

## 4.6 Applying the Exponent Laws

### **Lesson Focus**

Apply the exponent laws to simplify expressions

# Exponent Laws – P. 237

Recall the exponent laws for integer bases and whole number exponents.

Product of powers:  $a^m \cdot a^n = a^{m+n}$

Quotient of powers:  $a^m \div a^n = a^{m-n}, a \neq 0$

Power of a power:  $(a^m)^n = a^{mn}$

Power of a product:  $(ab)^m = a^m b^m$

Power of a quotient:  $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}, b \neq 0$

What other types of numbers could be a base? An exponent?

How would you use the exponent laws to evaluate an expression with these numbers?

# Example

Simplify by writing as a single power. Explain the reasoning.

a)  $0.3^{-3} \cdot 0.3^5$

$$\begin{aligned} &= (0.3)^{-3+5} \\ &= (0.3)^2 \end{aligned}$$

b)  $\left[ \left( -\frac{3}{2} \right)^{-4} \right]^2 \cdot \left[ \left( -\frac{3}{2} \right)^2 \right]^3$

$$\begin{aligned} &= \left( -\frac{3}{2} \right)^{-8} \cdot \left( -\frac{3}{2} \right)^6 \\ &= \left( -\frac{3}{2} \right)^{-8+6} \\ &= \left( -\frac{3}{2} \right)^{-2} = \left( -\frac{2}{3} \right)^2 \end{aligned}$$

# Example

Simplify by writing as a single power. Explain the reasoning.

c)  $\frac{(1.4^3)(1.4^4)}{1.4^{-2}}$

d)  $\left(\frac{7^{\frac{2}{3}}}{7^{\frac{1}{3}} \cdot 7^{\frac{5}{3}}}\right)^6$

$$\frac{7^4}{7^2 \cdot 7^5} = \frac{7^4}{7^{12}} = 7^{-8} = \left(\frac{1}{7}\right)^8$$

$$\begin{aligned} & -24/3 \\ = & 7 \\ & -8 \\ = & 7 \\ = & \left(\frac{1}{7}\right)^8 \end{aligned}$$

## Example – Your Turn

Simplify by writing as a single power. Explain your reasoning.

a)  $0.8^2 \cdot 0.8^{-7}$

b)  $\left[ \left( -\frac{4}{5} \right)^2 \right]^{-3} \div \left[ \left( -\frac{4}{5} \right)^4 \right]^{-5}$

c)  $\frac{(1.5^{-3})^{-5}}{1.5^5}$

d)  $\frac{9^{\frac{5}{4}} \cdot 9^{-\frac{1}{4}}}{9^{\frac{3}{4}}}$

c)  $\frac{(1.5)^{15}}{(1.5)^5} = 1.5^{10}$

d)  $\frac{9^{\frac{4}{4}}}{9^{\frac{3}{4}}} = 9^{\frac{1}{4}}$

# Homework

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# 3, 4, 5, 6, 10

$12xy$

Example

$(3x)(4y)$

Simplify. Explain the reasoning.

a)  $(x^3y^2)(x^2y^{-4})$

$x^{3+2} y^{2-4}$

$x^5 y^{-2}$

$\frac{x^5}{y^2}$

b)  $\frac{10a^5b^3}{2a^2b^{-2}}$

$= 5a^{5-2} b^{3-(-2)}$

$= 5a^3 b^5$



# Example

Simplify. Explain the reasoning.

a)  $(8a^3b^6)^{\frac{1}{3}}$

$$= 8^{\frac{1}{3}} a^1 b^2$$

$$= 2ab^2$$

b)  $(x^{\frac{3}{2}}y^2)(x^{\frac{1}{2}}y^{-1})$

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

$$= x^2 y$$

# Example

Simplify. Explain the reasoning.

$$\text{c) } \frac{4a^{-2}b^{\frac{2}{3}}}{2a^2b^{\frac{1}{3}}}$$

$$= 2a^{-2-2}b^{\frac{2}{3}-\frac{1}{3}}$$

$$= 2a^{-4}b^{\frac{1}{3}}$$

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

$$\text{d) } \left( \frac{100a^1}{25a^5b^{-\frac{1}{2}}} \right)^{\frac{1}{2}}$$

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

$$= 4^{\frac{1}{2}} \cdot a^{-2}b^{\frac{1}{4}}$$

$$= \frac{2b^{\frac{1}{4}}}{a^2}$$

# Homework

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# 7, 8, 9, 14, Handout **#1**

Example  
The radius of sphere is 4.7m.

A sphere has volume 425 m<sup>3</sup>.

What is the radius of the sphere to the nearest tenth of a metre?

$$V = \frac{4}{3}\pi r^3$$
$$(3) 425 = \frac{4}{3}\pi r^3$$
$$\sqrt[3]{\frac{1275}{4\pi}} = \frac{\sqrt[3]{1275}}{\sqrt[3]{4\pi}}$$
$$\sqrt[3]{101.46} = r \approx 4.7m$$

## Go Deeper

What is the value of  $\left(\frac{a^6b^9}{a^5b^8}\right)^{-2}$  when  $a = -3$  and  $b = 2$ ?

$$\begin{aligned} & (ab)^{-2} \\ & \left(\frac{1}{a \cdot b}\right)^2 \\ & \left(\frac{1}{(-3)(2)}\right)^2 = \left(\frac{1}{-6}\right)^2 = \left(\frac{1}{36}\right) \end{aligned}$$

# Homework

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# 15, 16, 17, 19, 21, 22\* Handout #2