UNIT 7 Logarithmic Functions

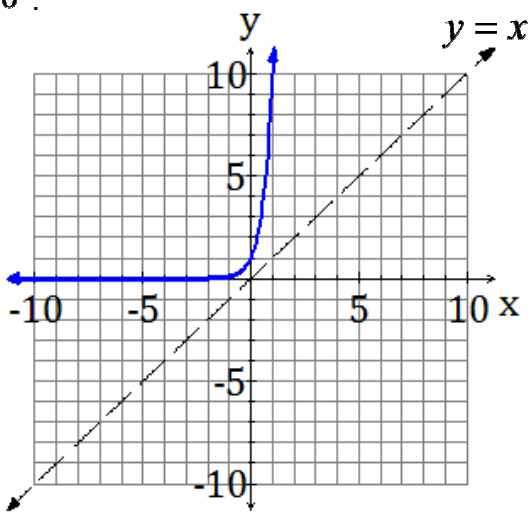
7.1: Characteristics of Logarithmic Functions with Base 10 and Base e

Investigation - Part A: The Common Logarithm

1. Complete the table of values for $y = 10^x$.

$y = 10^x$	
x	y
-2	
-1	
0	
1	
2	

$x = 10^y$	
x	y



2. How can you use the table to create a table of values for the new function $x = 10^y$?

3. Sketch the graph of $x = 10^y$ on the same axes.

4. How are these two functions related?
What is the connection to the line $y = x$?

5. The equation of the second function, $x = 10^y$ can be rewritten in another form called **logarithmic** form:

_____ or _____

6. Compare the characteristics of both functions:

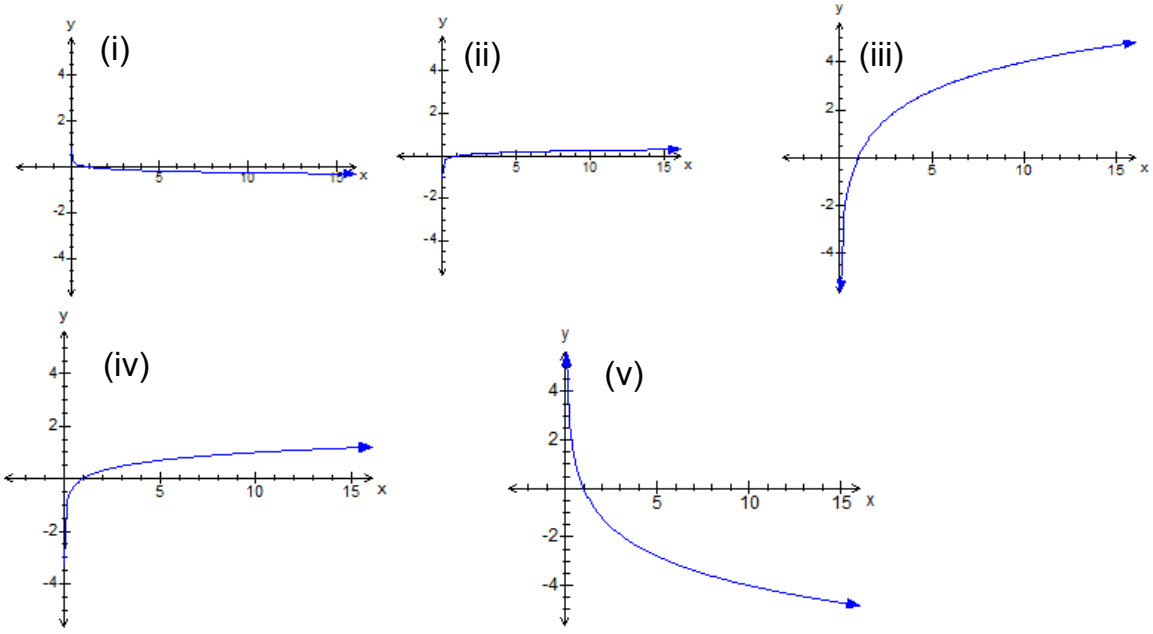
	Exponential	Logarithmic
Domain		
Range		
y-intercept		
x-intercept		
Increasing/ Decreasing		
End Behaviour		

