

# Review - Exponent Laws

Rewrite bases where possible. If a common base cannot be created, determine whether the equation has no solution or requires logarithms.”

## Part A — Direct Recognition

1.  $2^x = 32$
2.  $3^{x+1} = 81$
3.  $4^{x-2} = 64$
4.  $2^{x+1} = 2^{3x-1}$
5.  $27^x = 9^{x+1}$
6.  $243 = 3^x$
7.  $8^x = 2^6$
8.  $27^x = 9^{x+1}$
9.  $4^{3x} = 128$

## Part B — Exponent Laws

8.  $8 \cdot 2^5 = 2^x$
9.  $4^x \cdot 16 = 64$
10.  $2^{x+2} \cdot 2^3 = 2^{10}$
11.  $3^x \cdot 9 = 3^5$
12.  $16^x = 8^{x+2}$
13.  $(2^{x+1})^3 = 2^{12}$
14.  $(3^{2x})^3 = 81$
15.  $(27^3)^3 = 3^x$
16.  $(5^{x+2})^2 = 5^{10}$
17.  $(2^{3x-1})^2 = 2^7$

## Part C — Fractional Exponents (Bridge)

**Reminder:**  $a^{1/n} = \sqrt[n]{a}$ ,  $a^{m/n} = \sqrt[n]{a^m}$

19.  $16^{1/2} = 2^x$
20.  $32^{1/5} = 2^x$
21.  $16^{3/4} = 2^x$
22.  $(8^{2/3}) = 2^x$

## Part D — When Exponent Laws Fail

23.  $2^x = 64$   $2^x = 63$ 
  - a) Why can the first one be solved using exponent laws and the other not?
  - b) What method is needed to solve it?
24.  $(3^x)^2 = 3^{x^2}$  (True or False)

## Challenge (Extension — Multi-step)

25.  $(4^{x+1})(2^5) = 65536$
26.  $(8^{-x})^2 = 2^6$
27.  $(512^{2/5})^2 = 2^x$
28.  $(16^{-x} \cdot 32^2)^4 = 64^{x+1}$
29.  $\left(\frac{81^{x+4}}{9^5}\right)^4 = \left(\frac{1}{3}\right)^x$
30.  $\left(\frac{81^2 \cdot 9^x}{729^3}\right)^{-1} = \frac{3^{3x+1}}{9^x}$

Solve the following equations by factoring (using the area model):

$$(3^x)^2 - 30(3^x) + 81 = 0$$

$$(8^x)^2 - 18(8)^x + 32 = 0$$

$$(4^x)^2 - 12(4^x) + 32 = 0$$

$$56(2^{x-1})^2 - 6(2^{x-1}) = 5$$

### How to Solve Exponential Equations by Factoring

These questions look complicated, but they all follow the **same 4-step process**.

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#### Step 1 — Substitution

If you see the same exponential expression repeated, let:

$$y = a^x \text{ (or } y = a^{x+k} \text{)}$$

Examples:

- $y = 3^x$

- $y = 2^{x+1}$

- $y = 2^{x-1}$

👉 This turns the equation into a **quadratic**.

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#### Step 2 — Rewrite the Equation

Replace every matching exponential expression with  $y$ .

You should get something like:

$$ay^2 + by + c = 0$$

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#### Step 3 — Solve the Quadratic

Factor (use area model if needed):

$$(y - a)(y - b) = 0$$

Solve for  $y$ .

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#### Step 4 — Back-Substitute

Replace  $y$  with the original exponential expression.

Solve for  $x$ .

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