

**Content and Language Objective:**

Students will learn the processes for raising powers, products, and quotients to powers rules and be able to explain the process for using these new rules in their own words.

**Warm-Up**

1.  $\frac{10x^5}{5x^{-3}} = 2x^8$

2.  $\frac{12a^2b^3}{18a^4b^2} = \frac{2b^1}{3a^2} = \frac{2b}{3a^2}$

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How should we evaluate  $(4^3)^2$ . To answer this question consider the following:

$$\begin{aligned}(4^3)^2 &= 4^{3 \cdot 2} = 4^6 \\ &= (4 \cdot 4 \cdot 4)(4 \cdot 4 \cdot 4) = 4^6 \\ &= 4^3 \cdot 4^3 = 4^{3+3} = 4^6\end{aligned}$$
$$(x^4)^3 = x^{12}$$

These results suggest that to raise a power to a power, multiply the exponents.

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**Try It!**

$$(5^2)^3 = 5^6$$

$$(2^4)^{-2} = 2^{-8} = \frac{1}{2^8}$$

$$(b^{-7})^5 = b^{-35} = \frac{1}{b^{35}}$$

$$\frac{(x^3)^{-2}}{(x^{-5})^2} = \frac{x^{-6}}{x^{-10}} = x^{-6+10} = x^4$$

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How can we simplify the expression  $(2x)^3$ ? Consider the following:

$$\begin{aligned}(2x)^3 &= 2^3 x^3 = 8x^3 \\ &= (2x)(2x)(2x) \\ &= 2 \cdot 2 \cdot 2 \cdot x \cdot x \cdot x = 8x^3\end{aligned}$$

This result suggests that to cube a product, cube each factor.

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Try It!

$$(6y)^2 \quad 36y^2$$

$$(x^2y)^{-2} \quad \frac{1}{x^4y^2}$$

$$(2xy^3)^4 \quad 16x^4y^{12}$$

$$2 \cdot 2 \cdot 2 \cdot 2$$

$$\frac{(2a^2b^{-3})^2}{4(ab^3)^3} = \frac{2^2a^4b^{-6}}{4a^3b^9} = \frac{4a^4}{4a^3b^9b^6} = \frac{a}{b^{15}}$$

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**The expression  $(\frac{a}{b})^3$  can be simplified as:**

$$(\frac{a}{b})^3 = \frac{a^3}{b^3}$$

$$(\frac{a^2}{b})^3 = \frac{a^6}{b^3}$$

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Try It!

$$\left(\frac{3}{x}\right)^3 = \frac{27}{x^3}$$

$$\left(\frac{1}{2^3}\right)^{-2} = \frac{1^{-2}}{2^{-6}} = \frac{2^6}{12} = \frac{64}{12} \text{ (64)}$$

$$\left(\frac{3x^{-3}}{y^2}\right)^4 = \frac{3^4 x^{-12}}{y^8} = \frac{81}{x^{12} y^8}$$

$$\left(\frac{3x^2}{4y^2z}\right)^3 = \frac{3^3 x^6}{4^3 y^6 z^3} = \frac{27x^6}{64y^6 z^3}$$

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**1.**  $\left(\frac{9x^2y}{3y^4z}\right)^3$

**2.**  $\left(\frac{2}{2^3}\right)^{-3}$

$$1. (-3, 2) (-5, 4) = -1$$

$$2. (1, 3) (0, 5) = -2$$

$$3. (2, -1) (2, -3) = \text{undefined}$$

$$4. (3, 4) (-2, 4) = 0$$

$$5. (-2, 0) (-3, 2) = -2$$

$$6. (-2, 5) (-1, 0) = -5 \quad \frac{0-5}{-1+2} = \frac{-5}{1} = -5$$

$$7. \underset{x_1 \ y_1}{(6, 4)} \underset{x_2 \ y_2}{(0, -1)} = \frac{5}{6} \quad \frac{-1-4}{0-6} = \frac{-5}{-6} = \frac{5}{6}$$

$$8. (3, 4) (5, 6) = 1$$

$$9. (6, -2) (1, 2) = -4/5$$

$$10. (3, 1) (6, 0) = -1/3$$

