Evaluate each of these:

1. $\log_5 125 = 3$ because $5^? = 125$

2. $\log_9 1 = 0$

3. $\log_4 4 = 1$

4. $\log 0.01 = -2$ because $10^? = .01 = \frac{1}{100}$

5. $\log_{27} 3 = \frac{1}{3}$ because $27^? = 3$

Hwk #10 Sec 8-3

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Problems 7, 8, 15, 16, 18, 22, 57, 58

Due Monday

Solve for x.

$4^x = 20$ → $\text{Log}_4 20 = x$ → You could use a calculator if the base were 10.

Property **Change of Base Formula**

For any positive numbers, M, b, and c, with $b \neq 1$ and $c \neq 1$

$$\log_b M = \frac{\log_c M}{\log_c b}$$

$\text{Log}_4 20 = x$

$$\log_b M = \frac{\log_c M}{\log_c b}$$

b = 4 M = 20

$$x = \frac{\text{Log}_{10} 20}{\text{Log}_{10} 4} = \frac{\text{Log } 20}{\text{Log } 4}$$

Use the change of base property to find the value of each.

1. $\text{Log}_5\ 500$

3.86

$\frac{\log 500}{\log 5}$

2. $\text{Log}_3 15$

2.46

$\frac{\log 15}{\log 3}$

Solve each.

1. $6^x = 100$

$\log_6 100 = x$

$= 2.57$

2. $25^x = 68$

$= 1.31$

3. $10^x = 1123$

$\log 1123 = x$

3.05

4. $7^x = 2$

$x = .36$

4. $10^{2x+7} = 135$

$\log 135 = 2x+7$

$-7 \qquad -7$

$\frac{\qquad}{2}$

$x = -2.43$

5. $2 \cdot 10^{x-1} + 3 = 50$

$-3 \quad -3$

$\frac{2 \cdot 10^{x-1}}{2} = \frac{47}{2}$

$10^{x-1} = 23.5$

$\log 23.5 = x - 1$

$x = 2.37$

6. $4^{2x+1} - 10 = 50$

$4^{2x+1} = 60$

$\log_4 60 = 2x+1$

$\frac{\log 60}{\log 4}$

$x = .98$

7. $\log_6 (x+5) = 2$

$6^2 = x+5$

$36 = x+5$

$x = 31$

8. $\log_x(x + 20) = 2$

$x^2 = x + 20$

$\log_5(25) = 2$

$x^2 - x - 20 = 0$

$(x+4)(x-5) = 0$

$x = -4, 5$

the base can't be negative (see next page)

Exponential Equation	Logarithmic Equation
$y = b^x$	$\log_b x = y$
Range: $y>0$	Domain: Any real number
Domain: Any real number	Range: Any real number
$b>0, b\neq 1$	$b>0, b\neq 1$

3. The amount of a certain substance decays 7% each year. There was 400 kg of this substance in 2008.

a) Find the amount of this substance in 2000 to the nearest tenth.

b) Find the amount of this substance in 2020 to the nearest tenth.

c) In how many years after 2008 will there be 50 kg remaining? Round to the nearest tenth.

$\frac{50}{400} = \frac{400(.93)^x}{400}$

$.125 = .93^x$

$\log_{.93}(.125) = x$

$x = 28.7$

$\frac{\log 0.125}{\log 0.93}$

The population of a city has been increasing 6.7% each year. The population in 1998 was 12,500.

In how many years will the population first exceed 250,000? Round to the nearest hundredth.

$250{,}000 = 12{,}500(1.067)^x$

$20 = 1.067^x$

$\log_{1.067}(20) = x = 46.2 \text{ years}$

$\frac{\log 20}{\log 1.067}$