# Lesson 5: Solving Equations with Exponents

**Recall**: Solving any equation means find the **value of the variable** that **makes the equation true**. When solving equations involving exponents, pay attention to the location of your variable in the equation.

**Variable already isolated**

- Apply correct order of operations (exponents before multiplication) and evaluate

Ex 1) Solve $A = 100(1.07)^5$

$A = 140.255\ldots$

**Variable is being multiplied by a power**

- Solve using inverse operations

Ex 2) Solve $7500 = N(1.25)^{1.50}$

$\frac{7500}{1.25^{1.5}} = N$

$5366.56\ldots = N$

$\frac{7500}{1.3975} = N$

$5368.72 = N$

Wrong

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**Variable is the base of a power**

- Use inverse operations to isolate the power
- The exponent in the power becomes the type of root needed to solve for the base
  - exponent of 2 → square root
  - exponent of 3 → cube root
  - exponent of 4 → 4th root
  - etc …
- When taking an even root, ask yourself: should I consider the negative answer as well?

Ex 3) Solve $5000 = 2000(B)^{10}$

$\frac{5000}{2000} = B^{10}$

$\sqrt[10]{\frac{5000}{2000}} = B$

$\pm 1.0959\ldots = B$

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**Variable is the exponent**

**Strategy #1 – Guess and Check**

- Since we don't (yet!) know how to "undo" the raising of a base to an unknown variable, we can use a "guess and check" strategy

Ex 4) Solve $1000 = 500(1.10)^t$

$\frac{1000}{500} = 1.10^t$

$2 = 1.10^t$

$7.28 = t$

$1.10^7 = 1.9487$

$1.10^8 = 2.1435$

$1.10^{7.5} = 2.0438\ldots$

$1.10^{7.28} = 2.001\ldots$

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**Strategy #2 – Change of Base**

Consider the equation $a^x = a^y$. Since the bases are equal, it follows that the exponents must be the same as well.

**If $a^x = a^y$, Then $x = y$.**

*IMPORTANT: We are NOT "Cancelling the bases."*
*We ARE creating a NEW equation that has the same solution as our original equation.*

**Steps to follow:**

- Rewrite all powers with a common base.
- Simplify to get a single power on each side of the equation.
- Create a new equation with the exponents
- Solve the new equation to get the solution(s) of the original equation

Ex 5) Solve

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

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

$\therefore 3x = 4$

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

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

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

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

$\therefore 2x - 1 = -3$

$2x = -2$

$x = -1$

c) $(2^x)(64) = (\sqrt{32})^x$

$(2^x)(2^6) = (\sqrt{2^5})^x$

$2^{x+6} = ((2^5)^{\frac{1}{2}})^x$

$2^{x+6} = 2^{\frac{5x}{2}}$

$\therefore x + 6 = \frac{5x}{2}$

$2(x+6) = 5x$

$2x + 12 = 5x$

$12 = 3x$

$\frac{12}{3} = x$

$4 = x$

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HW: 1. Sign & correct quiz

2. p. 261 # 1

p. 223 # 16, 17

3. handout