

Unit 3 Day 1

Properties of Exponents

Hint:

Expanded form:

$$2^3 = 2 \cdot 2 \cdot 2$$

Warm Up

Get out:

Unit 3 Packet cover &
Last Night's Homework

How much do you remember about exponents? Use expanded form to write the rules of the exponents.

OBJECTIVE 1

$$3^2 \cdot 3^4$$

$$y^4 \cdot y^{10}$$

$$12^3 \cdot 12^5$$

$$a^m \cdot a^n = \underline{\hspace{2cm}}$$

OBJECTIVE 2

$$\frac{3^6}{3^2}$$

$$\frac{y^{10}}{y^4}$$

$$\frac{12^5}{12^3}$$

$$\frac{a^m}{a^n} = \underline{\hspace{2cm}}$$

OBJECTIVE 3

$$\frac{3^2}{3^6}$$

$$\frac{y^4}{y^{10}}$$

$$\frac{12^3}{12^5}$$

$$\frac{1^{\dots}}{a^n} = \underline{\hspace{2cm}}$$

OBJECTIVE 4

$$(3^6)^2$$

$$(y^3)^4$$

$$(12m)^5$$

$$(a^m)^n = \underline{\hspace{2cm}}$$

$$(a \cdot b)^n = \underline{\hspace{2cm}}$$

Warm Up ANSWERS

How much do you remember about exponents? Use expanded form to write the rules of the exponents.

OBJECTIVE 1 Multiplying Exponential Expressions

$$3^2 \cdot 3^4$$

$$3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 = 3^6$$

$$y^4 \cdot y^{10}$$

$$y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y = y^{14}$$

$$12^3 \cdot 12^5$$

$$12 \cdot 12 \cdot 12 \cdot 12 \cdot 12 \cdot 12 \cdot 12 \cdot 12 = 12^8$$

$$\text{SUMMARY: } a^m \cdot a^n = \underline{a^{m+n}}$$

Warm Up ANSWERS

How much do you remember about exponents? Use expanded form to write the rules of the exponents.

OBJECTIVE 2 Dividing Exponential Expressions (Remember: $\frac{x}{x} = 1$)

$$\frac{3^6}{3^2} = \frac{3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3}{3 \cdot 3} = 3^4$$

$$\frac{y^{10}}{y^4} = \frac{y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y}{y \cdot y \cdot y \cdot y} = y^6$$

$$\frac{12^5}{12^3} = \frac{12 \cdot 12 \cdot 12 \cdot 12 \cdot 12}{12 \cdot 12 \cdot 12} = 12^2$$

SUMMARY: $\frac{a^m}{a^n} = \underline{\hspace{2cm} a^{m-n} \hspace{2cm}}$

Warm Up ANSWERS

How much do you remember about exponents? Use expanded form to write the rules of the exponents.

OBJECTIVE 3 Negative Exponential Expressions: Simplify 2 WAYS using expanded form AND the rule from OBJECTIVE 2

$$\frac{3^2}{3^6} = \frac{3 \cdot 3}{3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3} = \frac{1}{3^4} \quad \text{Or } 3^{2-6} = 3^{-4}$$

$$\frac{y^4}{y^{10}} = \frac{y \cdot y \cdot y \cdot y}{y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y} = \frac{1}{y^6} \quad \text{Or } y^{4-10} = y^{-6}$$

$$\frac{12^3}{12^5} = \frac{12 \cdot 12 \cdot 12}{12 \cdot 12 \cdot 12 \cdot 12 \cdot 12} = \frac{1}{12^2} \quad \text{Or } 12^{3-5} = 12^{-2}$$

$2^n = \square$	$10^n = \square$
$2^2 = 4$	$10^2 = 100$
$2^1 = 2$	$10^1 = 10$
$2^0 = 1$	$10^0 = 1$
$2^{-1} = \frac{1}{2}$	$10^{-1} = \frac{1}{10}$
$2^{-2} = \frac{1}{4}$	$10^{-2} = \frac{1}{100}$

SUMMARY: $\frac{1}{a^n} = a^{-n}$

Warm Up ANSWERS

How much do you remember about exponents? Use expanded form to write the rules of the exponents.

