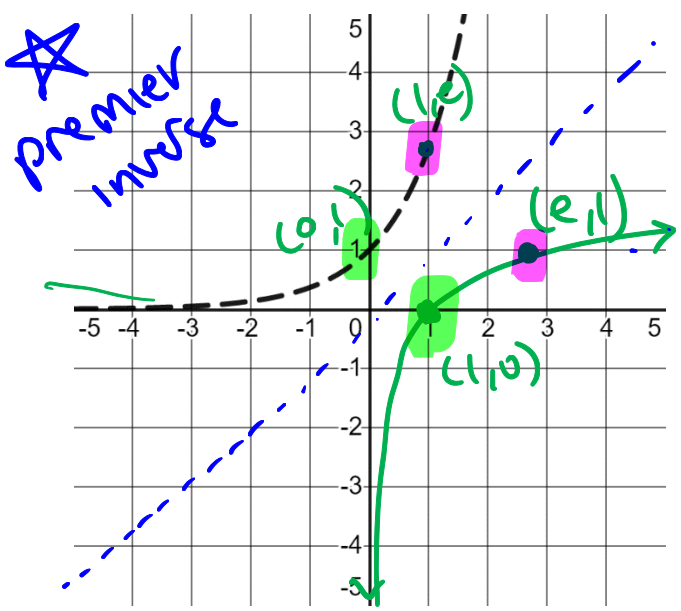
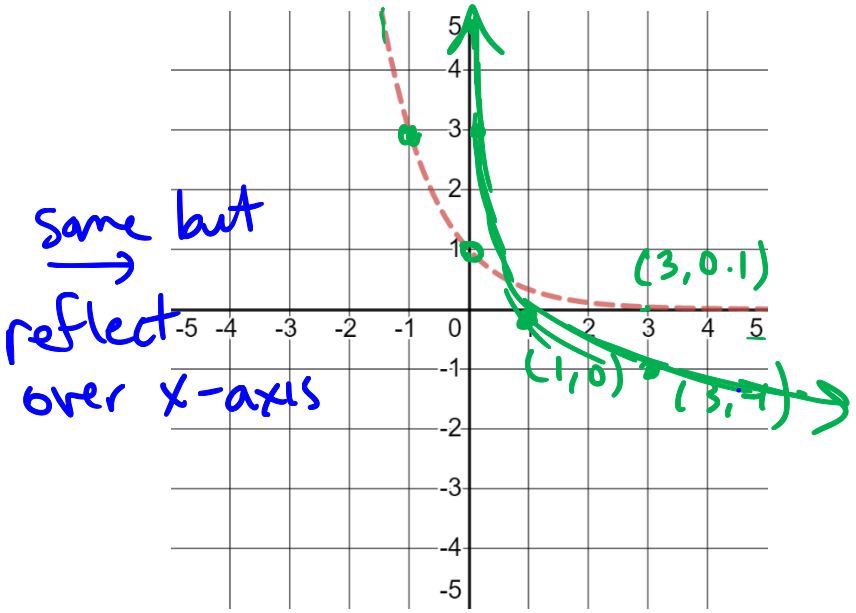
Exponential Inverses

KNOW	DO	UNDERSTAND
The inverse of an exponential is a log of the same base and knows the domain and range of a log function.	Can find the exact equation in base e to an exponential. Can graph the basic $\ln x$.	*Function Characteristics*:
Vocab & Notation • Logarithm, $\log x$ • Natural log, $\ln x$		

Graph the inverse of $y = e^x$ and $y = (1/3)^x = 3^{-x}$





$(x,y) \mapsto (y,x)$

★ inverse is a function (one-to-one)

$f(x) = e^x$ $f: \mathbb{R} \to (0,\infty)$ $f^{-1}: (0,\infty) \to \mathbb{R}$

★ inverse will be increasing if original was increasing.

Since the exponential function $f(x) = b^x$ needs that the base $b > 0$ and $b \neq 1$, we have the same restriction on the function $f^{-1}(x) = \log_b x$.

← symbols for the inverse

There are three common bases that you will use depending on your field.

- Engineering: Base 10 → $10^x = f(x)$ $f^{-1}(x) = \log x = \log_{10} x$
- Science and Mathematics: Base e → $e^x = g(x)$ $g^{-1}(x) = \ln x = \log_e x$ (natural log) $= \log x$
- Computer Science: Base 2 → $2^x = h(x)$ $h^{-1}(x) = \text{lb}\, x$

wolfram alpha

Example: Solve for k

$$\log(500 = 10^k)$$
$$\log 500 = \log 10^k$$
$$2.699 = k$$

$$\ln(2 = e^k)$$
$$\ln 2 = \ln e^k$$
$$0.693 = k = \ln 2$$

$$\sqrt{2} = 1.414\ldots$$

Practice: Solve for x

$$\log(1200 = 10^x)$$
$$\log 1200 = x$$
$$3.079 = x$$

$$\ln(20 = e^x)$$
$$\ln 20 = x$$
$$2.996 = x$$

$$2^{(9 = \log_2 x)}$$
$$2^9 = x = 512$$

$$5 = \frac{1}{4^k}$$
$$\ln\left(\frac{1}{5} = e^k\right)$$
$$\ln\left(\frac{1}{5}\right) = k = -1.609$$

$$10^{(3 = \log k)}$$
$$10^3 = k$$
$$1000 = k$$

$$e^{(8 = \ln x)}$$
$$e^8 = x = 2980.956$$

$$17 = \ln(e^k)$$
$$17 = k$$

$$32 = 10^{\log k}$$
$$32 = k$$

$$e^{(22 = \ln(\ln k))}$$
$$e^{(e^{22} = \ln k)}$$
$$e^{e^{22}} = k$$

When we evaluate an exponential $2^6 = x$, we are asking:
2 to the power of 6 is what?

When we evaluate a logarithm, we are asking the inverse. For $\log_2 32 = x$ we are asking:
2 to what power is 32?

$2^x = 32 \rightarrow x = 5$

$\log_2 32 = 5$, $2^5 = 32$ ✓

Practice: Without a calculator evaluate the following:

$\log_3 729$ $\log_5 625$ $\log_{19} 361$

3 to some power is 729

$3^x = 729$

$3^6 = 729$

$\log_3 729 = 6$, 3^6

19 to some power is 361

$19^x = 361$

$x = 2$

5 to some power is 625

$5^x = 625 \rightarrow x = 4$

Practice Problems: 8.1 page 380-381 # 1, 4-9, 12-15, 20-24