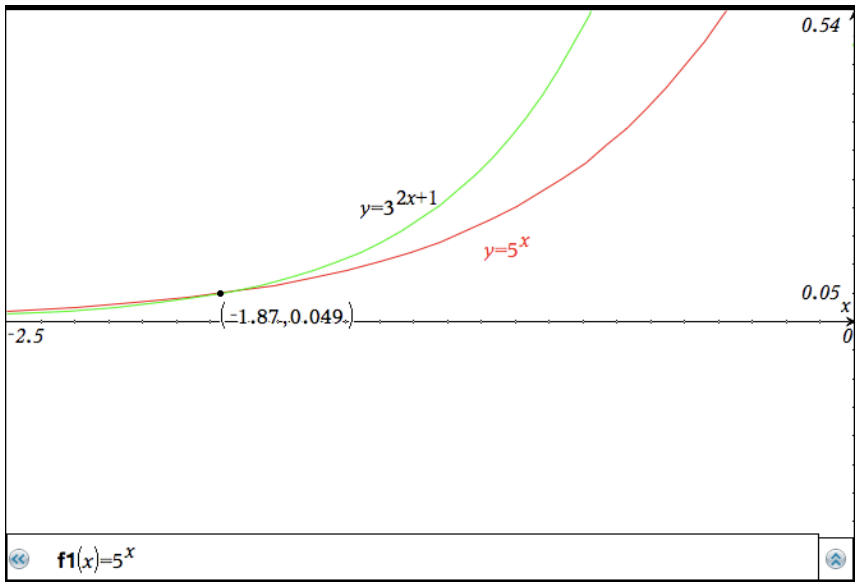
After watching the video, *Solving for Exponents,* complete the following problems.

1. Estimate a solution for $5^x = 3^{2x+1}$ using a graph. Then, solve using symbolic reasoning.
   Solution:

   Graph both functions using an appropriate window.



Using symbolic reasoning:

$5^x = 3^{2x+1}$

$\log\left(5^x\right) = \log\left(3^{2x+1}\right)$

$x\log 5 = (2x+1)\log 3$

$(\log 5)x - (2\log 3)x = \log 3$

$(\log 5 - 2\log 3)x = \log 3$

$$x = \frac{\log 3}{\log 5 - 2\log 3} \approx -1.869$$

2. According to data from the U.S. Department of Agriculture, beef consumption in the United States (in billions of pounds) x years after 1900 can be approximated by $-154.41 + 90.68 \log x$.

   a) According to this model, how much beef was consumed in 2000?

   beef consumption $= -154.41 + 90.68(\log 100)$

   beef consumption $= -154.41 + 90.68 \cdot 2$

   beef consumption $= 26.95$ billion pounds

   b) According to this model, when will beef consumption reach 50 billion pounds per year?

   $50 = -154.41 + 90.68(\log x)$

   $204.41 = 90.68(\log x)$

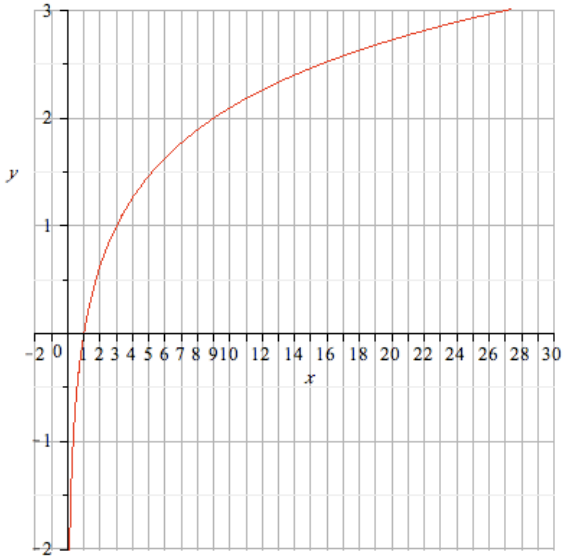
   $\frac{204.41}{90.68} = \log x$

   $10^{\frac{204.41}{90.68}} = x$ by definition of logarithms

   $179.55 \approx x$

   This means in approximately 179.55 years from the year 1900 or about the year 2079 beef consumption will reach 50 billion pounds per year.

3. The following is a graph of x versus $\log_b x$. What is the value of b? How do you know?



There are many ways to figure out the value of b. One way is to look at individual data points such as (9,2) and substitute them into the equation.

$$y = \log_b x$$
$$2 = \log_b 9$$
$$b^2 = 9$$
$$b = 3$$

4. Find the value of *b* given the following table of values. You don't need a calculator to find it!

x	$\log_b x$
1	0
18	1.6131
36	2.0000
50	2.1833

There are many ways to figure out the value of b. One way is to look at individual data points such as (36,2) and substitute them into the equation.

$$y = \log_b x$$
$$2 = \log_b 36$$
$$b^2 = 36$$
$$b = 6$$

5. Solve the following equation: $10^{x^2-3x+6} = 10{,}000$

It may be helpful to graph both sides of the equation and look at the graphical solution. A symbolic solution is provided below.

$$10^{x^2-3x+6} = 10{,}000$$
$$\log(10^{x^2-3x+6}) = \log(10{,}000)$$
$$x^2 - 3x + 6 = 4$$
$$x^2 - 3x + 2 = 0$$
$$(x-2)(x-1) = 0$$
$$x = 2, x = 1$$

The solution can also be found by rewriting 10,000 with a base of 10 to 10^4. Since the exponents must be equal to each other,

then
$$x^2 - 3x + 6 = 4$$
$$x^2 - 3x + 2 = 0$$
$$(x-2)(x-1) = 0$$
$$x = 2, x = 1$$

6. Solve the following equation: $10^{3x+2} = 10^5$

This equation can be solved by inspection. Since both sides of the equation are base ten values, the exponents are equal to each other. This means 3x+2=5, so x=1. If this is not noticed, then take the log of both sides of the equation; this is the result:

$$10^{3x+2} = 10^5$$
$$\log(10^{3x+2}) = \log(10^5)$$
$$3x + 2 = 5$$
$$x = 1$$