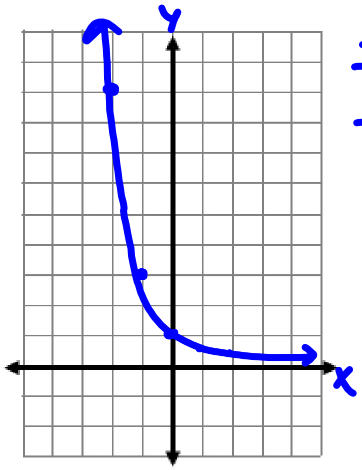
Exponential growth or decay?(Circle One)

Domain $\{x \mid x \in \mathbb{R}\}$

Range $\{y \mid y > 0\}$

2. Graph $y = 3^{-x}$

Show a table of values.



x	y
-2	9
-1	3
0	1
1	$\frac{1}{3}$
2	$\frac{1}{9}$

Exponential growth or decay?(Circle One)

Domain $\{x \mid x \in \mathbb{R}\}$

Range $\{y \mid y > 0\}$

3. Which statement is always true about the graph of $f(x) = \left(\frac{1}{8}\right)^x$?

1. The graph is always increasing.
2. The graph is always decreasing.
3. The graph passes through the point (1, 0).
4. The graph has an asymptote, x = 0.

State the transformations of the following functions.

4. $y = -3^{x-3} - 2$

① r x-axis ③ down 2
② right 3

5. $y = 2^{x+3} + 10$

① left 3
② up 10

6. A population of single celled-organisms was grown in a petri dish over a period of 16 hours. The number of organisms at a given time is recorded in the table below. Determine the exponential regression equation model, rounding all values to the ***nearest ten-thousandth***.

Time, hrs (x)	0	2	4	6	8	10	12	16
Number of Organisms (y)	25	36	52	68	85	104	142	260

$$y = (27.2025)(1.1509)^x$$

Simplify.

6. $x^{\frac{1}{4}} \bullet x^{\frac{3}{2}}$ $= x^{1/4} \cdot x^{6/4}$

$= x^{7/4}$

7. $\dfrac{11^{\frac{5}{7}}}{11^{\frac{2}{7}}}$ $= 11^{5/7 - 2/7}$

$= 11^{3/7}$

8. $(9x^4)^{\frac{3}{2}}$ $= 9^{3/2} x^{12/2}$

$= (\sqrt{9})^3 \cdot x^6$

$= 27x^6$

9. $\dfrac{a^{\frac{1}{3}} \bullet \sqrt[6]{a}}{a^{\frac{1}{4}}}$ $= \dfrac{a^{1/3} \cdot a^{1/6}}{a^{1/4}}$

$= \dfrac{a^{4/12} \cdot a^{2/12}}{a^{3/12}} = \dfrac{a^{6/12}}{a^{3/12}} = a^{3/12} = a^{1/4}$

10. The value(s) of x that satisfy $\sqrt{x^2 - 4x - 5} = 2x - 10$

1. {5}
2. {7}
3. {5,7}
4. {3,5,7}

$x^2 - 4x - 5 = (2x - 10)^2$

$x^2 - 4x - 5 = 4x^2 - 40x + 100$

$\underline{-x^2} \quad \underline{+4x} \quad \underline{+5} \qquad \underline{-x^2} \quad \underline{+4x} \quad \underline{+5}$

