Goals:
1. To evaluate exponential functions.
2. To graph exponential functions.
3. To solve applications.

\[
\begin{array}{c|c}
 t \text{ (in hrs)} & N(t) = \# \text{ of bacteria after } t \text{ hrs} \\
0 & 1 = 2^0 \\
1 & 2 = 2^1 \\
2 & 4 = 2^2 \\
3 & 8 = 2^3 \\
4 & 16 = 2^4 \\
5 & 32 = 2^5 \\
\vdots & 2^t \\
N(t) = 2^t \\
\end{array}
\]

So, after 20 hrs, there are \( N(20) = 2^{20} = 1,048,576 \) bacteria.

**Def:** Any function of the form \( f(x) = a^x \) is called exponential. \((a > 0, a \neq 1)\)

**Note:** The \( n \)th term of a geometric sequence, \( a_n = a, r^{n-1} \) is an exponential function in the variable \( n \), where \( n \) is a whole number.
(e) Graph

a) \( f(x) = 2^x \)

\[
\begin{array}{c|c}
 x & f(x) = 2^x \\
-3 & 2^{-3} = \frac{1}{8} \\
-2 & \frac{1}{4} \\
-1 & \frac{1}{2} \\
0 & 1 \\
1 & 2 \\
2 & 4 \\
3 & 8 \\
\end{array}
\]

\( y = 0 \) is an asymptote.

6) \( g(x) = 2^{x-3} \)

Use transformations. Treat \( y = f(x) = 2^x \) as a base function.

\[
y = f(x) = 2^x
\]

\[
g(x) = 2^{x-1} - 3
\]

\[
g(x) = f(x-1) - 3
\]
Describe how to use the graph of \( f(x) = 2^x \) to get the graph of...

a) \( h(x) = -2^x \)
   
   \[ = -f(x) \]
   
   reflection across \( x\)-axis

b) \( k(x) = 2^{-x} \)

   \[ = f(-x) \]

   reflection across \( y\)-axis

c) \( l(x) = -2^{x+1} + 5 \)

   \[ = -f(x+1) + 5 \]

   1. reflection across \( x\)-axis
   2. \( v\)-shift: 5
   3. \( h\)-shift: -1
Notes:

1. Domain of \( f(x) = a^x \) is \((-\infty, \infty)\)
2. Range of \( f(x) = a^x \) is \((0, \infty)\)

\[ a > 1 \quad \text{and} \quad 0 < a < 1 \]

3. The natural exponential function is...
   \[ y = e^x, \text{ where } e \approx 2.718 \ldots \]

Use a graphing utility to graph the function. If the function has a horizontal asymptote, state the equation of the horizontal asymptote.

\[ f(x) = \frac{12}{1 + 5.5e^{-0.2x}}, \quad x \geq 0 \]

Horizontal asymptote: \( y = \frac{12}{1 + 5.5} \)

\[ f(x) = \frac{12}{1 + 5.5e^{-0.2x}}, \quad x \geq 0 \]
The function \( A(t) = 200e^{-0.014t} \) gives the amount of medication, in milligrams, in a patient’s bloodstream \( t \) minutes after the medication has been injected into the patient’s bloodstream.

(a) Find the amount of medication, to the nearest milligram, in the patient’s bloodstream after 30 minutes.

\[ \boxed{\phantom{00000} \times \text{mg}} \]

(b) Use a graphing utility to determine how long it will take, to the nearest minute, for the amount of medication in the patient’s bloodstream to reach 50 milligrams.

\[ \boxed{\phantom{00000} \times \text{min}} \]