

## AGENDA

Objective:

- SWBAT Write equivalent forms (**conversions**) for exponential and logarithmic equations
- Use the **common log** function to solve exponential and logarithmic equations

Language Objective: SWBAT use a table to translate exponential and logarithmic equations into equivalent forms by writing the question each equation is representing.

- 1) Do Now
- 2) Intro to Logarithms
- 3) Conversions & the Common Log
- 4) Think...Pair...Share
- 5) Apply to the table
- 6) Exit Ticket

HW: "Logs Worksheet #1"

## Exponential and Log Functions (Sections 6.1 – 6.5 in Algebra 2)

At the end of this unit, you should be able to...

- ✓ Identify a linear, quadratic, or exponential function
  - ✓ Classify an exponential function as representing exponential growth or exponential decay
  - ✓ Determine the multiplier for exponential growth and decay
  - ✓ Write and evaluate exponential expressions to model growth and decay situations
  - ✓ Use the compound interest formula
- Write **equivalent forms** for **exponential** and **logarithmic** equations
  - Use the **common log** function to solve exponential and logarithmic equations
  - **Simplify and evaluate expressions** involving logarithms and the **properties** of logarithms
  - Use the definitions of exponential and logarithmic functions **to solve equations**
  - **Graph** exponential and logarithmic functions
  - **Model and solve real-world problems** involving exponential and logarithmic relationships

### DO NOW

1) Solve for x

a)  $8^x = 64$       b)  $3^x = 27$       c)  $2^x = 16$       d)  $10^x = 1,000,000$

x = \_\_\_\_\_

x = \_\_\_\_\_

x = \_\_\_\_\_

x = \_\_\_\_\_

2) A new YouTube video's views are increasing at a rate of 900% per week! If it was first created and had 4 views, and now 48,000 views, **how many weeks** has this video been online?  
(guess and check...)

## Exponential and Log Functions (Sections 6.1 – 6.5 in Algebra 2)

At the end of this unit, you should be able to...

- ✓ Identify a linear, quadratic, or exponential function
- ✓ Classify an exponential function as representing exponential growth or exponential decay
- ✓ Determine the multiplier for exponential growth and decay
- ✓ Write and evaluate exponential expressions to model growth and decay situations
- ✓ Use the compound interest formula

- Write **equivalent forms** for **exponential** and **logarithmic** equations
- Use the **common log** function to solve exponential and logarithmic equations
- Use the definitions of exponential and logarithmic functions **to solve equations**
- **Simplify and evaluate expressions** involving logarithms and the **properties** of logarithms
- **Graph** exponential and logarithmic functions
- **Model and solve real-world problems** involving exponential and logarithmic relationships

### DO NOW

1) Solve for x

a)  $8^x = 64$

b)  $3^x = 27$

c)  $2^x = 16$

d)  $10^x = 1,000,000$

x = 2

x = 3

x = 4

x = 6

2) A new YouTube video's views are increasing at a rate of 900% per week! If it was first created and had 4 views, and now 48,000 views, **how many weeks** has this video been online?  
(guess and check...)

$$48,000 = 4(1+9)^t$$

$$48,000 = 4(10)^t$$

$$12,000 = (10)^t$$

$$(10)^3 = 1000$$

$$(10)^4 = 10000 \rightarrow t \approx 3.1$$

## Logarithmic Functions

-used to solve for \_\_\_\_\_

-used for very **LARGE** or very small numbers

$$\log_b(y) = x$$

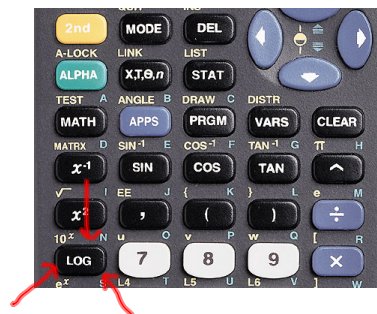
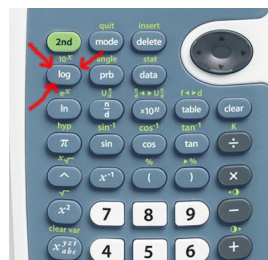
Exponentials

Logarithms

$$y = b^x$$

$$\log_b(y) = x$$

A new YouTube video's views are increasing at a rate of 900% per week! If it was first created and had 4 views, and now 48,000 views, **how many weeks** has this video been online?



