## 4.6 Applying the Exponent Laws

#### THINK ABOUT IT

Work on your own.

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

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

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### THINK ABOUT IT

Work on your own.

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

$$\left(\frac{a^{5}b^{6}}{a^{6}b^{9}}\right)^{2} = \frac{a^{10}b^{16}}{a^{12}b^{18}} = \frac{a^{2}b^{-2}}{a^{2}b^{2}} = \frac{1}{a^{2}b^{2}} = \frac{1}{a^{2}b^{2}} = \frac{1}{a^{2}b^{2}}$$

## Let's put all of our exponent skills to the test...

## Don't forget the basic laws:

### **Make Connections**

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:  $(ab)^m = a^mb^m$ 

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

## Warm Up

Simplify or evaluate each of the following:

$$1.(-3)^{2} = 9$$

$$(3+4)^{3} + 4$$

$$3.(2x^{3}y^{6})^{4} = 6$$

$$16 \int_{-2}^{2} x^{4}$$

$$3. \frac{(2x^3y^6)^4}{3!} = 4. \frac{(-5a^3)(2a^2)^3}{(2a^3)^2} = \frac{(-5a^3)(8a^6)}{4a^6}$$

$$6. 5^{-2} = \frac{1}{5^2} = \frac{1}{25} = -10a^3$$

$$7. \frac{2^{-1}}{3} = \frac{1}{3(2)^{1}}$$

$$= \frac{3(2)^{1}}{5}$$

$$9.5^{8} \times (5^{3})^{12} \div 5^{8} \times (5^{7})^{2} = (-1)^{10} = 1$$

 $2. -3^2 = -9$ 

7.  $\frac{2^{-1}}{3} = \frac{1}{3(2)!}$  8.  $(2^3 - 3^2)^{10} = \frac{1}{3(2)!}$  Sum does  $(8 - 9)^{10} = \frac{1}{3(2)!}$  Not  $(-1)^{10} = \frac{1}{3(2)!}$ 

$$\left(\frac{3+5}{2}\right)^3$$

$$= (8)^3$$

$$= 5/2$$

## Fractions:

$$\frac{7}{3} - \frac{1}{2} + \frac{3}{4}$$

$$\frac{7}{3} - \frac{1}{2} + \frac{3}{4}$$

$$\frac{7}{3} - \frac{1}{2} + \frac{3}{4}$$

$$\frac{31}{2} = \frac{31}{2}$$



### Simplifying Algebraic Expressions with **Rational Exponents**

Simplify. Explain the reasoning.

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

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

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

a) 
$$(8a^3b^6)^{\frac{1}{3}}$$
 b)  $(x^{\frac{3}{2}}y^2)(x^{\frac{1}{2}}y^{-1})$  c)  $\frac{4a^{-2}b^{\frac{2}{3}}}{2a^2b^{\frac{1}{3}}}$  d)  $\left(\frac{100a}{25a^5b^{-\frac{1}{2}}}\right)^{\frac{1}{2}}$ 

#### SOLUTION

a) 
$$(8a^3b^6)^{\frac{1}{3}} = 8^{\frac{1}{3}} \cdot a^{3(\frac{1}{3})} \cdot b^{6(\frac{1}{3})}$$
 Using the power of a power law.  

$$= (2^3)^{\frac{1}{3}} \cdot a^1 \cdot b^2$$

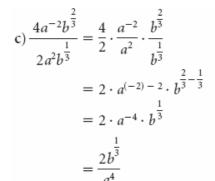
b) 
$$(x^{\frac{3}{2}}y^2)(x^{\frac{1}{2}}y^{-1}) = x^{\frac{3}{2}} \cdot x^{\frac{1}{2}} \cdot y^2 \cdot y^{-1}$$
 Use the product of powers law. 
$$= x^{\frac{3}{2} + \frac{1}{2}} \cdot y^{2 + (-1)}$$
$$= x^2y$$

(Solution continues.)

4.6 Applying the Exponent Laws



# Simplifying Algebraic Expressions with Rational Exponents



Use the quotient of powers law.

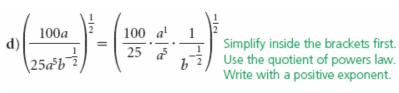
Write with a positive exponent.

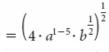
(Solution continues.)

4.6 Applying the Exponent Laws

### Example 3

### **Simplifying Algebraic Expressions with Rational Exponents**





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

Use the power of a power law.

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

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

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

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

Write with a positive exponent.











4.6 Applying the Exponent Laws

Simplify. Explain the reasoning.

a) 
$$(8a^3b^6)^{\frac{1}{3}}$$
  $\frac{3}{1} \cdot \frac{1}{3}$  b)  $(x^{\frac{3}{2}}y^2)(x^{\frac{1}{2}}y^{-1})$ 

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

c) 
$$\frac{4a^{-2}b^{\frac{2}{3}}}{2a^{2}b^{\frac{1}{3}}}$$
  $= 1$  d)  $\left(\frac{100a}{25a^{5}b^{-\frac{1}{2}}}\right)^{\frac{1}{2}}$ 

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

$$a) \left( 8a^{3}b^{6} \right)^{1/3} = b \times y$$

$$= g^{1/3} \times (\frac{1}{3}) = \lambda^{2} y$$

$$= 2ab^{2}$$

() 
$$4a^{-2}b^{2/3}$$
 $2a^{2}b^{1/3}$ 
 $35a^{5}b^{-1/2}$ 
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$$=\frac{2b''y}{a^2}=\frac{2\sqrt{b}}{a^2}$$