

## 4.7 Exponential and Logarithmic Equations

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We can use logs to solve exponential equations

WE know that  $2^x = 4$

EX Solve  $5^x = 9$

$$\log 5^x = \log 9$$

$$x \frac{\log 5}{\log 5} = \frac{\log 9}{\log 5}$$

$$x = \frac{\log 9}{\log 5}$$

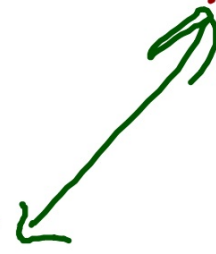
$$x \approx 1.37$$

$$2^x = 2^2$$

$$\log_5 5^x = \log_5 9$$

$$x = \log_5 9$$

$$x = \frac{\log 9}{\log 5}$$



Ex 2 Solve  $6^x = 3^{x+1}$

$$\log 6^x = \log 3^{x+1}$$

$$x \log 6 = (x+1) \log 3$$

$$x \log 6 = \cancel{x \log 3} + \log 3$$
$$- x \log 3 \quad - x \log 3$$

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

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

$$x \left( \log \left( \frac{6}{3} \right) \right) = \log 3$$

$$x \frac{\log(2)}{\log(2)} = \frac{\log(3)}{\log(2)}$$

$$x \approx 1.58$$

Ex3 using ln instead of log

$$e^{3x} = 5^{1-x}$$

$$\ln e^{3x} = \ln 5^{1-x}$$

$$3x = \ln 5 - x \ln 5$$

$$3x + x \ln 5 = \ln 5$$

$$x(3 + \ln 5) = \ln 5$$

$$x = \frac{\ln 5}{3 + \ln 5}$$

HW 4P 1, 2, 9 degh  
p. 128

~~plus~~  
~~ln 5~~  
~~3~~  
~~ln 5~~

Ex 4 | Solve  $3 \cdot 6^{x-1} = 2 \cdot 3^{x+2}$

giving your answer in the form

$$x = \frac{\ln a}{\ln b}, \text{ where } a, b \in \mathbb{Z}^+$$

↑ element of  $\mathbb{Z}^+$   
 ↑ integers  
 ↑ positive

$$\ln(3 \cdot 6^{x-1}) = \ln(2 \cdot 3^{x+2})$$

$$\ln 3 + \ln 6^{x-1} = \ln 2 + \ln 3^{x+2}$$

$\ln 3 + (x-1)\ln 6 = \ln 2 + (x+2)\ln 3$

$$\ln 3 + x \ln 6 - \ln 6 = \ln 2 + x \ln 3 + 2 \ln 3$$

$-\ln 3 \quad \quad \quad + \ln 6 \quad \quad \quad - \ln 3 + \ln 6$

$$x \ln 6 = \ln 2 + x \ln 3 + \boxed{2 \ln 3 - \ln 3} + \ln 6$$

$-x \ln 3 \quad \quad \quad -x \ln 3$

$$x(\ln 6 - \ln 3) = \ln 2 + \ln 3 + -\ln 3 + \ln 6$$

$$x(\ln 6 - \ln 3) = \ln 2 + (\ln 9 - \ln 3) + \ln 6$$

$$x \frac{(\ln 6 - \ln 3)}{(\ln 4 - \ln 3)} = \frac{\ln 2 + (\ln 9 - \ln 3) + \ln 6}{(\ln 4 - \ln 3)}$$

$$x = \frac{\ln 2 + \ln\left(\frac{9}{3}\right) + \ln 6}{\ln\left(\frac{4}{3}\right)}$$

HW 4Q  
P 129

1, 2, 3 abd

$$= \frac{\ln(2) + \ln(3) + \ln(6)}{\ln(2)}$$

$$= \frac{\ln(2 \cdot 3 \cdot 6)}{\ln(2)} = \frac{\ln(36)}{\ln(2)}$$

~~$$\frac{\ln(36) - \ln(2)}{\ln(2)}$$~~