



# Warm Up

Simplify (leave solutions with positive exponents)

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

*x exponents*

$$= \frac{4^3 x^9 b^6}{4^3 x^9}$$

$$= \frac{b^6}{64 x^9}$$

b)  $\left(\frac{m^7}{m^{-4} 3m^5}\right)^{-2}$

*product law on denominator (add ex)*

*quotient in law in bracket (subtract ex)*

$$= \left(\frac{m^7}{3m^1}\right)^{-2}$$

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

$$= \frac{m^{-12}}{3^{-2}}$$

$$= \frac{3^2}{m^{12}}$$

$$= \frac{9}{m^{12}}$$

# Homework

## Worksheet Solutions

### Laws of exponents Practice Worksheet

Simplify. Your answer should contain only positive exponents.

$$1) \frac{2u^3v^3 \cdot (3u^2)^2}{2u^2}$$

$9u^5v^3$

$$2) \frac{(4xy^2)^3}{(4y^3)^4 \cdot 2y^3} \cdot \frac{x^2}{8y^9}$$

$$3) \frac{(4uv^2)^2}{3u^2v^4 \cdot 3v^2} \cdot \frac{16}{9v^2}$$

$$4) \left( \frac{4a^4b^3}{3a^4b^3 \cdot 4a^3b^4} \right)^3 \cdot \frac{27a^3}{4b^3}$$

$$5) \left( \frac{3y^3 \cdot 3x^3y^4}{4x^4y^2} \right)^4 \cdot \frac{6561y^{20}}{256x^4}$$

$$6) \left( \frac{3xy^4 \cdot 3x^3y^2}{yx^4} \right)^3$$

$729y^{15}$

$$7) \frac{2ba^2}{4a(2a^3b^4)^3} \cdot \frac{1}{16a^8b^{11}}$$

$$8) \frac{(2x^2y^2)^4}{(2x^2 \cdot (yx^2)^3)^2} \cdot \frac{4y^2}{x^8}$$

$$9) \frac{(m^2n^2)^2}{3m^4n^2 \cdot 2m^3n^2} \cdot \frac{1}{6m^3}$$

$$10) \frac{x^2}{4x^4y^2 \cdot (3x^4y^2)^2}$$

$$11) \left( \frac{n}{m \cdot 2m^4n^4} \right)^4 \cdot \frac{1}{16m^{20}n^{12}}$$

$$12) \left( \frac{3x^2y^3 \cdot 4x^3y^2}{3xy^3} \right)^4$$

$256x^{16}y^8$

$$13) \left( \frac{3x^2y^4 \cdot x^3y^3}{(2x^2y^3)^4} \right)^2 \cdot \frac{9}{256x^6y^{10}}$$

$$14) \left( \frac{2u^4v^3 \cdot 2uv^3}{4u^3} \right)^4$$

$4^8 \cdot \sqrt[4]{9}$

$$15) \frac{3uv^2}{2u^3v^2 \cdot (2v^2)^2} \cdot \frac{3}{8u^2v^4}$$

$$16) \frac{(4y)^3}{4y \cdot 3y^2} \cdot \frac{16}{3}$$

Test Review Sheet


1)  $\sqrt[3]{\frac{125}{8}} = \frac{\sqrt[3]{125}}{\sqrt[3]{8}} = \frac{5}{2}$

2)  $\sqrt[3]{100}$   $\sqrt[4]{16}$   $\sqrt[3]{130}$   $\sqrt{81}$   
 $\sqrt[3]{64} \sqrt[3]{125}$   $\downarrow$   $\sqrt[3]{125} \sqrt[3]{216}$   $\sqrt[3]{81} \sqrt[3]{100}$   
 $\downarrow$   $\downarrow$   $\downarrow$   $\downarrow$   
 4 No 5 No 5 Yes 6 No 9 No 10 No