7. Use graphing technology to graph the following functions and match them with those provided on the graph below.

DESMOS

A. $y = \log_{10} x$ _____ B. $y = 4\log_{10} x$ _____ C. $y = -4\log_{10} x$ _____

D. $y = \frac{1}{4}\log_{10} x$ _____ E. $y = -\frac{1}{4}\log_{10} x$ _____



8. What is the effect on the graph of $y = a\log_{10} x$ if $a > 0$? $a < 0$?

9. Does "a" affect the x-coordinate or the y-coordinate? Is this a vertical or a horizontal transformation?

10. Which point is easily identified from the graph?

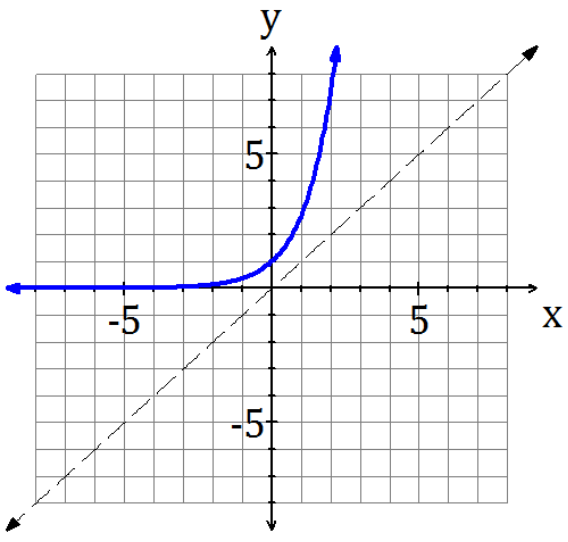
Part B: The Natural Logarithm

1. Complete the table of values for $y = e^x$ and $x = e^y$.

   Note: e is an irrational number like π where e = 2.71828... $y = (2.71828...)^x$

$y = e^x$	
x	y
-2	
-1	
0	
1	
2	

$x = e^y$	
x	y



2. Sketch the graph of $x = e^y$ on the same axes. How does it compare to $y = e^x$?

3. The equation of the second function, $x = e^y$ can be rewritten in another form called **logarithmic** form:

_____ or _____

4. Compare the characteristics of both functions:

	Exponential	Logarithmic
Domain		
Range		
y-intercept		
x-intercept		
Increasing/ Decreasing		
End Behaviour		

5. How do the characteristics of the function $y = \ln x$ compare to those of $y = \log_{10} x$? (Does it matter if the base is 10 or e?)

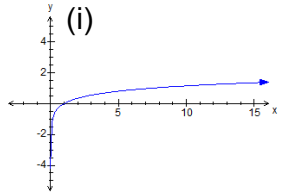
6. Match each function below with its graph:

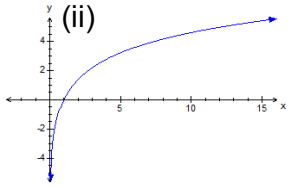
A. $y = -\frac{1}{2}\ln x$ _____

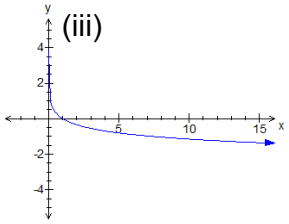
B. $y = 2\ln x$ _____

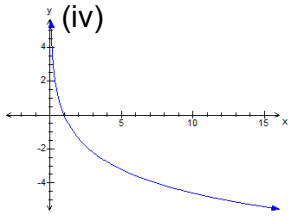
C. $y = \frac{1}{2}\ln x$ _____

D. $y = -2\ln x$ _____



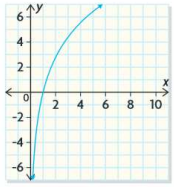
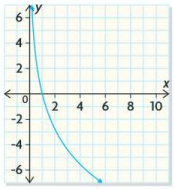






SUMMARY:

All logarithmic functions of the form $f(x) = a\log x$ and $f(x) = a\ln x$ have the following characteristics:

x- intercept	one (1, 0)	
Number of y - intercepts	none	
	1. Q4 to Q1 or if a > 0 (positive) increasing	2. Q1 to Q4 if a < 0 (negative) decreasing
		
Domain	$\{x / x > 0, x \in R\}$	
Range	$\{y / y \in R\}$	

Example 1: (Ex. 1/2, p. 414/5)

Predict the x-intercept, the number of y-intercepts, the domain and the range, and the end behaviour of the following functions:

a) $y = 15\log x$

x-intercept:

y-intercept:

Domain:

Range:

End Behaviour:

b) $y = -4\ln x$

x-intercept:

y-intercept:

Domain:

Range:

End Behaviour:

Example 2: (Ex. 3, p. 417)

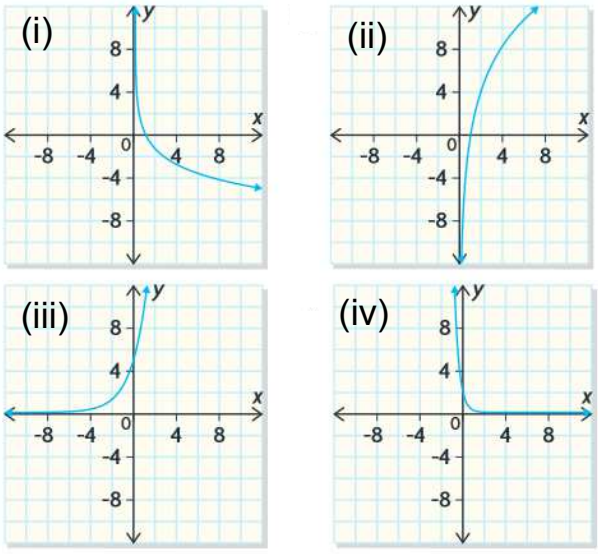
Which function matches each graph? Provide your reasoning.

A. $y = 5(2)^x$ _____

B. $y = 2(0.1)^x$ _____

C. $y = 6\log x$ _____

D. $y = -2\ln x$ _____



Practice:
p. 420 - 425, #2, 3, 5ace, 8