## Logarithmic Functions

-used to solve for \_\_\_\_\_

-used for very **LARGE** or very small numbers

$$\log_b(y) = x$$

Exponentials

Logarithms

$$y = b^x$$

$$\log_b y = x$$

A new YouTube video's views are increasing at a rate of 900% per week! If it was first created and had 4 views, and now 48,000 views, **how many weeks** has this video been online?

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

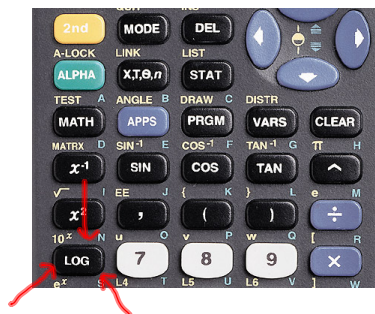
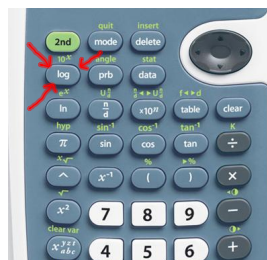
$$48,000 = 4(1+9)^t$$

$$12,000 = (10)^t$$

$$\log_b y = x \rightarrow \log_{10} 12,000 = t$$

$$\log(12,000) = 4.08$$

for about 4 weeks!



I. Conversions

$$y = (b)^x \qquad \log_b y = x$$

Write in logarithmic form.

1)  $4^2 = 16$

2)  $11^2 = 121$

3)  $6^{-2} = \frac{1}{36}$

Write in exponential form.

1)  $\log_5 25 = 2$

2)  $\log_6 36 = 2$

3)  $\log_{10} 1000 = 3$

II. Evaluating and Solving

Common Log  $\rightarrow b = \underline{\hspace{2cm}}$

$$y = 10^x \rightarrow \underline{\hspace{4cm}} \rightarrow \underline{\hspace{4cm}}$$

Ex A. Write in exponential form, logarithmic form, and solve!

1) "10 to what power is 100?"

2) "10 to what power is 240?"

Exponential: \_\_\_\_\_

Exponential: \_\_\_\_\_

Logarithmic: \_\_\_\_\_

Logarithmic: \_\_\_\_\_

Solution: \_\_\_\_\_

Solution: \_\_\_\_\_

We can use the  
calculator here!

I. Conversions

$$y = (b)^x \quad \log_b y = x$$

Write in logarithmic form.

1)  $4^2 = 16$

$\log_4(16) = 2$

2)  $11^2 = 121$

$\log_{11}(121) = 2$

3)  $6^{-2} = \frac{1}{36}$

$\log_6(1/36) = -2$

Write in exponential form.

1)  $\log_5 25 = 2$

$5^2 = 25$

2)  $\log_6 36 = 2$

$6^2 = 36$

3)  $\log_{10} 1000 = 3$

$10^3 = 1000$

II. Evaluating and Solving

Common Log  $\rightarrow b = \underline{10}$

$$y = 10^x \rightarrow \underline{\log_{10}(y) = x} \rightarrow \underline{\log(y) = x}$$

*no base assumes  $b=10$*

Ex A. Write in exponential form, logarithmic form, and solve!

1) "10 to what power is 100?"

Exponential:  $\underline{10^x = 100}$

Logarithmic:  $\underline{\log(100) = x}$

Solution:  $\underline{x=2}$

2) "10 to what power is 240?"

Exponential:  $\underline{10^x = 240}$

Logarithmic:  $\underline{\log(240) = x}$

Solution:  $\underline{x=2.38}$

We can use the  
calculator here!

Think...Evaluate...Pair...Share...

B. Evaluate each logarithmic expression

a)  $\log_{10} 1026$

b)  $\log_{10} 0.08$

C. Evaluate each equation for x. → (change to common log form)

a)  $10^x = 31$

b)  $10^x = 0.0054$

Fill in the following chart for each blank box and the solution for x.