3)  $\sqrt{50}$  ,  $\sqrt[3]{-125}$  ,  $\sqrt{4.9} = \sqrt{\frac{49}{10}}$  ,  $\sqrt{\frac{81}{36}}$   
 Not in perfect square list, so irrational  
 = -5 Rational  
 $= \frac{\sqrt{49}}{\sqrt{10}} = \frac{7}{\sqrt{10}}$  so irrational  
 $= \frac{\sqrt{81}}{\sqrt{36}} = \frac{9}{6}$  Rational

4)  $\sqrt{28}$  ,  $\sqrt[3]{40}$  ,  $\sqrt[5]{301}$  ,  $\sqrt[3]{-83}$   
 5.2915 , 3.419 , 3.1310 , -4.36 least

- 5) a) integer but not whole? any negative (Ex -1)  
 ±1, ±2, ±3  
 b) is a whole but not integer? 0  
 0, 1, 2, 3  
 c) whole but not natural? 0  
 0, 1, 2, 3, 4

6)   $c^2 = a^2 + b^2$   
 $= 4^2 + 9^2$   
 $= 16 + 81$   
 $c^2 = 97$   
 $c = \sqrt{97}$

7)  $\sqrt[3]{648}$   $\sqrt[3]{216 \times 3}$   $\sqrt[3]{216} \sqrt[3]{3}$   
 6  $\sqrt[3]{3}$   
 look in perfect cube list

8)  $\sqrt{605}$   $\sqrt{121 \times 5}$   $11 \sqrt{5}$   
 look in perfect square list  
 find largest perfect square that divides into 605

9) a)  $4 \sqrt[3]{7}$   $\sqrt[3]{4^3 \times 7}$   $\sqrt[3]{64 \times 7}$   $= \sqrt[3]{448}$   
 b)  $5 \sqrt{10}$   $= \sqrt{5^2 \times 10}$   $= \sqrt{25 \times 10}$   $= \sqrt{250}$

10)  $71^{3/4} = (\sqrt[4]{71})^3$  Remember  $x^{m/n} = \sqrt[n]{x^m}$

11) a)  $(\sqrt[3]{6})^2$   $6^{2/3}$  b)  $(\sqrt[5]{11})^3$   $11^{3/5}$  c)  $(\sqrt[3]{9})^2$   $(\frac{9}{9})^{2/3}$  d)  $\sqrt[5]{\frac{5}{6}}$   $(\frac{5}{6})^{1/5}$

Review for test sheet continued

12)  $8.4^{0.75}$  as radical  $\rightarrow 8.4^{3/4} = \sqrt[4]{8.4^3}$  or  $(\sqrt[4]{8.4})^3$

b)  $7.5^{1.25} = (7.5)^{5/4} = \sqrt[4]{7.5^5}$  *change 1.25 to fraction 5/4*

13) Evaluate  $(\frac{343}{216})^{2/3}$   $\rightarrow \frac{(\sqrt[3]{343})^2}{(\sqrt[3]{216})^2} = \frac{7^2}{6^2} = \frac{49}{36}$

b)  $(\frac{1024}{1600})^{-3/5}$   $\rightarrow \frac{1024^{-3/5}}{1600^{-3/5}} = \frac{(\sqrt[5]{1024})^{-3}}{(\sqrt[5]{1600})^{-3}} = \frac{(\sqrt[5]{1024})^3}{(\sqrt[5]{1600})^3} = \frac{16}{125}$

