

Name: Key

## Solving Exponential Functions

With the SAME Base	With Different Bases
<p>Two powers with the same base are <u>equal</u> if their <u>exponents</u> are equal.</p> <p>a. <math>3^{x+1} = 3^5</math> Write the equation.  <math>x+1 = 5</math> Equate the exponents.  <math>\frac{-1}{-1} \quad \frac{-1}{-1}</math> Subtract 1 from each side.  <math>x = 4</math> Simplify.</p> <p>b. <math>6 = 6^{2x-3}</math>  <math>1 = 2x - 3</math>  <math>\frac{+3}{+3} \quad \frac{+3}{+3}</math>  <math>\frac{4}{2} = \frac{2x}{2}</math>  <math>2 = x</math></p>	<p>To solve some exponential functions, you must first <u>rewrite</u> each side of the equation using the <u>same</u> base.</p> <p>a. <math>5^x = 125</math> Write the equation.  <math>5^x = 5^3</math> Rewrite 125 as <math>5^3</math>.  <math>x = 3</math> Equate the exponents.</p> <p>b. <math>4^x = 2^{x-3}</math>  <math>(2^2)^x = 2^{x-3}</math>  <math>2^{2x} = 2^{x-3}</math>  <math>2x = x - 3</math>  <math>\frac{-x}{-x} \quad \frac{-x}{-x}</math>  <math>x = -3</math></p>
<b>With a base that is a fraction or decimal (<math>0 &lt; b &lt; 1</math>)</b>	
First, rewrite the base as an exponent.	
<p>a. <math>(\frac{1}{2})^x = 4</math> Write the equation.  <math>(2^{-1})^x = 2^2</math> Rewrite <math>\frac{1}{2}</math> as <math>2^{-1}</math> and 4 as <math>2^2</math>.  <math>2^{-x} = 2^2</math> Power of a Power Property  <math>-x = 2</math> Equate the exponents.  <math>x = -2</math> Solve for x.</p>	<p>b. <math>4^{x+1} = \frac{1}{64}</math>  <math>4^{x+1} = (4^{-1})</math>  <math>4^{x+1} = (4^3)^{-1}</math>  <math>4^{x+1} = 4^{-3}</math>  <math>x+1 = -3</math> <math>x = -4</math></p>

Practice:

3.  $4^{5x} = 4^{10}$

$5x = 10$

$x = 2$

4.  $7^{x-4} = 7^8$

$x - 4 = 8$

$x = 12$

5.  $3^{9x} = 3^{7x+8}$

$9x = 7x + 8$

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

$2x = 8$

$x = 4$

6.  $2^{4x} = 2^{x+9}$

$4x = x + 9$

$\frac{-x}{-x} \quad \frac{-x}{-x}$

$3x = 9$

$x = 3$

$$7. 2^x = 64$$

$$2^x = 2^6$$

$$\boxed{x=6}$$

$$8. 3^x = 243$$

$$3^x = 3^5$$

$$\boxed{x=5}$$

$$9. 7^{x-5} = 49^x$$

$$7^{x-5} = (7^2)^x$$

$$7^{x-5} = 7^{2x}$$

$$\begin{array}{r} x-5 = 2x \\ -x \quad -x \end{array}$$

$$\boxed{-5=x}$$

$$10. 216^x = 6^{x+10}$$

$$(6^3)^x = 6^{x+10}$$

$$6^{3x} = 6^{x+10}$$

$$\begin{array}{r} 3x = x+10 \\ -x \quad -x \end{array}$$

$$2x = 10$$

$$\boxed{x=5}$$

$$11. 64^{2x+4} = 16^{5x}$$

$$(4^3)^{2x+4} = (4^2)^{5x}$$

$$4^{6x+12} = 4^{10x}$$

$$\begin{array}{r} 6x+12 = 10x \\ -6x \quad -6x \end{array}$$

$$12 = 4x$$

$$\boxed{3=x}$$

$$12. 27^x = 9^{x-2}$$

$$(3^3)^x = (3^2)^{x-2}$$

$$3^{3x} = 3^{2x-4}$$

$$\begin{array}{r} 3x = 2x-4 \\ -2x \quad -2x \end{array}$$

$$\boxed{x=-4}$$

$$13. \left(\frac{1}{5}\right)^x = 125$$

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

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

$$-x = 3$$

$$\boxed{x=-3}$$

$$14. \left(\frac{1}{4}\right)^x = 256$$

$$(4^{-1})^x = 4^4$$

$$4^{-x} = 4^4$$

$$-x = 4$$

$$\boxed{x=-4}$$

$$15. \frac{1}{128} = 2^{5x+3}$$

$$128^{-1} = 2^{5x+3}$$

$$(2^7)^{-1} = 2^{5x+3}$$

$$2^{-7} = 2^{5x+3}$$

$$\begin{array}{r} -7 = 5x+3 \\ -3 \quad -3 \end{array}$$

$$-10 = 5x$$

$$\boxed{-2=x}$$

$$16. 3^{4x-9} = \frac{1}{243}$$

$$3^{4x-9} = 243^{-1}$$

$$3^{4x-9} = (3^5)^{-1}$$

$$3^{4x-9} = 3^{-5}$$

$$\begin{array}{r} 4x-9 = -5 \\ +9 \quad +9 \end{array}$$

$$4x = 4$$

$$\boxed{x=1}$$

$$17. 36^{-3x+3} = \left(\frac{1}{216}\right)^{x+1}$$

$$36^{-3x+3} = (216^{-1})^{x+1}$$

$$36^{-3x+3} = 216^{-x-1}$$

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

$$6^{-6x+6} = 6^{-3x-3}$$

$$\begin{array}{r} -6x+6 = -3x-3 \\ +3x \quad +3x \end{array}$$

$$-3x+6 = -3$$

$$\begin{array}{r} -3x = -9 \\ -3 \quad -3 \end{array}$$

$$\boxed{x=3}$$

$$18. \left(\frac{1}{27}\right)^{4-x} = 9^{2x-1}$$

$$(27^{-1})^{4-x} = 9^{2x-1}$$

$$27^{-4+x} = 9^{2x-1}$$

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

$$3^{-12+3x} = 3^{4x-2}$$

$$\begin{array}{r} -12+3x = 4x-2 \\ +12 \quad +12 \end{array}$$

$$3x = 4x+10$$

$$-4x \quad -4x$$

$$-x = 10$$

$$\boxed{x=-10}$$