

Lesson 4: Simplifying Expressions with Exponents

Summary of Exponent Laws:

Rule	Numeric Example	Algebraic Example
Product	$2^3 \times 2^4 = 2^7$	$a^m \times a^n = a^{m+n}$
Quotient	$5^6 \div 5^2 = 5^4$	$a^m \div a^n = a^{m-n}$
Power of a power	$(3^3)^2 = 3^6$	$(a^m)^n = a^{mn}$
Power of a product	$(2 \times 3)^4 = 2^4 \times 3^4$	$(xy)^m = x^m y^m$
Power of a quotient	$\left(\frac{3}{5}\right)^2 = \frac{3^2}{5^2}$	$\left(\frac{x}{y}\right)^m = \frac{x^m}{y^m}, y \neq 0$
Zero exponent	$4^0 = 1$	$a^0 = 1, a \neq 0$
Negative exponents	$6^{-2} = \frac{1}{6^2}$	$a^{-n} = \frac{1}{a^n}, a \neq 0$
Rational exponents	$8^{\frac{2}{3}} = (\sqrt[3]{8})^2$	$x^{\frac{m}{n}} = \sqrt[n]{x^m} = (\sqrt[n]{x})^m$

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- When simplifying expressions involving exponents follow the **laws and rules for exponents** and the **order of operations**.

- Power of a power rule must be done BEFORE product rule (exponents before multiplication).
- Simplify all expressions in the numerator and denominator FIRST, before using quotient rule to divide (large fraction bar is a grouping symbol)
- When you have nested grouping symbols, simplify the innermost first.

- Rewrite any decimal exponents as fractions.
- Rewrite numbers as powers with the same bases, if possible.
- Express all final answers using **positive exponents**.
- Express all answers in **rational form** (no decimals!)

(())

Ex 1) Simplify, then evaluate. Express answers in rational form with positive exponents

a) $\frac{(2x^3)^4(-x^2)}{8x^{-4}}$

$$\begin{aligned}
 &= \frac{(2^4 x^{12})(-x^2)}{8x^{-4}} \\
 &= \frac{2^3 x^{-4}}{1} \\
 &= -2x^{14} \\
 &= -2x^{18}
 \end{aligned}$$

b) $(-2x^2y^6)(-3x^3y)^2$

$$\begin{aligned}
 &= (-2x^2y^6)(9x^6y^2) \\
 &= -18x^8y^8
 \end{aligned}$$

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c. $\frac{(2x^2y^8)(x^3y^2)}{(-2x^3y^2)^2}$

$\frac{x^{-1}y^6}{2}$

$= \frac{2^1 x^5 y^{10}}{2^2 x^6 y^4}$ or $\frac{2 x^5 y^{10}}{4 x^6 y^4}$

$= \frac{y^6}{2x}$

$\frac{\cancel{2} y^6}{2x}$

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Ex 2) Simplify. Express answers with positive exponents

a) $\left(\frac{x^5(y^2)^3}{x^3y^8} \right)^{-2}$

$= \left(\frac{x^5 y^6}{x^3 y^8} \right)^{-2}$

$= \left(\frac{x^2}{y^2} \right)^{-2}$

$= \left(\frac{y^2}{x^2} \right)^2$

$= \frac{y^4}{x^4}$

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Ex 2) Simplify. Express answers with positive exponents

$$\begin{aligned}
 \text{b) } & \left(\frac{(xy^{-2})^3}{x^{-3}y^4} \right)^{-\frac{1}{2}} \\
 &= \left(\frac{x^3 y^{-6}}{x^{-3} y^4} \right)^{-\frac{1}{2}} \\
 &= \left(\frac{x^6}{y^{10}} \right)^{-\frac{1}{2}} \\
 &= \left(\frac{y^{10}}{x^6} \right)^{\frac{1}{2}} \\
 &= \frac{y^5}{x^3}
 \end{aligned}$$

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Ex 3) Simplify, then evaluate. Express answers in rational form with positive exponents

$$\begin{aligned}
 \text{a) } & \frac{\sqrt{16p^{-2}}}{\sqrt[3]{(125p^{-6})^{-2}}} \\
 &= \frac{(16p^{-2})^{\frac{1}{2}}}{(125^{-2}p^{12})^{\frac{1}{3}}} \\
 &= \frac{4p^{-1}}{125^{-\frac{2}{3}}p^4} \\
 &= \frac{4p^{-1}}{5^{-2}p^4} \rightarrow \frac{(5^2)(4)}{p^5} \\
 &= \frac{100}{p^5}
 \end{aligned}$$

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Ex 3) Simplify, then evaluate. Express answers in rational form with positive exponents

$$b) \left(\frac{(16x^3)^2 (8y^2)}{32(xy)^4} \right)^{-1.5}$$

$$= \left(\frac{(2^4 x^3)^2 (2^3 y^2)}{2^5 (x^1 y^1)^4} \right)^{-1.5}$$

$$= \left(\frac{(2^8 x^6) (2^3 y^2)}{2^5 x^4 y^4} \right)^{-1.5}$$

$$= \left(\frac{2^6 x^2}{y^2} \right)^{-\frac{3}{2}}$$

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

$$= \left(\frac{y^3}{2^9 x^3} \right)$$

$$= \frac{y^3}{512 x^3}$$

Do ALL homework questions without a calculator, unless specified otherwise.

$$\text{recall: } 2^2 = 4$$

$$2^3 = 8$$

$$2^4 = 16$$

$$2^5 = 32$$

$$2 \times \frac{3}{2} = 3$$

$$6 \times \frac{3}{2} = \frac{18}{2} = 9$$

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HW U2L4:

1. p.235 #1-2ace, 3, 4-9ace, 11

(calculator permitted for 11b)

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