14)  $\frac{1}{9} = \frac{1}{3^2} = 3^{-2}$

15)  $[(-3x^4y^2)(7xy^3)]^{-2}$

*simplify inside bracket first since like terms*

$(-21x^5y^5)^{-2}$

$= (-21)^{-2} (x^5)^{-2} (y^5)^{-2}$

$= \frac{1}{(-21)^2 x^{10} y^{10}} = \frac{1}{441 x^{10} y^{10}}$

b)  $(\frac{x^3 y^3 z}{x^4 y z})^2$

*simplify inside bracket first*

$(\frac{x^3 y^2 z^2}{x^3 y^2 z})^2$

$(z)^2$

$= z^2$

c)  $(\frac{3x^4}{z^2})^5$

$\frac{3^5 x^{20}}{z^{10}} = \frac{243 x^{20}}{z^{10}}$

OR  $(\frac{3x^4}{z^2})^5 = \frac{3^5 x^{20}}{z^{10}}$

*more negative exponent to opposite top/bottom*

d)  $(\frac{4xy^2}{12x^4y^3})^3$

$= \frac{4^3 x^3 y^4}{12^3 x^{12} y^9} = \frac{64 x^3 y^4}{1728 x^{12} y^9} = \frac{4 x^3 y^4}{27 x^9 y^9} = \frac{4 x^{-6} y^{-5}}{27} = \frac{4}{27 x^6 y^5}$

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

$= (\frac{3 a^{-1} b^2}{4})^{-2} = \frac{4^2}{3^2 a^{-2} b^4} = \frac{16 a^2}{9 b^4}$

$$e) \left( \frac{3 a^{-7} b^5}{4} \right)^{-2} =$$

$$\frac{3^{-2} a^{14} b^{-10}}{4^{-2}}$$

$$= \frac{4^2 a^{14}}{3^2 b^{10}} = \frac{16 a^{14}}{9 b^{10}}$$

$$\begin{aligned} & \frac{125^{-\frac{2}{5}}}{1} \\ &= \frac{1}{125^{\frac{2}{5}}} \\ &= \frac{1}{(\sqrt[5]{125})^2} \quad \text{leave it} \end{aligned}$$

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

**CHECK YOUR UNDERSTANDING**

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



## Homework

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9(b,d,f,h), #10(b,d), 11, 12, 15(a,b,c,d),  
16(a,b,c,d), 17(a,) 19(a), 21(a,b), #22(a,b)

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

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

$$= \sqrt[3]{8} a^1 b^2$$

$$= 2 a b^2$$

**Example 1****Simplifying Numerical Expressions with Rational Number Bases**

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

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

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

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

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

**SOLUTION**

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

Use the product of powers law:

When the bases are the same, add the exponents.

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

(Solution continues.)

# Homework

## Page 233-234

### Exercises

A

3 4 5 6 7 8

B

9 10 11 12 13 14 15 16

17 18 19

C

20 21

1)  $2a \cdot 2a^2$

3)  $3k \cdot k$

5)  $2n \cdot 3n^3 \cdot 2n^2$

7)  $(v^0)^5 v^3$

9)  $n^{-5}(n^4)^{-3}$

11)  $(2m^3 \cdot 2n^{-3})^{-4}$

13)  $(x^3 y^3)^{-1}(x^3 y^{-1})^3$

15)  $(2uv^3)^{-4}(u^{-4} v^4)^{-1}$

17)  $uv(u^4 v^2)^{-4}$

19)  $\left(\frac{n^3}{n^{-3} \cdot 2n^3}\right)^4$

21)  $\left(\frac{x^{-2}}{(x^4)^4(x^4)^4}\right)^{-2}$

23)  $\frac{3n^{-3}}{3m^4 n^2}$

25)  $\frac{m^3 n^{-3}}{3m}$

2)  $3n \cdot 2n^3$

4)  $3xx^2$

6)  $n^3(n^3)^5$

8)  $b^5(b^4)^2$

10)  $(x^4)^0$

12)  $xy^3 \cdot$

14)  $(2x^4)^3$

16)  $(y^{-2})^2$

18)  $(y^2)^{-2} \cdot 2yx^3 \cdot x^3 y^2$

20)  $\frac{2m^{-4} \cdot ((2m^{-3})^4(2m)^{-3})^4}{2m^2}$

22)  $\left(\frac{(2r^4)^2}{2rr^0}\right)^4$

24)  $\frac{x^3}{3x^{-2}}$

26)  $\frac{3x^2 y^0}{4x^4 y^3}$

Answers to Assignment (ID: 1)

