

### 3.3 Logarithmic Fncs. & Graphs

- Obj: 1. Convert eqns. from log form to exponential form & vice versa.  
 2. Evaluate & graph common <sup>log<sub>10</sub></sup> & natural <sup>log<sub>e</sub> = e</sup> logarithmic fncs.

Solve:  $x + 3 = 7$      $\frac{3x}{3} = \frac{9}{3}$      $\sqrt{x^2} = \sqrt{16}$   
 inv. op     $-3 \quad -3$      $x = 3$      $x = \pm 4$   
 $x = 4$

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$$\log_2 8 = ? \quad 3$$

"log base 2 of 8"

2 to what exponent is 8?

$$\log_4 16 = 2$$

4 to what exp. is 16?

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$$\log_2 \frac{1}{2}$$

2 to what exp is  $\frac{1}{2}$ ?

-1

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

$$\log_4 1$$

4 to what exp. is 1?

$$4^? = 1$$

0

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$$\log_2 7 = x$$

logarithmic form

$$2^x = 7$$

exponential form

$$\log_b^{\text{argument}} a = x$$

$$b^{\text{base}} = a$$

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$$\log_3 \sqrt{3}$$

$$3^{\frac{1}{2}} = (\sqrt{3}) = 3^{\frac{1}{2}}$$

$$\log_5 \frac{1}{25}$$

$$5^{-2} = \frac{1}{25} = \frac{1}{5^2}$$

$$\log_7 1$$

$$7^0 = 1$$

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## Basic Properties

$$\log_b 1 = 0$$

$$b^0 = 1$$

$$b^{\log_b x} = x$$

$$\log_b b = 1$$

$$b^1 = b$$

$$b^{\log_b 11} = 11$$

$$\log_b b^y = y$$

$$b^y = b^y$$

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Common Logarithms:

$$\log_{10} x$$

$$\log x$$

$$\underline{10}^{\log_{10} 7} = 7$$

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$$\log_{10} 100$$
$$10^? = 100$$
$$2$$

$$\log \frac{1}{1000}$$
$$10^? = \frac{1}{1000}$$
$$-3$$

$$\log \sqrt{10}$$
$$10^? = \sqrt{10}$$
$$\frac{1}{2}$$

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## Evaluating w/ a calculator

Evaluate, then check:

$$\log_{10} 34.5 \approx 1.5378$$

$$10^{1.5378} \approx 34.5$$

$$\log .43 \approx -0.3665$$

$$10^{-.3665} \approx .43$$

$\log(-3) \rightarrow$  error!  
can't take the logarithm of a neg.

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## Solving

$$\log x = 3$$

$$10^3 = x$$

$$x = 1000$$

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$$\log_2 x = 5$$

$$2^5 = x$$

$$x = 32$$

$$\log x = 4$$

$$10^4 = x$$

$$x = 10000$$

$$\log x = -3$$

$$10^{-3} = x$$

$$x = \frac{1}{1000}$$

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natural base

$$e \approx 2.718 \dots$$

$$\log_e x$$

natural log

↓

$$\ln x$$

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$$\ln \sqrt{e}$$

$$e^? = \sqrt{e}$$

$$\frac{1}{2}$$

$$\log_b b^y = y$$

$$\ln e^5$$

$$e^? = e^5$$

$$5$$

$$e^{\ln 4} = 4$$

$$b^{\log_b x} = x$$

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Evaluate & check:

$$\ln 23.5 \approx 3.157$$

$$e^{3.157} \approx 23.5$$

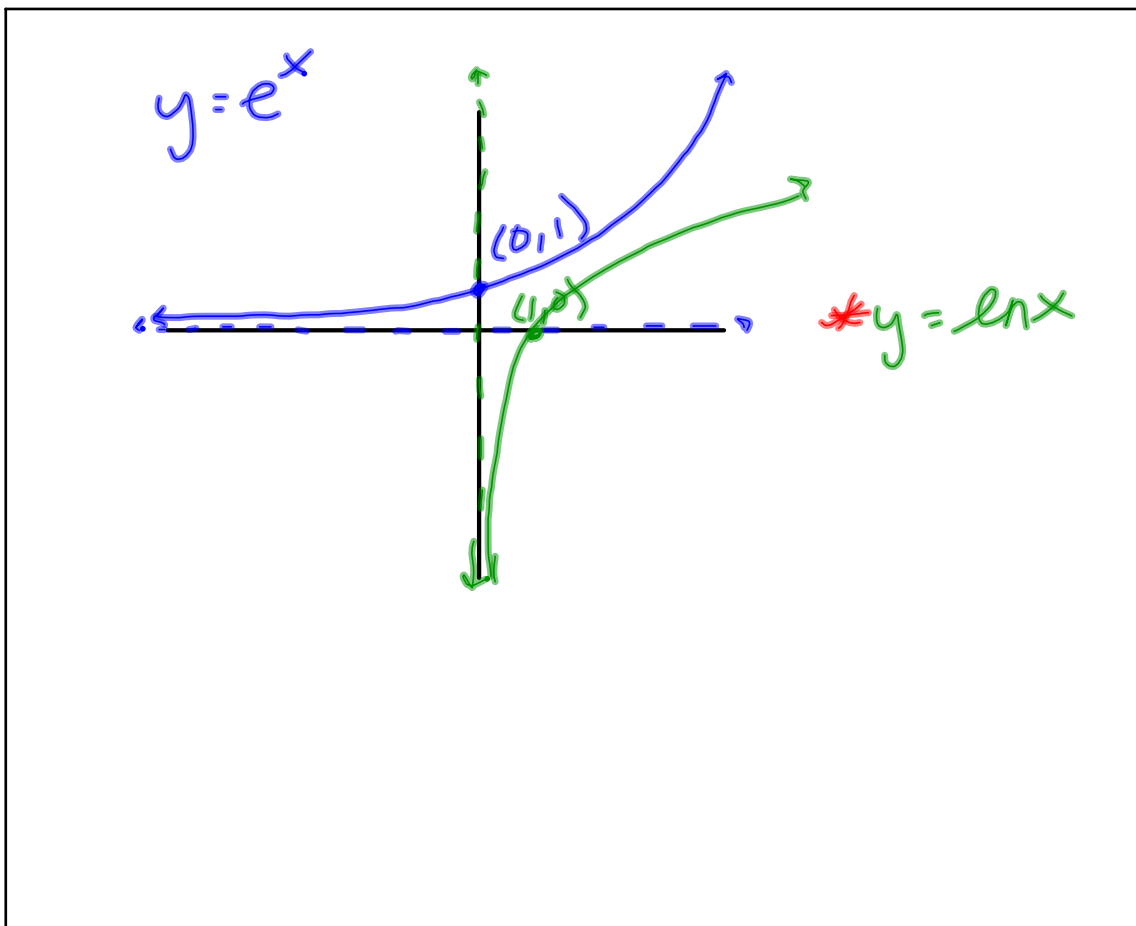
$$\ln .48 \approx -.733$$

$$e^{-.733} \approx .48$$

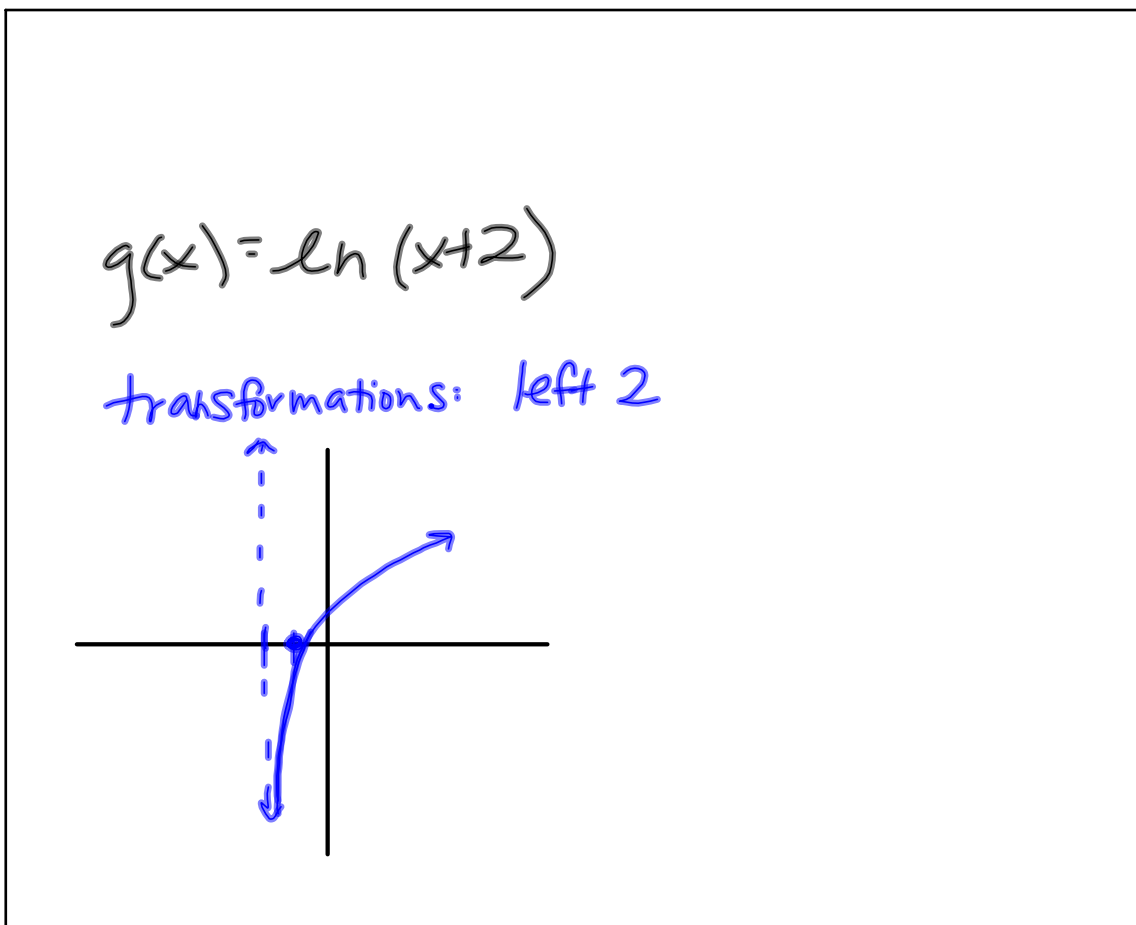
$$\ln(-3)$$

argument cannot be neg.

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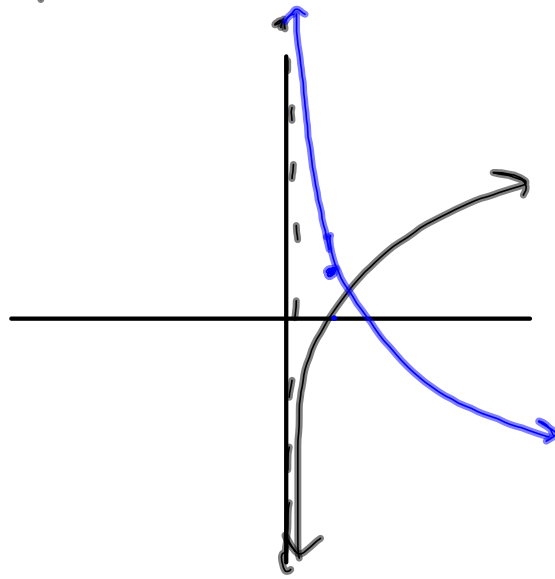


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$$h(x) = -\ln x + 1$$

up 1  
refl. over x-axis



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