Solving Exponential Equations Using Common Bases

Learning Goals

- Change bases in powers
- Solve equations by
  - changing bases in powers
  - systematic trial
  - graphing

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Solving Exponential Equations Using Common Bases

Algebra can be used to solve exponential functions if they can be expressed as powers with the same base.

$8^2 =$ 64

$4^3 =$ 64

$2^6 =$ 64

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In the equation $a^x = a^y$, the bases are the same.

For this equation to be true, the exponents must be same

That is:

If $a^x = a^y$
Then $x = y$

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Steps:

1. Change both sides into powers with the same base.
2. Set exponents equal to each other.
3. Solve for the variable

Change to a power with a different base.

$4^3 =$

$(2^2)^3$

$= 2^6$

$9^4 =$

$(3^2)^4$

$= 3^8$

$2^6 =$

$(2^3)^2$

$= 8^2$

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Example 1: Solve the following equations:

$5^{-2} = \frac{1}{5^2}$

a) $3^{2x} = 81$

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

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

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

$2x = 4$

$x = 2$

b) $5^{2x-1} = \frac{1}{125}$

$5^{2x-1} = \frac{1}{5^3}$

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

$2x - 1 = -3$

$2x = -2$

$x = -1$

c) $2^{5x+2} = \sqrt{2}$

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

$5x + 2 = \frac{1}{2}$

$10x + 4 = 1$

$10x = -3$

$x = \frac{-3}{10}$

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d) $2^{3x-1} = 1$

$2^{3x-1} = 2^0$

$3x - 1 = 0$

$3x = 1$

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

e) $4^x = 8\sqrt{2}$

$(2^2)^x = 2^3 \cdot 2^{\frac{1}{2}}$

$2^{2x} = 2^{3\frac{1}{2}}$

$2^{2x} = 2^{\frac{7}{2}}$

$2x = \frac{7}{2}$

$x = \frac{7}{4}$

f) $36^{2x+4} = \sqrt{1296^x}$

$36^{2x+4} = 36^x$

$2x + 4 = x$

$x + 4 = 0$

$x = -4$

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Solving Exponential Equations using Systematic Trial

$3^x = 7$ $5^{x+1} = 10$

1. Trial and Error
2. Solve function

1. $3^1 = 3$
$3^2 = 9$
$3^{1.5} = 5.19$
$3^{1.8} = 7.22$

2. solve $(3^x = 7, x)$
$x = 1.77124$

$5^{x+1} = 10$
Trial and Error
$5^{1.43} = 10$
$x + 1 = 1.43$
$x = 0.43$

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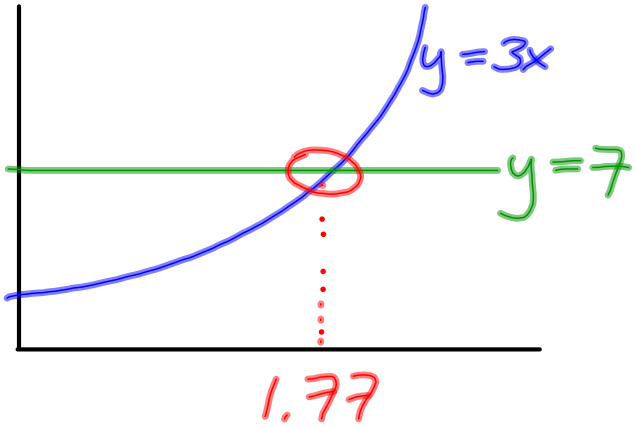
Solving Exponential Equations using Graphing

$3^x = 7$

Graph $y = 3^x$
$y = 7$



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Seatwork

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