

Objective: To solve exponential equations
with the same base.

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$2^2 = 4$	$2^3 = 8$	$2^4 = 16$	$2^5 = 32$
$3^2 = 9$	$3^3 = 27$	$3^4 = 81$	$3^5 = 243$
$4^2 = 16$	$4^3 = 64$	$4^4 = 256$	$4^5 = 1024$
$5^2 = 25$	$5^3 = 125$	$5^4 = 625$	$5^5 = 3125$
$6^2 = 36$	$6^3 = 216$	$6^4 = 1296$	
$7^2 = 49$	$7^3 = 343$		
$8^2 = 64$	$8^3 = 512$		
$9^2 = 81$			
$10^2 = 100$			

Steps to solving exponential equations with same base:

- 1.) Rewrite both sides of the equation using powers of the same base.
- 2.) Use properties of exponents, if needed.
- 3.) When both sides have the same base, drop the bases and set exponents equal to each other.
- 4.) Solve for the variable.

Examples: (Easy)

a.) $3^{x+1} = 3^5$

$$\begin{array}{r} x+1 = 5 \\ -1 \quad -1 \\ \hline x = 4 \end{array}$$

b.) $6^1 = 6^{2x-3}$

$$\begin{array}{r} 1 = 2x-3 \\ +3 \quad +3 \\ \hline 4 = 2x \\ \frac{4}{2} = \frac{2x}{2} \\ \hline x = 2 \end{array}$$

c.) $10^{3x} = 10^{2x+3}$

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

Examples: (Medium)

a.) $5^x = 125$

$$5^x = 5^3$$
$$x = 3$$

b.) $4^x = 2^{x-3}$

$$(2^2)^x = 2^{x-3}$$
$$2^{2x} = 2^{x-3}$$
$$2x = x-3$$
$$\begin{array}{r} 2x = x-3 \\ -x \quad -x \\ \hline x = -3 \end{array}$$

c.) $9^{x+2} = 27^x$

$$(3^2)^{x+2} = (3^3)^x$$
$$3^{2x+4} = 3^{3x}$$
$$2x+4 = 3x$$
$$\begin{array}{r} 2x+4 = 3x \\ -2x \quad -2x \\ \hline 4 = x \end{array}$$
$$x = 4$$

Examples: (Hard)

$2^{-1} = \frac{1}{2}$

a.) $\left(\frac{1}{2}\right)^x = 4$

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

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

$$\frac{-x}{-1} = \frac{2}{-1}$$

$$x = -2$$

b.) $4^{x+1} = \frac{1}{64}$

$$4^{x+1} = 4^{-3}$$

$$x+1 = -3$$

$$\begin{array}{r} x+1 = -3 \\ -1 \quad -1 \\ \hline \end{array}$$

$$x = -4$$