- 4)  $3x^3$
- 8)  $b^{13}$
- 12)  $x^9 y^5$
- 16)  $\frac{2x^3}{y^4}$
- 20)  $\frac{16}{m^{66}}$
- 24)  $\frac{x^5}{3}$

- 3)  $3k^2$
- 7)  $y^3$
- 11)  $\frac{256m^{12}}{n^{12}}$
- 15)  $\frac{1}{16y^{16}}$
- 19)  $\frac{n^{12}}{16}$
- 23)  $\frac{1}{n^5 m^4}$

- 2)  $6n^4$
- 6)  $n^{18}$
- 10)  $x^3$
- 14)  $16x^{13} y^3$
- 18)  $\frac{2x^6}{y}$
- 22)  $16r^{28}$
- 26)  $\frac{3}{4x^2 y^3}$

- 1)  $4a^3$
- 5)  $12n^6$
- 9)  $\frac{1}{n^{17}}$
- 13)  $\frac{x^6}{y}$
- 17)  $\frac{1}{4^{15} v^7}$
- 21)  $x^{68}$
- 25)  $\frac{m^2}{3n^3}$

Pre-Algebra

Name \_\_\_\_\_

Assignment

Date \_\_\_\_\_ Pg \_\_\_\_\_

Simplify. Your answer should contain only positive exponents.

Wednesday Sheet

1)  $\frac{2u^3v^3 \cdot (3u^2)^2}{2u^2}$

2)  $\frac{(4xy^2)^3}{(4y^3)^4 \cdot 2y^3}$

3)  $\frac{(4uv^2)^2}{3u^2v^4 \cdot 3v^2}$

4)  $\left(\frac{4a^4b^3}{3a^4b^3 \cdot 4a^3b^4}\right)^3$

5)  $\left(\frac{3y^3 \cdot 3x^3y^4}{4x^4y^2}\right)^4$

6)  $\left(\frac{3xy^4 \cdot 3x^3y^2}{yx^4}\right)^3$

7)  $\frac{2ba^2}{4a(2a^3b^4)^3}$

8)  $\frac{(2x^2y^2)^4}{(2x^2 \cdot (yx^2)^3)^2}$

9)  $\frac{(m^2n^2)^2}{3m^4n^2 \cdot 2m^3n^2}$

10)  $\frac{x^2}{4x^4y^2 \cdot (3x^4y^2)^2}$

11)  $\left(\frac{n}{m \cdot 2m^4n^4}\right)^4$

12)  $\left(\frac{3x^2y^3 \cdot 4x^3y^2}{3xy^3}\right)^4$

13)  $\left(\frac{3x^2y^4 \cdot x^3y^3}{(2x^2y^3)^4}\right)^2$

14)  $\left(\frac{2u^4v^3 \cdot 2uv^3}{4u^3}\right)^4$

15)  $\frac{3uv^2}{2u^3v^2 \cdot (2v^2)^2}$

16)  $\frac{(4y)^3}{4y \cdot 3y^2}$

ANSWERS TO ASSIGNMENT (WJ. 1)

1)  $9u^5v^3$   
 5)  $\frac{6561y^{20}}{256x^4}$   
 9)  $\frac{1}{6m^3}$   
 13)  $\frac{9}{256x^8y^{10}}$

2)  $\frac{x^3}{8y^9}$   
 6)  $729y^{15}$   
 10)  $\frac{1}{36x^{10}y^6}$   
 14)  $\frac{1}{u^8v^{24}}$

3)  $\frac{16}{9v^2}$   
 7)  $\frac{1}{16a^8b^{11}}$   
 11)  $\frac{1}{16m^{20}n^{12}}$   
 15)  $\frac{3}{8u^2v^4}$

4)  $\frac{1}{27a^9b^{12}}$   
 8)  $\frac{1}{4y^2x^3}$   
 12)  $256x^{16}y^8$   
 16)  $\frac{16}{3}$