Logarithmic Functions **Name:** _____

Definition 1. *Let $a > 0$ and $a \neq 1$. Then $\log_a(x)$ is the exponent we raise a to get x.*

1. Write, in words, the meaning of $\log_5(25)$.

2. What number does $\log_5(25)$ represent? 2. _____

3. Write, in words, the meaning of $\log_7(1)$.

4. What number does $\log_7(1)$ represent? 4. _____

5. Write, in words, the meaning of $\log_{\frac{1}{2}}(16)$.

6. What number does $\log_{\frac{1}{2}}(16)$ represent? 6. _____

Definition 2. *Let a be a positive number with $a \neq 1$. The logarithm function with base a, denoted* $\boldsymbol{\log_a}$*, is defined by*

$$\left[\log_a x = y\right] \iff \left[a^y = x\right]$$

So $\log_a(x)$ is the exponent we raise a to get x.

Write each in logarithmic form.

7. $2^4 = 16$ 7. _____

8. $10^4 = 10,000$ 8. _____

9. $0.001 = 10^3$ 9. _____

10. $\left(\frac{1}{3}\right)^{-2} = 9$ 10. _____

11. $10^{x+5} = 10$ 11. _____

Write each in exponential form.

12. $\log_3\left(\frac{1}{81}\right) = -4$ 12. _____

13. $\log_7 49 = 2$ 13. _____

14. $\log_5 125 = 3$ 14. _____

15. $\log_4 x = \frac{1}{2}$ 15. _____

16. $\log_x 9 = 2$ 16. _____

Properties of Logarithms

Property	Reason
1. $\log_a 1 = 0$	We must raise a to the power 0 to get 1.
2. $\log_a a = 1$	We must raise a to the power 1 to get a.
3. $\log_a a^x = x$	We must raise a to the power x to get a^x.
4. $a^{\log_a x} = x$	$\log_a x$ is the power to which a must be raised to get x.

Evaluate Each Expression.