OBJECTIVE 4 Exponential Expressions Raised to a Power

$$(3^6)^2 \quad (3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3) (3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3) = 3^{12}$$

$$(y^3)^4 \quad (y \cdot y \cdot y) (y \cdot y \cdot y) (y \cdot y \cdot y) (y \cdot y \cdot y) = y^{12}$$

$$(12m)^5 \quad (12m) (12m) (12m) (12m) (12m) = 12^5 m^5$$

$$\text{SUMMARY: } (a^m)^n = \underline{a^{mn}}$$

$$\text{SUMMARY: } (a \cdot b)^n = \underline{a^n b^n}$$



Homework Answers

Unit 2 Packet p. 25

I T I S A S L O P E U P

1 $\frac{1}{16}$ x^{18} 3 x^9 $6x^2y^3$ x^{12} 16 x^{11} $9x^6y^4$ x^8 $\frac{1}{x^3}$ $6\sqrt{2}$ $3\sqrt{8}$ $4x^2$ $6x^3y^4$

Homework Answers

Unit 2 Packet p.26 #1-15 all, #17-35 odds

1. 192

6. $\frac{1}{x^3}$

11. $3x^3$

2. $8x^6$

7. 1

12. $2x^3$

3. x^8

8. 1

13. $4c^7d^{13}$

4. $4x^5$

9. y^{12}

14. $16f^{10}g^{22}$

5. 36

10. x^8y^4

15. x^4y^4

Homework Answers

Unit 2 Packet p.25 #1-15 all, #17-35 odds

16. xy

21. x^5

27. x^7

32. $\frac{1}{4x^4y^6}$

17. $\frac{x^{12}}{64y^9}$

22. 16

28. $4x^{13}$

33. $\frac{y^6}{4x^6}$

18. $\frac{x^8}{256y^{16}}$

23. x^4

29. $\frac{1}{f^4}$

34. $\frac{1}{4x^3y^7}$

19. $\frac{1}{y^7}$

24. $\frac{1}{x^6}$

30. x^5

35. $\frac{64x^{12}}{y^{12}}$

20. $\frac{1}{49}$

25. x^2

31. $2x^{14}$

26. $\frac{1}{j^3}$

Homework:

Packet pg. 1 - 2

AND

Print Packet, if you haven't yet.

The Lesson...a few together!

$$\begin{aligned} 1. \quad 5^x \cdot 5^2 &= 5^7 & 5^{x+2} &= 5^7 \\ & & x + 2 &= 7 \\ & & x &= 5 \end{aligned}$$

You can only do this if
all of the terms have
the same base!!!

$$\begin{aligned} 2. \quad (5^3)^x &= 5^6 & 5^{3x} &= 5^6 \\ & & 3x &= 6 \\ & & x &= 2 \end{aligned}$$

$$\begin{aligned} 6. \quad (3^{-2})^x &= \frac{1}{3^2} & -2x &= 3^{-2} \\ & & -2x &= -2 \\ & & x &= 1 \end{aligned}$$

$$3. \quad \frac{5^6}{5^x} = 5^4$$

You Try!

$$\begin{aligned} 4. \quad \frac{5^2}{5^x} &= 1 & 5^{2-x} &= 5^0 \\ & & 2-x &= 0 \\ & & x &= 2 \end{aligned}$$

Now you try through
the bottom of the
page...

You Try the Rest!

1. $5^x \cdot 5^2 = 5^7$

$x = 5$

5. $3^{-2} \cdot 3^x = 3^2$

$x = 4$

9. $4^{2/3} \cdot 4^x = 4$

$x = 1/3$

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

$x = 2$

6. $(3^{-2})^x = \frac{1}{3^2}$

$x = 1$

10. $(4^x)^{1/2} = 4$

$x = 2$

3. $\frac{5^6}{5^x} = 5^4$

$x = 2$

7. $\frac{3^x}{3^{12}} = \frac{1}{3^2}$

$x = 10$

11. $\frac{4^{3/2}}{4^x} = 4$

$x = 1/2$

4. $\frac{5^2}{5^x} = 1$

$x = 2$

8. $(3^x)^2 = 1$

$x = 0$

12. $4^6 4^x = 1$

$x = -6$

Together

★ = you try

II. Find the values of x and y in each of the following expressions.

$\frac{5^x}{3^y} = \left(\frac{5}{3}\right)^2$ $x = 2, y = 2$	$\left(\frac{2^3}{3^x}\right)^{-2} = \frac{3^6}{2^y}$ $x = 3, y = 6$	★ $\left(\frac{x^2}{5}\right)^3 = \frac{2^6}{5^y}$ $x = 2, y = 3$
$(5 \cdot 6)^2 = 5^x 6^y$ $x = 2, y = 2$	★ $(2^x \cdot 6^3)^4 = 2^8 \cdot 6^y$ $x = 2, y = 12$	★ $(3^x 4^2)^3 = 4^y$ $x = 0, y = 6$

III. These will have more than 1 correct solution pair for x & y . Find at least 3 solution pairs.

$$(5^x)(5^y) = 5^{12}$$

$$★ (3^x)^y = 3^{18}$$

$$★ \frac{4^x}{4^y} = 1$$

Possible Solutions

Option 1: (1, 11)

Option 2: (2, 10)

Option 3: (6, 6)

Possible Solutions

Option 1: (3, 6)

Option 2: (2, 9)

Option 3: (18, 1)

Possible Solutions

Option 1: (5, 5)

Option 2: (1, 1)

Option 3: (4, 4)

Complete Parts IV and V

Wait to switch with your neighbors until I give the word...

