7-1 Exponential Functions, Growth and Decay

Lesson Objective

Write and evaluate exponential expressions to model growth and decay situations.

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Growth that doubles every year can be modeled by using a function with a variable as an exponent. This function is known as an *exponential function*. The parent **exponential function** is $f(x) = b^x$, where the **base** b is a constant and the exponent x is the independent variable.

Base Exponent

$$f(x) = b^x, \text{ where } b > 0, b \neq 1$$

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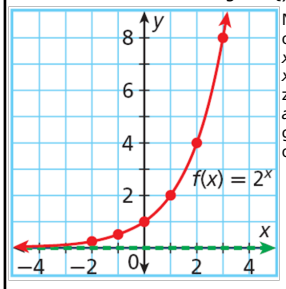
The graph of the parent function $f(x) = 2^x$ is shown. The domain is all real numbers and the range is $\{y|y > 0\}$.



Notice as the x-values decrease, the graph of the function gets closer and closer to the x-axis. The function never reaches the x-axis because the value of 2^x cannot be zero. In this case, the x-axis is an *asymptote*. An **asymptote** is a line that a graphed function approaches as the value of x gets very large or very small.

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A function of the form $f(x) = ab^x$, with $a > 0$ and $b > 1$, is an **exponential growth** function, which increases as x increases. When $0 < b < 1$, the function is called an **exponential decay** function, which decreases as x increases.

Remember!

In the function $y = b^x$, y is a function of x because the value of y *depends* on the value of x.

Remember!

Negative exponents indicate a reciprocal. For example:

$$x^{-2} = \frac{1}{x^2}$$

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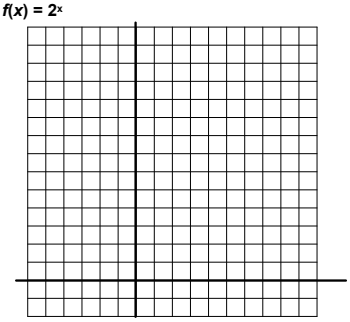
Graph the function $f(x) = 2^x$

x	y
-3	
-2	
-1	
0	
1	
2	
3	
4	



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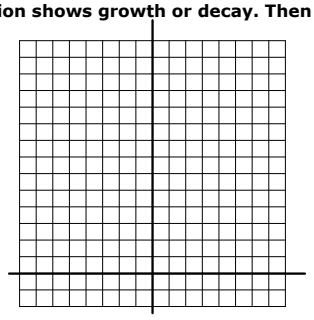
Tell whether the function shows growth or decay. Then graph.

$$f(x) = 10\left(\frac{3}{4}\right)^x$$

x	y
0	
2	
4	
6	
8	
10	
12	



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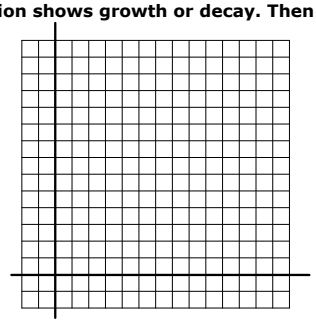
Tell whether the function shows growth or decay. Then graph.

$g(x) = 100(1.05)^x$

x	y
-1	
0	
1	
2	
3	
4	
5	



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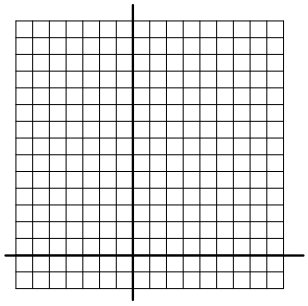
Tell whether the function $p(x) = 5(1.2^x)$ shows growth or decay. Then graph.

x	y
-6	
-3	
-1	
0	
2	
4	
8	
10	



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