$\sqrt[4]{625}$

6.1 Day 4: Solving Exponential Equations

Exponential equations have variables in the *exponent*. In Algebra 2, you'll learn much more advanced ways of solving these. For now, the key concept is to get the bases the same!

$4 \times 4 = 16$

$4^2 = 16$

$5^{(3+2)} = 5^{(2(3)-1)}$

Ex: $3^x = 9$

$3^x = 3^2$

$x = 2$

Ex: $4^{x+1} = 16$

$4^{x+1} = 4^2$

$x+1 = 2$

$-1 \quad -1$

$x = 1$

Check $4^{1+1} = 16$ ✓

Ex: $5^{x+2} = 5^{2x-1}$

$x+2 = 2x-1$

$-x \quad -x$

$2 = x-1$

$+1 \quad +1$

$3 = x$

Ex: $10^{3x-2} = 100$

$10^{3x-2} = 10^2$

$3x-2 = 2$

$+2 \quad +2$

$\frac{3x}{3} = \frac{4}{3}$

$x = \frac{4}{3}$

Ex: $\left(\frac{1}{2}\right)^{6x+4} = \left(\frac{1}{2}\right)^{8x}$

$6x+4 = 8x$

$-6x \quad -6x$

$\frac{4}{2} = \frac{2x}{2}$

$2 = x$

Ex: $(-19)^{6x-1} = (-19)^1$

$6x-1 = 1$

$+1 \quad +1$

$\frac{6x}{6} = \frac{2}{6}$

$x = \frac{1}{3}$

The next section is a little harder! We willl first need to review the rules of exponents from earlier this section.

$x^a \cdot x^b =$ x^{a+b}

$(x^a)^b =$ x^{ab}

$x^{-a} =$ $\frac{1}{x^a}$

$x^{\frac{1}{a}} =$ $\sqrt[a]{x}$

Ex: $2^{x+2} \cdot 2^{3x+1} = 2^{15}$

$x+2+3x+1 = 15$

$4x+3 = 15$

$-3 \quad -3$

$\frac{4x}{4} = \frac{12}{4}$

$x = 3$

Ex: $3^x \cdot 3^{4x-7} = 9$

$3^x \cdot 3^{4x-7} = 3^2$

$x+4x-7 = 2$

$5x-7 = 2$

$+7 \quad +7$

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

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

Ex: $(7^x)^6 = 49$

$(7^x)^6 = 7^2$

$\frac{6x}{6} = \frac{2}{6}$

$x = \frac{1}{3}$

Ex: $(2^{x+1})^5 = 8$ 2^3

$5(x+1) = 3$

$5x + 5 = 3$

$-5 \quad -5$

$\frac{5x}{5} = \frac{-2}{5}$

$x = -\frac{2}{5}$

Ex: $(3^{2x+1})^4 = 9^x$

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

$4(2x+1) = 2x$

$8x + 4 = 2x$

$-8x \quad -8x$

$\frac{4}{-6} = \frac{-6x}{-6}$

$\frac{2}{-3}$

Challenge Problem! $(3)^{5x+5} = \left(\frac{1}{9}\right)^{x+1}$

$(3)^{5x+5} = \left(\frac{1}{3^2}\right)^{x+1}$

$3^{5x+5} = (3^{-2})^{x+1}$

$5x+5 = -2(x+1)$

$5x+5 = -2x - 2$

$+2x \quad +2x$

$7x + 5 = -2$

$-5 \quad -5$

$\frac{7x}{7} = \frac{-7}{7}$

$x = -1$

Try the following problems. Make sure your answers are in the answer bank below.

1. $9^{4x-6} = 9^5$

2. $5^{3x-1} = 25^x$

3. $4^{x+1} = 16^{3x}$

4. $8^{3x+1} = 64^{x+2}$

5. $\left(6^{x+4}\right)^2 = 6^{4x}$

6. $\left(\frac{3}{4}\right)^{x+2}\left(\frac{3}{4}\right)^{7x+18} = \left(\frac{3}{4}\right)^{12x}$

$\frac{1}{5}$	3	4	$\frac{11}{4}$	1	5