

SOLUTIONS

Math 120

Winter 2009

Handout 16: Manipulating Equations Using Logarithms

Solve each of the following equations for x . You should use algebra and logarithms (where appropriate) to solve the equations. Show all of your work.

You should not use your calculator to solve these equations except for performing arithmetic and working out the numerical values of logarithms. You can use either common or natural logarithms.

(a) $3 \cdot 10^x = 900$

$$10^x = 300$$

$$\log(10^x) = \log(300)$$

$$x \cdot \log(10) = \log(300)$$

$$x = \frac{\log(300)}{\log(10)}$$

$$\approx 2.477121255$$

(b) $10^{\ln(x)} = 100$

$$\log(10^{\ln(x)}) = \log(100)$$

$$\ln(x) \cdot \log(10) = \log(100)$$

$$\ln(x) = 2$$

$$e^{\ln(x)} = e^2$$

$$x = e^2$$

$$\approx 7.389056$$

(c) $7 \cdot e^{3x} = 2000$

$$e^{3x} = \frac{2000}{7}$$

$$\ln(e^{3x}) = \ln\left(\frac{2000}{7}\right)$$

$$3x \cdot \ln(e) = \ln\left(\frac{2000}{7}\right)$$

$$3x = \ln\left(\frac{2000}{7}\right)$$

$$x = \frac{\ln\left(\frac{2000}{7}\right)}{3}$$

$$\approx 1.884997437$$

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$$(d) \quad e^{\ln(4x+5)} = 3$$

$$4x + 5 = 3$$

$$4x = -2$$

$$x = -1/2.$$

$$(f) \quad 5^{x+1} = 22e^{3x}$$

$$\ln(5^{x+1}) = \ln(22) + \ln(e^{3x})$$

$$(x+1) \cdot \ln(5) = \ln(22) + 3x$$

$$x \cdot \ln(5) - 3x = \ln(22) - \ln(5)$$

$$x = \frac{\ln(22) - \ln(5)}{\ln(5) - 3} \approx -1.065471692.$$

$$(g) \quad (1+x)^5 = 777$$

$$1+x = 777^{1/5}$$

$$x = 777^{1/5} - 1$$

$$x \approx 2.785159667$$

(No logs involved!)