9. 4 – Intro to Logarithms

Name:_____ 1

Two areas of application for logarithms are how we measure earthquakes and sound. What are those measurements called?

1.

2.

Definition of a Logarithm

$$y = \log_b x \text{ if and only if } \underline{\hspace{3cm}}$$

$$b > 0, b \neq 1, x > 0$$

How do you say $\log_b x$?   "_____"

Practice: Rewrite in exponential form

1. $\log_3 243 = 5$
2. $\log_5 125 = 3$
3. $\log_9 1 = 0$
4. $\log_{\frac{1}{2}} 16 = -4$

Practice: Rewrite in logarithmic form

5. $3^2 = 9$
6. $2^5 = 32$
7. $5^0 = 1$
8. $\sqrt[3]{64} = 4$

Evaluate the following logarithms (without a calculator):

9. $\log_2 8$
10. $\log_7 \frac{1}{7}$
11. $\log_{\frac{1}{3}} 81$
12. $\log_{25} 5$

Common Logarithm: $\log_{10} x \xrightarrow{write \ as} \underline{\hspace{2cm}}$

Natural Logarithm: $\log_e x \xrightarrow{write \ as} \underline{\hspace{2cm}}$

Evaluate using a calculator:

13. $\log 13 \approx$
14. $\ln 6 \approx$

Things that simplify…

1. $\log_b b^x =$
2. $b^{\log_b x} =$

Simplify:

15. $10^{\log 6}$
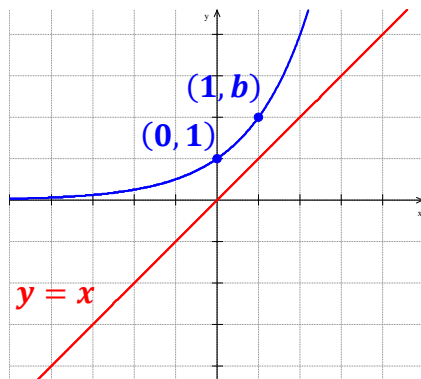16. $\log_3 9^x$
17. $e^{\ln 3x}$
18. $\ln e^{\frac{x}{2}}$

GRAPHING LOGARITHMIC FUNCTIONS:

$g(x) = b^x$ where $b > 1$

$g(x) = b^x$ where $0 < b < 1$
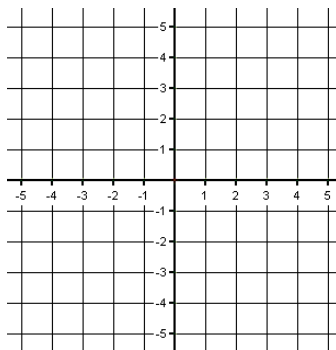
Graph $f(x) = \log_b x$ above by reflecting $g(x)$ across the line $y = x$.
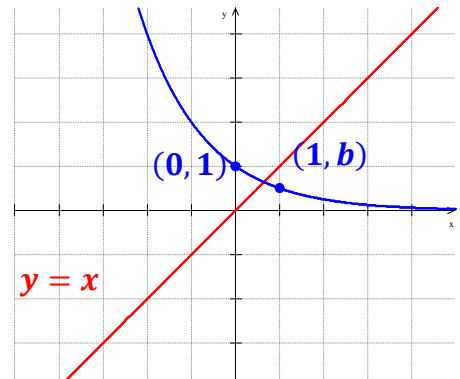
Graph $f(x) = \log_b x$ above by reflecting $g(x)$ across the line $y = x$.

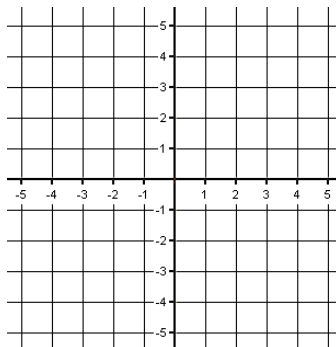19. Graph $y = \log_4 x$

x	y

Domain:

Range:

TRANSLATIONS

$$y = \log_b(x - h) + k$$

To graph the function above, sketch the graph of $y = \log_b(x)$, then translate the graph horizontally (left/right) by h units and vertically (up/down) by k units.

20. Graph $y = \log_3(x + 2) - 1$

x	y

$\Longrightarrow$

x	y

Domain:

Range:

Now summarize what you learned!

Algebra 2

Name_____

9.4 Practice - Intro to Logarithms

Date_____ Period_____

Rewrite each equation in exponential form.

