

3-4: Exponential and Logarithmic Equations

CP Precalculus
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Solving Exponential Equations (Common Base)

- Rewrite terms with a common base
- If two numbers with the same base are equal, the exponents are equal.

$$\begin{array}{l} 1). 4^x = 32 \quad (2^2)^x = 2^5 \\ \quad \quad \quad 2^{2x} = 2^5 \\ \quad \quad \quad 2x = 5 \\ \quad \quad \quad x = \frac{5}{2} \end{array} \quad \begin{array}{l} 2). 256^{2x} = 64 \quad (4^4)^{2x} = 4^3 \\ \quad \quad \quad 4^{8x} = 4^3 \\ \quad \quad \quad 8x = 3 \\ \quad \quad \quad x = \frac{3}{8} \end{array}$$

Solving Exponential Equations (Different Bases)

- Take log of each side (logs of equal numbers are also equal)
- Use Power Property to solve

$$1). 6^{4x} = 512$$

$$\log 6^{4x} = \log 512$$

$$4x \log 6 = \log 512$$

$$x = \frac{\log 512}{4 \log 6}$$

$$x \approx .8704$$

$$2). 6^{x-3} = 2^x$$

$$\log 6^{x-3} = \log 2^x$$

$$(x-3) \log 6 = x \log 2$$

$$x \log 6 - 3 \log 6 = x \log 2$$

$$x \log 6 - x \log 2 = 3 \log 6$$

$$x(\log 6 - \log 2) = 3 \log 6$$

$$x = \frac{3 \log 6}{\log 6 - \log 2}$$

$$x \approx 4.8928$$

Your MP3 player has about 126,000,000 bytes of memory. Each month you plan to use 5% of the memory remaining. How many months will it take you to use $\frac{1}{4}$ of the memory?

Let m =number of months it takes to use $\frac{1}{4}$ of the memory

Let $T(m)$ =amount of memory remaining after m months

$$T(m) = 126,000,000 \left(\frac{3}{4} \right)^m$$

$$a = 126,000,000$$

$$r = 0.05$$

$$b = 1 - 0.05 = 0.95$$

$$T(m) = 126,000,000 (.95)^m$$

$$T(m) = 126,000,000(0.95)^m$$

$$94,500,000 = 126,000,000(0.95)^m$$

$$\frac{94,500,000}{126,000,000} = 0.95^m$$

$$\log \frac{94,500,000}{126,000,000} = \log 0.95^m$$

$$\log \frac{94,500,000}{126,000,000} = m \log 0.95$$

$$\frac{\log \frac{94,500,000}{126,000,000}}{\log 0.95} = m$$

$$5.61 \approx m$$

Solving Logarithmic Equations

What is the solution of the following exponential equation?

$$1). \log 2x^2 - \log 5 = 1 \quad \log \frac{2x^2}{5} = 1$$

$$\frac{2x^2}{5} = 10^1$$

$$\frac{2x^2}{5} - 10 = 0$$

$$2x^2 - 50 = 0$$

$$x^2 = 25$$

$$x = \pm 5$$

Homework: p.196 #1-7 odd, 11-19 odd, 23-37 odd