PRECALCULUS: EXPONENTIAL FUNCTIONS WORKSHEET

Exponential Functions.
$f(x) = b^x$, where the *base* $b \neq 1$ is positive.

	base $b > 1$	**base** $b < 1$
dom f	$(-\infty, \infty)$	
ran f	$(0, \infty)$	
left end behavior	$f(x) \to 0$	
right end behavior	$f(x) \to \infty$	
increasing	$(-\infty, \infty)$	
decreasing	$\emptyset$	
concave up	$(-\infty, \infty)$	
concave down	$\emptyset$	

Exploring with graphs. Use desmos or another graphing calculator for the following.

(1) Pick two different bases > 1 and think about the exponential functions with those bases. Which one do you think will grow faster as $x \to \infty$? Which one approaches 0 faster as $x \to -\infty$? Confirm your prediction by graphing them.

(2) Compare the graphs of $f(x) = 2^x$ and $g(x) = -2^x$. What are the domain and range of $g(x)$? Where is it increasing? Decreasing? Concave up? Concave down? What is the end behavior?

(3) Compare the graphs of $f(x) = (\frac{1}{2})^x$ and $g(x) = 2^{-x}$. Use what you know about properties of exponentiation and geometric transformations of functions to explain what you see.

(4) Do the same thing for $f(x) = (\frac{2}{5})^x$ and $g(x) = (\frac{5}{2})^{-x}$.

(5) Generalize what you're seeing in the previous two problems. Let $0 < b < 1$ and consider $f(x) = b^x$. Write $f(x)$ equivalently as a geometric transformation of an exponential function with base > 1. What is this other base? Graph the functions to confirm your work.

(6) Use what you observed in the previous three problems to fill in the missing entries in the table of behavior above.

(7) Use what you know about geometric transformations of functions to sketch graphs of the following, then confirm your work with a graphing calculator.

$$f(x) = -3^{-x}$$
$$g(x) = 4 + 2^{-x}$$
$$h(x) = 4 \cdot 2^x$$
$$k(x) = 2^{2+x}$$
$$\ell(x) = 2 - 3^{2x}$$
$$m(x) = 2 - 9^x$$