1) $\log_{14} 196 = 2$

2) $\log_{18} 324 = 2$

3) $\log_{243} 3 = \dfrac{1}{5}$

4) $\log_3 243 = 5$

5) $\log_7 49 = 2$

6) $\log_{11} \dfrac{1}{121} = -2$

Rewrite each equation in logarithmic form.

7) $225^{-\frac{1}{2}} = \dfrac{1}{15}$

8) $19^2 = 361$

9) $7^2 = 49$

10) $3^2 = 9$

11) $18^{-2} = \dfrac{1}{324}$

12) $9^{-\frac{1}{2}} = \dfrac{1}{3}$

Evaluate each expression.

13) $\log_4 16$

14) $\log_6 \dfrac{1}{216}$
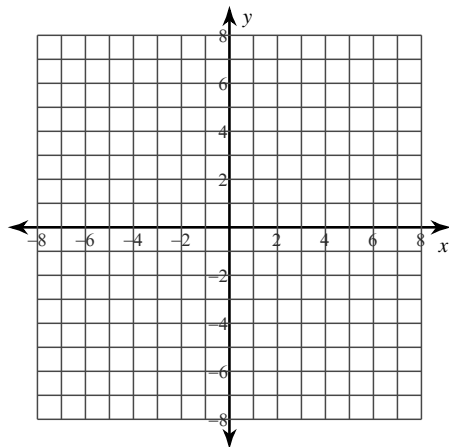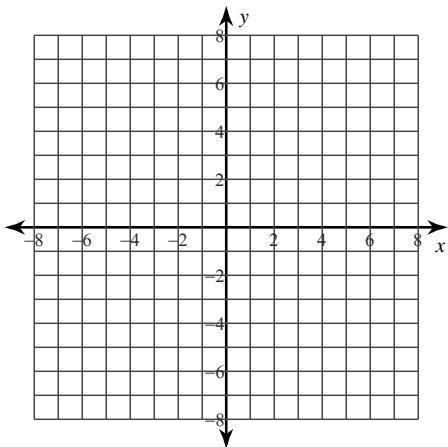
15) $\log_2 16$

16) $\log_2 32$

17) $\log_{16} \dfrac{1}{2}$

18) $\log_6 \dfrac{1}{36}$

Sketch the graph and identify the domain and range of each.
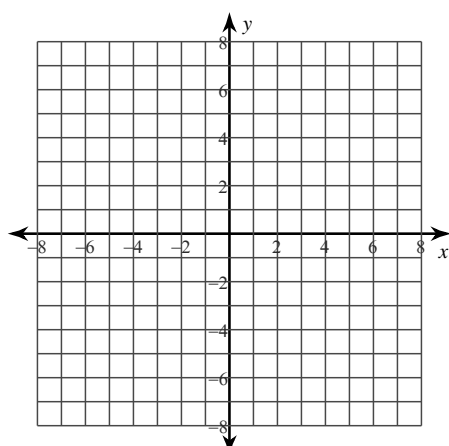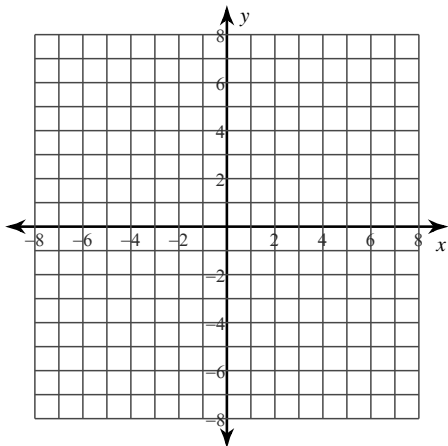
19) $f(x) = \log_4 (x - 1) - 5$

20) $f(x) = \log_3 (x + 5) - 5$

21) $f(x) = \log (x - 1) + 5$

22) $f(x) = \log_2 (x + 1) + 3$

9.4 Application and Extension

1. a. Evaluate $\log_3 27$ b. Evaluate $\log_{64} \frac{1}{4}$

2. Most tornadoes last less than an hour and travel less than 20 miles. The wind speed w (in miles per hour) near the center of a tornado is related to the distance d (in miles) the tornado travels. The following model shows this relationship:
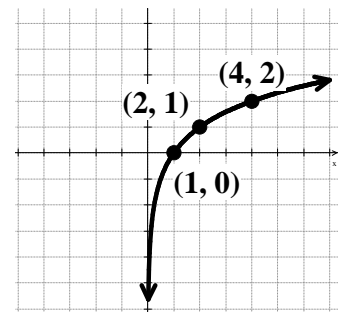$$w = 93 \log d + 65$$

