

Solving Exponential and Logarithmic Equations 1

Exponential equations are equations in which variable expressions occur as exponents.

Logarithmic equations are equations that involve logarithms of variable expressions.

Ex. 1 Solve by equating exponents

Solve: $8^x = 4^{x+1}$

$$2^{3(x)} = 2^{2(x+1)}$$

$$3x = 2x + 2$$

$$\begin{array}{r} -2x \\ \hline x = 2 \end{array}$$

Solve: $\frac{1}{5}^x = 25^{x+2}$

$$5^{-1(x)} = 5^{2(x+2)}$$

$$-1x = 2x + 4$$

$$\begin{array}{r} -3x = 4 \\ \hline -3 \quad -3 \\ \hline x = -4/3 \end{array}$$

YOU TRY!

Solve: $64^x = 16^{x+1}$

$$4^{3(x)} = 4^{2(x+1)}$$

$$3x = 2x + 2$$

$$\begin{array}{r} -2x \\ \hline x = 2 \end{array}$$

Solve: $3^{7x-3} = \frac{1^{2x}}{9}$

(This block is empty as the equation above is not solved in the image)

Ex. 2 Solve by taking a logarithm of each side

Solve: $8^x = 23$

$$\log_8 8^x = \log_8 23$$

$$x \log_8 8 = \log_8 23$$

$$x = \frac{\log_8 23}{\log_8 8}$$

$$\boxed{x = 1.51}$$

Solve: $7^{x-1} = 23$

$$\log_7 7^{x-1} = \log_7 23$$

$$x-1 = \frac{\log_7 23}{\log_7 7}$$

$$x-1 = 1.61$$

$$\begin{array}{r} +1 \\ \hline x = 2.61 \end{array}$$

YOU TRY!

Solve: $6^x = 27$

$$\log_6 6^x = \log_6 27$$

$$x = \frac{\log_6 27}{\log_6 6}$$

$$\boxed{x = 1.84}$$

Solve: $15 = 11^{2x+1}$

$$\log_{11} 15 = \log_{11} 11^{2x+1}$$

$$\frac{\log_{11} 15}{\log_{11} 11} = 2x+1$$

$$1.13 = 2x+1$$

$$\begin{array}{r} -1 \\ \hline 0.13 = 2x \\ \hline \cdot 13 \quad \cdot 2 \\ \hline x = .065 \end{array}$$

Ex. 3 Solve by taking a logarithm of each side

Solve: $9^{3x+2} - 6 = 5$

$$9^{3x+2} = 11$$

$$\log_9 9^{3x+2} = \log_9 11$$

$$3x+2 = \frac{\log_9 11}{\log_9 9}$$

$$3x+2 = 1.09$$

$$\begin{array}{r} -2 \\ \hline 3x = -0.91 \\ \hline \frac{3x}{3} = \frac{-0.91}{3} \\ \hline x = -0.30 \end{array}$$

Solve: $3(2^x) + 2 = 11$

$$3(2^x) = 9$$

$$\frac{3(2^x)}{3} = \frac{9}{3}$$

$$2^x = 3$$

$$\log_2 2^x = \log_2 3$$

$$x = \frac{\log_2 3}{\log_2 2}$$

$$\boxed{x = 1.58}$$