Exponential	Question?	Logarithmic	Solution
$2^x = 8$	What <b>power</b> of 2 = 8?	$\text{Log}_2(8) = x$	$x = \underline{\quad}$
$3^x = 9$	What <b>power</b> of 3 = 9?	$\text{Log}_3(9) = x$	$x = \underline{\quad}$
$10^x = 1,000,000$		$\text{Log}_{10}(1,000,000) = x$	$x = \underline{\quad}$
$\left(\frac{1}{2}\right)^x = \frac{1}{4}$	What <b>power</b> of $\frac{1}{2} = \frac{1}{4}$ ?		$x = \underline{\quad}$
	What <b>power</b> of $5 = \frac{1}{25}$ ?	$\text{Log}_5\left(\frac{1}{25}\right) = x$	$x = \underline{\quad}$
$36^x = 6$			$x = \underline{\quad}$



Evaluate each logarithmic expression

a)  $\log_{10} 1026$

b)  $\log_{10} 0.08$

$\log(1026) = 3.01$

$\log(0.08) = -1.10$

Solve each equation for x. → (change to common log form)

a)  $10^x = 31$

b)  $10^x = 0.0054$

$\log(31) = 1.49$

$\log(0.0054) = -2.27$

Fill in the following chart for each blank box and the solution for x.

Exponential	Question?	Logarithmic	Solution
$2^x = 8$	What power of 2 = 8?	$\text{Log}_2(8) = x$	$x = \underline{3}$
$3^x = 9$	What power of 3 = 9?	$\text{Log}_3(9) = x$	$x = \underline{2}$
$10^x = 1,000,000$	What power of 10 = 10,000,000?	$\text{Log}_{10}(1,000,000) = x$	$x = \underline{6}$
$\left(\frac{1}{2}\right)^x = \frac{1}{4}$	What power of $\frac{1}{2} = \frac{1}{4}$ ?	$\text{Log}_{\frac{1}{2}}\left(\frac{1}{4}\right) = x$	$x = \underline{2}$
$(5)^x = \frac{1}{25}$	What power of 5 = $\frac{1}{25}$ ?	$\text{Log}_5\left(\frac{1}{25}\right) = x$	$x = \underline{-2}$
$36^x = 6$	What power of 36 = 6?	$\text{Log}_{36}(6) = x$	$x = \underline{1/2}$

Score: \_\_\_\_\_/ 8

Name \_\_\_\_\_

## Exit Ticket

1) Convert the following into logarithmic form:

$$5^3 = 125$$

2) Convert the following to exponential form:

$$\log_7 343 = 3$$

3) Use the calculator to solve the for the following:  
(round to 2 decimal places)

$$\log_{10} 900 = \underline{\hspace{2cm}}$$

Score: \_\_\_\_\_/ 8

Name \_\_\_\_\_

## Exit Ticket

1) Convert the following into logarithmic form:

$$6^4 = 1296$$

2) Convert the following to exponential form:

$$\log_4 1024 = 5$$

3) Use the calculator to solve the for the following:  
(round to 2 decimal places)

$$\log_{10} 500 = \underline{\hspace{2cm}}$$

Score: \_\_\_\_\_/ 8

Name \_\_\_\_\_

## Exit Ticket

1) Convert the following into logarithmic form:

$$5^3 = 125 \quad \log_5 125 = 3$$

2) Convert the following to exponential form:

$$\log_7 343 = 3 \quad 7^3 = 343$$

3) Use the calculator to solve the for the following:  
(round to 2 decimal places)

$$\log_{10} 900 = \underline{2.95}$$

Score: \_\_\_\_\_/ 8

Name \_\_\_\_\_

## Exit Ticket

1) Convert the following into logarithmic form:

$$6^4 = 1296 \quad \log_6 1296 = 4$$

2) Convert the following to exponential form:

$$\log_4 1024 = 5 \quad 4^5 = 1024$$

3) Use the calculator to solve the for the following:  
(round to 2 decimal places)

$$\log_{10} 500 = \underline{2.70}$$

HW: "Logs Worksheet #1"

**Table of powers.** Fill in the table below. Use exact numbers (fractions, not decimals.) You need to **memorize** these!