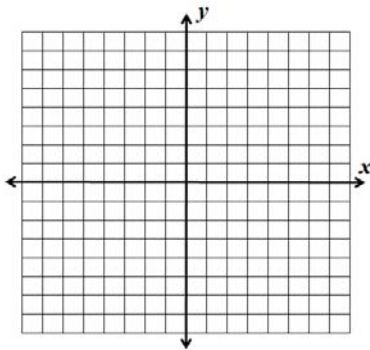   a. If a tornado has traveled 13.6 miles, what is its wind speed?

    b. If a tornado's wind speed is 207.3 mph, how far did it travel? (*hint: use a graphing calculator and graph both sides of the equation.*)

For 3-6, the graph of $f(x) = \log_2 x$ is given on the right along with three coordinate points. For each problem, translate $g(x)$ by using $f(x)$ as the "parent" function.
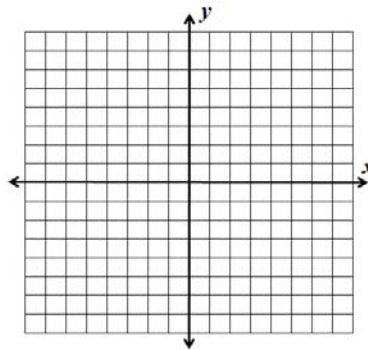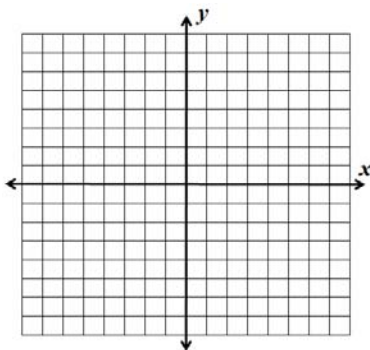
$$f(x) = \log_2 x$$
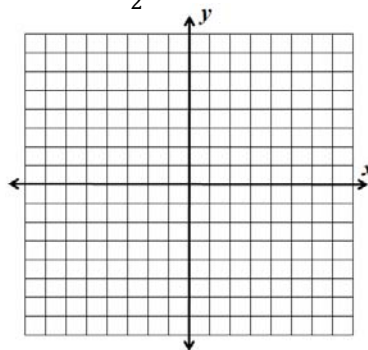
(4, 2)

(2, 1)

(1, 0)

3. $g(x) = 2\log_2 x$

4. $g(x) = -\log_2 x$

5. $g(x) = \log_2(-x)$

6. $g(x) = \frac{1}{2}\log_2 x - 3$

7. When Mr. Sullivan has indigestion and flatulence, the disturbance can often feel like an earthquake. On different days, Sully's students measured the "disturbance" and recorded the information (see table).

Minutes after lunch	Magnitude measured on the *Ripped It* Scale
5	3.1
10	3.6
20	4.2
35	4.4

a. Using your calculator, find a logarithmic regression model that matches the data. Round to three decimal places. (*Hint: Enter the data into two lists in the calculator, then hit "STAT" and then "CALC" menu. One of the options will be "LnReg."*)

b. Using your model, estimate the disturbance of an event 45 minutes after Sully's lunch.

c. In Sully's class after lunch, a student is surprised to feel a disturbance of 4.1 magnitude. How long has it been since lunch ended? (*Round your answer to three decimals.*)

Algebra Skillz:

1. Below are graphs of $f(x) = |x|$ (thin line) and its translation (bold line). Write an equation of the translation.
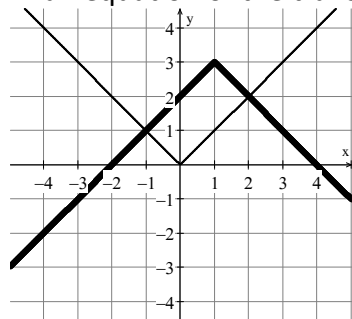
Simplify the fraction by rationalizing the denominator.

2. $\dfrac{5}{\sqrt{10}}$

3. $\dfrac{3}{2\sqrt{6}}$

Solve by factoring.
4. $5x^3 - 10x^2 - 175x = 0$

5. $18x^2 - 15x + 3 = 0$

SAT Prep:

1. Simplify: $(2^{3x})(2^{5-x})$

(A) $(2)^{15x-3x^2}$
(B) $(2)^{5-3x^2}$
(C) $(2)^{2x+5}$
(D) $(2)^{5-2x}$

2. If $f(x) = 2(4)^{x+4}$, find $f(-5)$.