Check your Neighbor's Answers!

Part IV.

$$(4x)(x) = 4x^2$$



$$\frac{x^2}{x^3} = x$$

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

$$\frac{50c^2d^2}{5cd^5} = 45c^2d^3$$

$$\frac{10c}{d^3}$$

Check your Neighbor's Answers!

Part V.

$$(2x^2y^3)^5$$

$$32x^{10}y^{15}$$

$$\frac{2xy^2}{8x^2y}$$

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

$$\frac{-3x^2}{y^6}$$

$$\frac{-3x^2}{y^6} = \textit{simplified!}$$

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

$$\frac{16x^4}{9}$$

$$(3x)^{-2}(x^2)$$

$$\frac{1}{9}$$

$$(-2xy)^4$$

$$16x^4y^4$$

Work shown here!

IV. When there are so many rules to keep track of, it's very easy to make careless mistakes. To help you guard against that, it helps to become a critical thinker. Take a look at the expanded and simplified examples below. One of them has been simplified correctly and there's an error in the other two. Identify the correctly simplified example with a ☺. For the incorrectly simplified examples, write the correct answer and provide suggestions so that the same mistake is not made again.

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

• subtract exponents
• be careful with signs
• if ☺ sign, "move it and lose it"

$(4x)(x) = 4x^2$

☺
Good job!

$$\frac{50c^2d^2}{5cd^5} = 10c^{2-1}d^{2-5} = 10cd^{-3} = \frac{10c}{d^3}$$

V. You've seen some of the more common mistakes that can happen when simplifying exponential expressions, and you may have made similar mistakes in the past. For each of the next rows of problems, complete one of the problems correctly and two of the problems incorrectly. For the incorrect problems, try to use errors that you think might go unnoticed if someone wasn't paying close attention. When you finish, you'll switch papers with two different neighbors (one for each row) so that they can check your work, find, fix, and write suggestions for how those mistakes can be avoided.

$$\frac{(2x^2y^3)^5}{2^5 x^{2 \cdot 5} y^{3 \cdot 5}} = \frac{2^5 x^{10} y^{15}}{32x^{10}y^{15}}$$

$$\frac{(3x)^{-2}(x^2)}{3^2(x)^{-2}x^2} = \frac{x^0}{9} = \frac{1}{9}$$

$$\frac{3^{-2}2^4x^3x}{3^2} = \frac{16x^4}{9}$$

$$\frac{-3x^2}{y^6} = \frac{-3x^2}{y^6}$$

done!

$$\frac{2xy^2}{2^3x^2y} = \frac{2^1x^1y^2}{2^3x^2y^1} = \frac{2^{1-3}x^{1-2}y^{2-1}}{2^2x^1y^1} = \frac{y}{4x}$$

$$\frac{(-2xy)^4}{(-2)^4(x)^4(y)^4} = \frac{16x^4y^4}{16x^4y^4}$$

Extra Practice

Part VI. Simplify and rewrite without negative exponents.

$$1) 6 \cdot c^3 \cdot d^{-2}$$

$$\frac{6c^3}{d^2}$$

$$2) 6x^4x^{-10}$$

$$\frac{6}{x^6}$$

$$3) (2^0 \cdot x^{-3})^4$$

$$\frac{1}{x^{12}}$$

$$4) \frac{a^{12}b^{-3}}{a^5b^5}$$

$$\frac{a^7}{b^8}$$

$$5) \left(\frac{5x^{13}y^5z^2}{3 \cdot 5^2} \right)^0$$

$$1$$

$$6) (g^3 \cdot g^{-2})^4$$

$$g^4$$

$$7) \left(\frac{4c^{-5}}{8d^0} \right)^3 \frac{1}{8c^{15}}$$

$$8) \left(\frac{x^{-8}}{y^{11}} \right)^{-2} x^{16}y^{22}$$

$$9) \frac{(2x^3) \cdot (x^4)^2}{8x^{11}} \frac{1}{4}$$

Homework:

Packet pg. 1 - 2

AND

Print Packet, if you haven't yet.

Graffiti Wall Activity

- Use the exponent properties we have learned to write **equivalent expressions** to the one at the top of each paper around the room
- You can use additional properties at each step, but must at least use the listed property
- **ONLY** do one bullet in each rotation
- When you are finished, your neighbor will check your expressions and you will check theirs!

Tests Returned

Reminder:

- If you received a 70% or lower you should come to tutorials to complete test corrections. The test corrections will count as a single homework grade.
- There are no test retakes.
- There is a Midterm Mastery Test at the end of the quarter. If you earn a 70% or higher on the Midterm Mastery Test, then one test grade below a 70 can be replaced by a 70%.