$\frac{3x^2}{3} \frac{-36x}{3} + \frac{105}{3} = \frac{0}{3}$

$x^2 - 12x + 35 = 0$

$(x-7)(x-5) = 0$

$x - 7 = 0 \quad x - 5 = 0$

$x = 7 \quad x = 5$

Check $x = 7$

$\sqrt{49 - 28 - 5} = 14 - 10$

$\sqrt{16} = 4$

$4 \overset{\checkmark}{=} 4$

$x = 5$

$\sqrt{25 - 20 - 5} = 10 - 10$

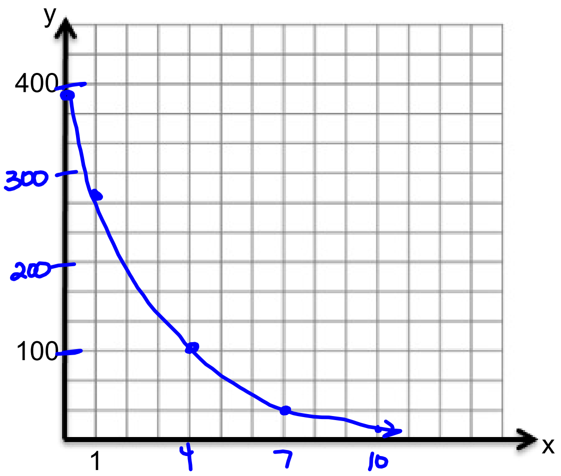
$\sqrt{0} = 0$

$0 \overset{\checkmark}{=} 0$

Warm-up

Unit 9 Day 8

Graph $y = 400(.85)^{2x} - 6$



x	0	1	4	7	10
y	394	283	103	35	10

Find the average rate of change for the interval of $1 \le x \le 4$

$$\frac{\Delta y}{\Delta x} = \frac{103 - 283}{4 - 1} = \frac{-180}{3} = -60$$

Word Problems Involving Exponential Functions:

$A(t) = a(1 \pm r)^t$ think: end = start $(1 \pm r)^{time}$

where:

$A(t) \rightarrow$ Ending amount

$a \rightarrow$ starting amount

$(1 \pm r) \rightarrow$ growth or decay factor

$r \rightarrow$ Rate of growth or decay (as a decimal)

$t \rightarrow$ time (same units as rate)

For 1 & 2, given the equation, determine

a. increasing or decreasing
b. the initial amount
c. the rate of change
d. the growth/decay factor
e. Find P(3) to the nearest hundredth

1. $P(t) = 6000(.8)^t$

a) decreasing
b) 6000
c) $.8 = 80\%$ change from 100%? 20% ↓
d) .8
e) $P(3) = 6000(.8)^3 = 3072$

2. $P(t) = 10{,}000(1.25)^t$

a) increasing
b) 10,000
c) $1.25 = 125\% \rightarrow 25\% \uparrow$
d) 1.25
e) $P(3) = 10{,}000(1.25)^3$
19,531.25

$-.15 = r$

3. A certain car depreciates about 15% each year.

a

   a. Write a function to model the depreciation in value for a car valued at $25,000.
   b. Suppose the car was worth $25,000 in 2013. How much will the car be worth in 2018?

$A(t) = a(1 \pm r)^t$

a) $V(t) = 25000(1-.15)^t = 25000(.85)^t$

b) $t = 2018 - 2013 = 5$

$V(5) = 25000(.85)^5 = \$11,092.63$

4. Weeds are growing in Tony's front lawn at a rate of 5% per week. The lawn is 7500 square feet. If there are 40 square feet covered with weeds now, how many square feet, to the nearest integer, of the lawn will be covered with weeds after 7 weeks? **Hint: Write the function first and then evaluate for 7 weeks.**

$W(t) = 40(1+.05)^t$

$W(t) = 40(1.05)^t$

$W(7) = 40(1.05)^7 = 56.284\ldots \sim \boxed{56 \text{ sq.ft.}}$

5. In New York State, the minimum wage has grown exponentially. In 1966, the minimum wage was $1.25 an hour and in 2015, it was $8.75. Algebraically determine the $\overset{r}{\text{rate of growth}}$ to the *nearest percent*.

$A(t) = a(1+r)^t$

$t = 2015 - 1966$
49

$$\frac{8.75}{1.25} = \frac{1.25(1+r)^{49}}{1.25}$$

$$(7)^{1/49} = \left((1+r)^{49}\right)^{1/49}$$

$$1.0405 = 1+r$$

$$.0405 = r$$

x100 to get %

$$r = 4\%$$

Quiz #3