$2^x$	$3^x$	$4^x$	$5^x$	$6^x$	$7^x$	$8^x$	$9^x$	$10^x$
$2^{10} =$								
$2^9 =$								
$2^8 =$								
$2^7 =$								
$2^6 =$	$3^{-6} =$							
$2^5 =$	$3^{-5} =$	$4^{-5} =$	$5^{-5} =$					
$2^4 =$	$3^{-4} =$	$4^{-4} =$	$5^{-4} =$					$10^{-4} =$
$2^3 =$	$3^{-3} =$	$4^{-3} =$	$5^{-3} =$	$6^{-3} =$	$7^{-3} =$	$8^{-3} =$	$9^{-3} =$	$10^{-3} =$
$2^2 =$	$3^{-2} =$	$4^{-2} =$	$5^{-2} =$	$6^{-2} =$	$7^{-2} =$	$8^{-2} =$	$9^{-2} =$	$10^{-2} =$
$2^1 =$	$3^{-1} =$	$4^{-1} =$	$5^{-1} =$	$6^{-1} =$	$7^{-1} =$	$8^{-1} =$	$9^{-1} =$	$10^{-1} =$
$2^0 =$	$3^0 =$	$4^0 =$	$5^0 =$	$6^0 =$	$7^0 =$	$8^0 =$	$9^0 =$	$10^0 =$
$2^1 =$	$3^1 =$	$4^1 =$	$5^1 =$	$6^1 =$	$7^1 =$	$8^1 =$	$9^1 =$	$10^1 =$
$2^2 =$	$3^2 =$	$4^2 =$	$5^2 =$	$6^2 =$	$7^2 =$	$8^2 =$	$9^2 =$	$10^2 =$
$2^3 =$	$3^3 =$	$4^3 =$	$5^3 =$	$6^3 =$	$7^3 =$	$8^3 =$	$9^3 =$	$10^3 =$
$2^4 =$	$3^4 =$	$4^4 =$	$5^4 =$					$10^4 =$
$2^5 =$	$3^5 =$	$4^5 =$	$5^5 =$					
$2^6 =$	$3^6 =$							
$2^7 =$								
$2^8 =$								
$2^9 =$								
$2^{10} =$								

$11^x$	$12^x$	$13^x$	$14^x$	$15^x$
$11^{-2} =$	$12^{-2} =$	$13^{-2} =$	$14^{-2} =$	$15^{-2} =$
$11^{-1} =$	$12^{-1} =$	$13^{-1} =$	$14^{-1} =$	$15^{-1} =$
$11^0 =$	$12^0 =$	$13^0 =$	$14^0 =$	$15^0 =$
$11^1 =$	$12^1 =$	$13^1 =$	$14^1 =$	$15^1 =$
$11^2 =$	$12^2 =$	$13^2 =$	$14^2 =$	$15^2 =$

HW: "Logs Worksheet #1" continued...

**Rewrite each equation in exponential form.**

1)  $\log_6 36 = 2$

2)  $\log_{289} 17 = \frac{1}{2}$

3)  $\log_{14} \frac{1}{196} = -2$

4)  $\log_3 81 = 4$

**Rewrite each equation in logarithmic form.**

5)  $64^{\frac{1}{2}} = 8$

6)  $12^2 = 144$

7)  $9^{-2} = \frac{1}{81}$

8)  $\left(\frac{1}{12}\right)^2 = \frac{1}{144}$

**Evaluate each expression.**

21)  $\log_4 64$

22)  $\log_6 216$

23)  $\log_4 16$

24)  $\log_3 \frac{1}{243}$

25)  $\log_5 125$

26)  $\log_2 4$

27)  $\log_{343} 7$

28)  $\log_2 16$

29)  $\log_{64} 4$

30)  $\log_6 \frac{1}{216}$

HW: "Logs Worksheet #1"

