

# Exponential Functions

## Warm Up

Solve the following equations. Show all work! Check for extraneous solutions.

1. $12 = 4\sqrt{b-1}$	2. $\sqrt{2v-7} = v-3$	3. $(18-n)^{\frac{1}{2}} = \left(\frac{n}{8}\right)^{\frac{1}{2}}$
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## Exponential Function Review

Explain the difference between  $f(x)$  and  $g(x)$ . Write a function for each.

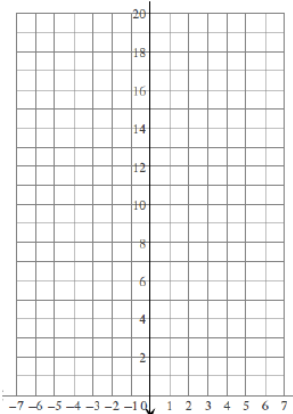
$x$	0	1	2	3	4	5
$f(x)$	5	7	9	11	13	15
$g(x)$	5	10	20	40	80	160

## ✓ Graphing Exponentials

Fill in the information regarding each exponential function, then graph.

1.  $y = 8 \cdot 0.5^x$

x	y
-2	
-1	
0	
1	
2	



Growth or Decay  
(circle)

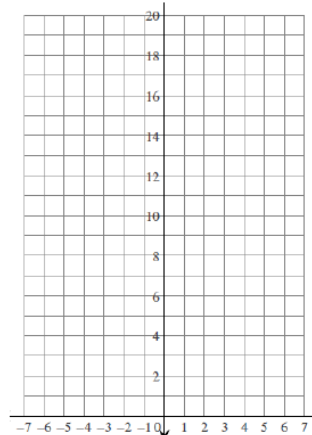
y-intercept:

\_\_\_\_\_

Horizontal asymptote: \_\_\_\_\_

2.  $y = 2(3)^x + 1$

x	y
-2	
-1	
0	
1	
2	



Growth or Decay (circle)

y-intercept:

\_\_\_\_\_

Horizontal asymptote: \_\_\_\_\_

$$y = a \cdot b^x$$

✓ Word Problem Type 1: General Exponential Form

Growth	Decay
$y = a(1 + r)^t$	$y = a(1 - r)^t$
A piece of artwork was initially worth \$400, but has increased in value each year by 9%. a.) Write a function. b.) What is the value of the artwork after 6 years? c.) How many years will it take for the art to be worth triple it's initial value?	Ms. Hahn bought a car in 2012 and it car was initially valued at \$19,000 and depreciates at a rate of 15% per year. a.) Write a function. b.) What is the value of the car after 4 years? c.) In what year will the car be worth \$5,000?

✓ Word Problem Type 2: Compound Interest n times per year

$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

A: amount after time t  
P: principle (initial value)  
r: interest rate per year  
n: number of compounding periods per year  
t: number of years

- What are some of the possible values of n?

Annually n =  
Semiannually n =

Quarterly n =  
Monthly n =

Daily n =

1. At 10% compounded quarterly, what will \$1,000 grow to in 10 years?	2. Suppose you invest \$6,000 at a rate of 7% compounded semi-annually. How much will the investment be worth in 5 years?	3. At 9% interest compounded monthly, what is the value of a \$3,500 investment after 8 years?
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✓ Word Problem Type 3: Continuous Compound Interest

$$A = Pe^{rt}$$

A: amount after time t  
 P: principle (initial value)  
 r: interest rate per year  
 t: number of years

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|---|--|
| 1. An amount of \$2340 is deposited in a bank paying an annual interest rate of 3.1% compounded continuously. Find the balance after 3 years. | 2. An amount of \$6,500 is deposited in a bank paying an annual interest rate of 5% compounded continuously. Find the balance after 4 years. |
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✓ Solving Exponentials with Logarithms

Solve the following equation. Round the value of x to the nearest hundredth.

$$3^x = 20$$

What difficulties are you having and why?



**Logarithm**

Let  $b$  be a positive where ( $b \neq 1$ ).

The logarithm to the base  $b$ , denoted  $\log_b x$  is defined as follows  $\log_b x = y$  if and only if  $b^y = x$

Change the following from exponential form to logarithmic form

- 1)  $16 = 4^2$                       2)  $243 = 3^5$                       3)  $\left(\frac{1}{2}\right)^4 = \frac{1}{16}$

Change the following from logarithmic form to exponential form.

- 4)  $\log_2 8 = 3$                       5)  $\log_4 16 = 2$                       6)  $\log_{\frac{2}{3}} \frac{16}{81} = 4$

So, convert equation form when solving exponential equations.

$$3^x = 20$$

Solve the following exponential equations using logarithms.

1.  $4^x = 250$

2.  $-2(5^x) = -734$

3.  $2^x + 9 = 92$

4.  $5e^x = 120$

5. The population of a small ant farm is 300, but is increasing at a monthly rate of 12%. How many months will it take for the ant farm to reach 1000 ants? Round to the nearest hundredth.

### Scavenger Hunt


## Practice

Read each sentence about a town's population change and determine the formula that matches the statement.

- \_\_\_\_\_ 1. A town starts with 500 people and grows by 50 people per year.
- \_\_\_\_\_ 2. A town starts with 500 people and grows by 50% per year.
- \_\_\_\_\_ 3. A town starts with 500 people and declines by 50% per year.
- \_\_\_\_\_ 4. A town starts with 500 people and declines by 50 people per year.

- a.  $y = 500(50)^t$                       d.  $y = 500(50t)$                       g.  $y = 500(t)^{50}$   
b.  $y = 500(0.50)^t$                       e.  $y = 500 + 50t$                       h.  $y = 500 - 50t$   
c.  $y = (500 \cdot 50)^t$                       f.  $y = 500(-0.50)^t$                       i.  $y = 500(1.5)^t$

5.

The population of a small town is 7,000, and is growing at a rate of 12% per year.

- a. Write an exponential equation to represent the population growth. \_\_\_\_\_  
b. What will the population of the town be in 15 years? \_\_\_\_\_

6.

There are 950 students enrolled in Math 150 at the beginning of the semester. If students drop at the rate of 1% per week, how many students will be enrolled during the 15<sup>th</sup> week of the semester?

7. James invests \$1500 for 20 years at a 6.25% annual interest rate. How much will be in the account if:

- a. the account is compounded annually                      b. the account is compounded monthly  
c. the account is compounded semiannually                      d. the account is compounded daily  
e. the account is compounded quarterly                      f. the account is compounded continuously

6. Congratulations! You have just won \$50,000! You decide to invest your money and the bank presents you with two investment options. You may either invest your \$50,000 at 5% interest, compounded monthly, for a period of 10 years OR you can invest that \$50,000 at 5% interest compounded continuously, for ten years. Which investment option will yield greater profit? WHY?