17. $\log_3 1$ 17. _____

18. $\log_4 64$ 18. _____

19. $\log_8 8^{17}$ 19. _____

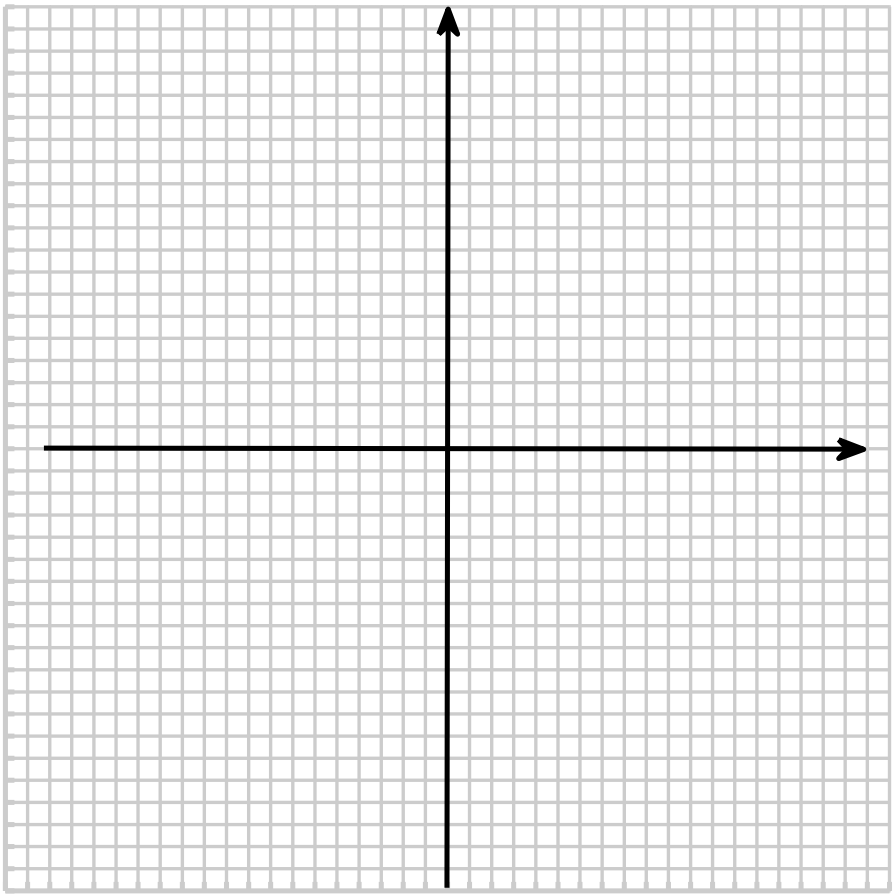
20. $\log_{10} \sqrt{10}$ 20. _____

21. $3^{\log_3 8}$ 21. _____

22. $10^{\log 5}$ 22. _____

Sketch the graphs of $f(x) = 2^x$ and $f^{-1}(x) = \log_2(x)$ on the same set of axes.

x	2^x
-4	
-3	
-2	
-1	
0	
1	
2	
3	
4	

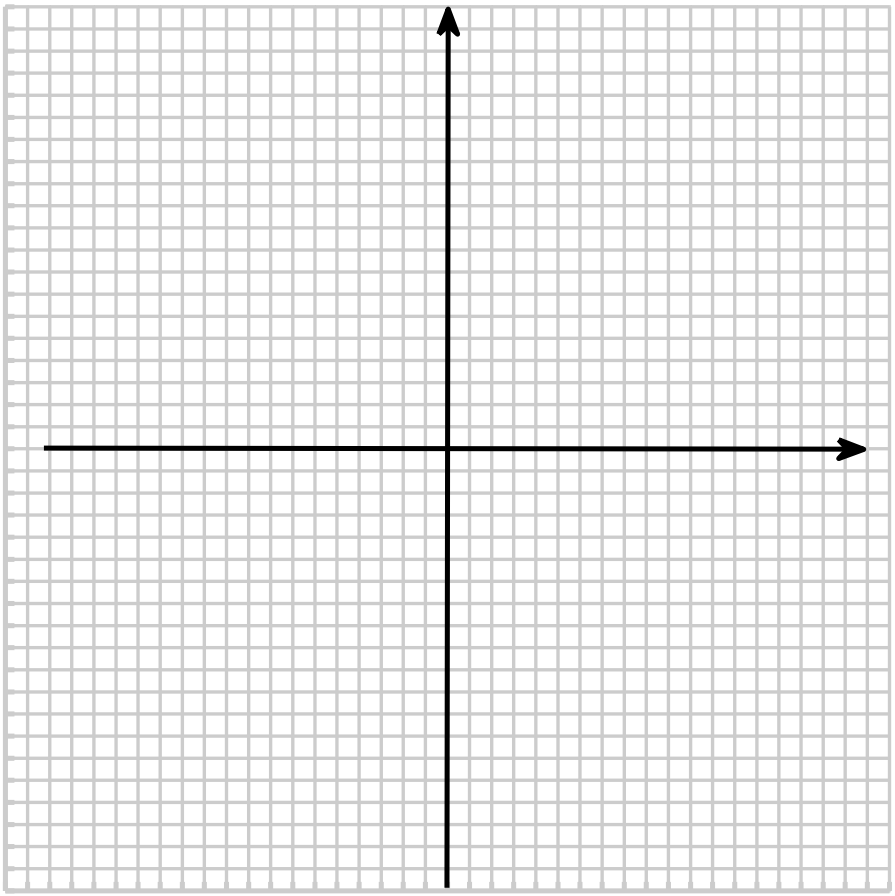


23. What interval represents the domain of $f^{-1}(x)$? 23. _____

24. What equation represents the vertical asymptote for $f^{-1}(x)$? 24. _____

25. What interval represents the range of $f^{-1}(x)$? 25. _____

Graph
$g(x) = \log_4(x)$**.**



26. What interval represents the domain of $g(x)$? 26. _____

27. What equation represents the vertical asymptote for $g(x)$? 27. _____

28. What interval represents the range of $g(x)$? 28. _____

Definition 3. *The logarithm with base 10 is called the* ***common logarithm*** *and is described by omitting the base:*

$$\log(x) = \log_{10}(x)$$

Definition 4. *The logarithm with base e is called the* ***natural logarithm*** *and is denoted by* ***ln****:*

$$\ln(x) = \log_e(x)$$