**Table of powers.** Fill in the table below. Use exact numbers (fractions, not decimals.) You need to memorize these!

$2^x$	$3^x$	$4^x$	$5^x$	$6^x$	$7^x$	$8^x$	$9^x$	$10^x$
$2^{10}=$								
$2^9=$								
$2^8=$								
$2^7=$								
$2^6= \frac{1}{64}$	$3^{-6}=$							
$2^5= \frac{1}{32}$	$3^{-5}=$	$4^{-5}=$	$5^{-5}=$					
$2^4= \frac{1}{16}$	$3^{-4}=$	$4^{-4}=$	$5^{-4}=$					
$2^3= \frac{1}{8}$	$3^{-3}=$	$4^{-3}=$	$5^{-3}=$	$6^{-3}= \frac{1}{216}$	$7^{-3}=$	$8^{-3}=$	$9^{-3}=$	$10^{-4}= \frac{1}{10000}$
$2^2= \frac{1}{4}$	$3^{-2}=$	$4^{-2}= \frac{1}{16}$	$5^{-2}=$	$6^{-2}= \frac{1}{36}$	$7^{-2}=$	$8^{-2}=$	$9^{-2}=$	$10^{-3}= \frac{1}{1000}$
$2^1= \frac{1}{2}$	$3^{-1}=$	$4^{-1}= \frac{1}{4}$	$5^{-1}=$	$6^{-1}= \frac{1}{6}$	$7^{-1}= \frac{1}{7}$	$8^{-1}=$	$9^{-1}=$	$10^{-2}= \frac{1}{100}$
$2^0= 1$	$3^0= 1$	$4^0= 1$	$5^0= 1$	$6^0= 1$	$7^0= 1$	$8^0= 1$	$9^0= 1$	$10^{-1}= \frac{1}{10}$
$2^1= 2$	$3^1= 3$	$4^1= 4$	$5^1= 5$	$6^1= 6$	$7^1= 7$	$8^1= 8$	$9^1= 9$	$10^0= 1$
$2^2= 4$	$3^2= 9$	$4^2= 16$	$5^2= 25$	$6^2= 36$	$7^2= 49$	$8^2= 64$	$9^2= 81$	$10^1= 10$
$2^3= 8$	$3^3= 27$	$4^3= 64$	$5^3= 125$	$6^3= 216$	$7^3= 343$	$8^3= 512$	$9^3=$	$10^2= 100$
$2^4= 16$	$3^4= 81$	$4^4= 256$	$5^4= 625$					$10^3= 1000$
$2^5= 32$	$3^5= 243$	$4^5=$	$5^5=$					$10^4= 10000$
$2^6= 64$	$3^6= 729$							
$2^7= 128$								
$2^8=$								
$2^9=$								
$2^{10}=$								

$11^x$	$12^x$	$13^x$	$14^x$	$15^x$
$11^{-2}=$	$12^{-2}=$	$13^{-2}=$	$14^{-2}=$	$15^{-2}=$
$11^{-1}=$	$12^{-1}=$	$13^{-1}=$	$14^{-1}=$	$15^{-1}=$
$11^0=$	$12^0=$	$13^0=$	$14^0=$	$15^0=$
$11^1=$	$12^1=$	$13^1=$	$14^1=$	$15^1=$
$11^2=$	$12^2=$	$13^2=$	$14^2=$	$15^2=$

## HW: "Logs Worksheet #1" continued...

Rewrite each equation in exponential form.

1)  $\log_6 36 = 2$

$$6^2 = 36$$

2)  $\log_{289} 17 = \frac{1}{2}$

$$289^{\frac{1}{2}} = 17$$

3)  $\log_{14} \frac{1}{196} = -2$

$$14^{-2} = \frac{1}{196}$$

4)  $\log_3 81 = 4$

$$3^4 = 81$$

Rewrite each equation in logarithmic form.

5)  $64^{\frac{1}{2}} = 8$

$$\log_{64} 8 = \frac{1}{2}$$

6)  $12^2 = 144$

$$\log_{12} 144 = 2$$

7)  $9^{-2} = \frac{1}{81}$

$$\log_9 \frac{1}{81} = -2$$

8)  $\left(\frac{1}{12}\right)^2 = \frac{1}{144}$

$$\log_{\frac{1}{12}} \frac{1}{144} = 2$$

Evaluate each expression.

21)  $\log_4 64$

$$3$$

22)  $\log_6 216$

$$3$$

23)  $\log_4 16$

$$2$$

24)  $\log_3 \frac{1}{243}$

$$-5$$

25)  $\log_5 125$

$$3$$

26)  $\log_2 4$

$$2$$

27)  $\log_{343} 7$

$$\frac{1}{3}$$

28)  $\log_2 16$

$$4$$

29)  $\log_{64} 4$

$$\frac{1}{3}$$

30)  $\log_6 \frac{1}{216}$

$$-3$$