Lesson 5.3 Fall 2009

Objectives: To solve an exponential equation by writing it in logarithmic form.
To know and use the change of base formula.
To solve logarithmic and exponential equations.
To solve logarithmic and exponential inequalities.

Exponential equation is an equation that has a variable in the exponent.

Method 1 (most effective for a base of *e* or 10)

1. Isolate the base with the exponential variable
2. Divide by the coefficient of the exponential variable – if necessary
3. Change the equation to logarithmic form.
4. Solve for the variable.

EXAMPLES: Solve

1. $4000 = 200(10^{4x})$

2. $3000 = 500(e^{4x})$

Method 2

1. Isolate the base with the exponential variable.
2. Divide by the coefficient of the exponential variable - if necessary
3. Take the log of both sides (log or ln)
4. Solve for the variable.

Solve

1. $4^x = 65$

2. $6400 = 32(2^{4x})$

Applications

EXAMPLE)#42 The demand function for a dining room table is given by $p = 4000(3^{-q})$ dollars per table, where *p* is the price and *q* is the quantity, in thousands of tables, demanded at that price. What quantity will be demanded if the price per table is $256.60?

EXAMPLE#45 After a television advertising campaign ended, sales of Genapet fell rapidly, with daily sales given by $S = 3200e^{-0.08x}$ dollars, where x is the number of days after the campaign ended.

a. What were daily sales when the campaign ended?

b. How many days passed after the campaign ended before daily sales were below half of what they were at the end of the campaign?

Let's look at a formula to help solve $4^x = 65$.

<u>Change of base formula:</u>

If $a > 0,\ a \neq 0,$ and $x > 0$, then

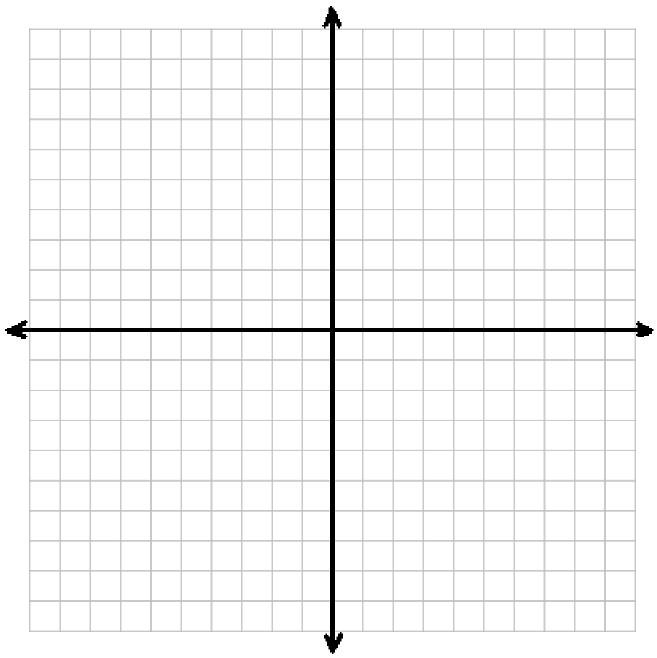
$$\log_a x = \frac{\log x}{\log a} \quad \text{and} \quad \log_a x = \frac{\ln x}{\ln a}$$

Therefore $4^x = 65$. Becomes $x = \log_4 65 = \dfrac{\log 65}{\log 4} =$ ________

#12 Use a change of base formula to evaluate

$\log_7(215)$

Graph $y = \log_4 (3x)$ by using a change of base formula.



EXAMPLE#76. If $1000 is invested at the end of each year in an annuity that pays 8% compounded annually, the number of years it takes for the future value to amount to $30,000 is given by $t = \log_{1.08} 3.4$. Use the change of base formula to find the number of years until the future value is $30,000.

Solving Logarithmic Equations

EXAMPLE: Solve (remember to isolate the log first)

1. $6 + 3 \ln x = 15$

2. $4 + 2 \ln x = 6$

3. $\log_4 (3x - 5) = 3$

4. $\log_5(x+4) - \log_5 x = 2$

5. $3\ln x + 8 = \ln(3x) + 12.18$

<u>Solving Inequalities</u>

1. $6^x > 2340$

2. $15(4^x) \leq 15{,}360$

EXAMPLE #80 The concentration of a drug in the bloodstream from the time the drug is administered until 8 hours later is given by $y = 100(1 - e^{-0.312(8-t)})$ percent, where the drug is administered at time $t = 0$. For what time period is the amount of drug present more than 60%?

Homework Course Compass 5.3 and supplement and bookwork page 358 # 39, 43, 62