

## Laws of Exponents Lesson Notes

Product of Powers
Example: $a^2 \cdot a^3 = aa \cdot aaa = a^5$ Algebraic Rule: $x^m \cdot x^n = x^{m+n}$ *bases must be the same to use the product of powers rule

*factors expanded*

*- Add exponents  
- multiply coefficients*

Simplify.

1.  $x^7 \cdot x^2$   $x^{7+2}$   
 $x^9$

2.  $3k^2 \cdot k^9$   $3 \cdot 1 = 3$   
 $k^{2+9} = k^{11}$   
 $3k^{11}$

3.  $4x^9(x^3)$   
 $4x^{12}$

4.  $(x^2y)(xy^7)$   $x^{2+1}y^{1+7}$   
 $x^3y^8$

5.  $2(-3e)e^2$   $2 \cdot (-3) = -6$   
 $e^{1+2} = e^3$   
 $-6e^3$

6.  $-3(2d^3)d^4$   
 $-6d^7$

Solve.

7. In little league, Mary throws a softball ( $4b^2$ ) times every day. How many times does she throw the ball in ( $2b^3$ ) days?

$(4b^2)(2b^3)$   $8b^5$   $8b^5$

8. Find the area of a rectangle that has a length of  $5(x^2y)$  and a width of  $(x^3y^3)$ .

$(5x^2y)(x^3y^3) = 5x^5y^4$

*1) multiply exponents*

Power of a Power Example: $(a^2)^3 = (aa)(aa)(aa) = a^6$ Rule: $(x^m)^n = x^{m \cdot n}$	Power of a Product Example: $(x^m y^n)^p = x^{m \cdot p} y^{n \cdot p}$ Rule: $(xy)^m = x^m y^m$	power applies to every term in parentheses including coefficient
Power of a Monomial Example: $(a^2 b^3)^2 = (a^2 b^3)(a^2 b^3) = (aabb) = a^4 b^6$ Rule: $(x^m y^n)^p = x^{m \cdot p} y^{n \cdot p}$		

Simplify.

9.  $(-3m)^3 (-3)^3 \cdot m^3$   
 $-27m^3$

10.  $(3x^4)(2x^4)$  <sup>P  
E  
M  
D</sup>  
 $-4(9x^8)$   
 $-36x^8$

11.  $(x^7)(x^7)$   $(-5)^2$   $(x^7)^2$   
 $3(25x^{14})$   
 $75x^{14}$

12.  $(x^2y^4)^3 (x^6y^5z)$   
 $(x^6y^{12})(x^6y^5z)$   
 $x^{12}y^{17}z$

13.  $-2(-6x^6y^3)^2$   
 $-2(36x^{12}y^6)$   
 $-72x^{12}y^6$

14.  $5x(2x^2)^3$   
 $5x(8x^6)$   
 $40x^7$

15. Eric studies  $(2xy^3)^2$  hours for  $(-2x^2y^4)^2$  days. How many hours did Eric study?

$(2xy^3)^2 (-2x^2y^4)^2 = (4x^2y^6)(4x^4y^8)$   
 $(2xy^3)(2xy^3) (-2x^2y^4)(-2x^2y^4) = 16x^6y^{14}$

16. Find the volume of a cube whose side measures  $(-9kx^3)$ .

$V = s^3$   
 $V = (-9kx^3)^3$   
 $V = -729k^3x^9$

- Divide coefficients  
 - Subtract exponents

Quotient of Powers
Examples: $\frac{a^5}{a^3} = \frac{aaaaa}{aaa} = a^2$
Rule: $\frac{x^m}{x^n} = x^{m-n}$
*bases must be the same to use the Quotient of Powers rule

Simplify.

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

18.  $\frac{-x^5y^7}{x^3y^2}$   
 $-x^2y^5$

19.  $\frac{(-x)^3y^5}{xy}$   $\frac{-x^3y^5}{xy}$   
 $-x^2y^4$

20.  $\frac{-x^7y^8}{-x^2y}$   
 $x^5y^7$

21.  $\frac{3x^{10}y^{11}}{x^{10}y}$   
 $3y^{10}$

22.  $\frac{x^3y^6}{x^5y}$   
 $\frac{y^5}{x^2}$   
 $x^{3-5} = x^{-2}$   
 reciprocal  
 $\frac{1}{x^2}$

Solve.

23. The area of a rectangle is  $(64x^4y^{10})$ . If the length of the rectangle is  $(2xy^3)$ , find the width.

$$w = \frac{A}{l} \quad w = \frac{64x^4y^{10}}{2x^1y^3} \quad \boxed{w = 32x^3y^7}$$

24. The area of a rectangle is  $63x^5y^9$ . Find the width of the rectangle if its length is  $9x^4y^6$ .

$$w = \frac{A}{l} \quad w = \frac{63x^5y^9}{9x^4y^6} \quad \boxed{w = 7xy^3}$$

25. The volume of a rectangular prism is  $(36x^5y^9)$ . Find the length of the prism if its width is  $(3x^2y)$  and its height is  $(4xy^3)$ .

$$\frac{V}{wh} = \frac{lwh}{wh} \quad l = \frac{V}{wh}$$

$$l = \frac{36x^5y^9}{(3x^2y)(4xy^3)} \quad \rightarrow \text{multiply first}$$

$$l = \frac{36x^5y^9}{12x^3y^4} \quad \rightarrow \text{now divide}$$

$$\boxed{l = 3x^2y^5}$$

Name \_\_\_\_\_

Homework

Date \_\_\_\_\_

Period \_\_\_\_\_

- 1) multiply coefficients  
 2) Add exponents (factors) Laws of Exponents Lesson Assignment

Simplify.

1.  $a^2 \cdot a^3 \cdot a^6$

$a^{11}$

2.  $(cd^2)(c^3d^6)$

$c^4d^8$

3.  $(3p^4)(4p^2)$

$12p^6$

4.  $(x^2y^4)(x^6y^5z)$

$x^8y^9z$

5.  $-4(-6x^6y^3)(y)$

$+24x^6y^4$

6.  $5x^2(7x^2)$

$35x^4$

Solve.

7. Eric studies
- $(2xy^3)$
- hours for
- $(-2x^2y^4)$
- days. How many hours did Eric study?

$-4x^3y^7$  hours

8. Find the area of a rectangle with a length of
- $(8m^3)$
- and a width of
- $(4x^2m^4)$
- .

A = lw

$32x^2m^7$  sq. units

9. How much does Christy make if she earns
- $\$(3x^3y)$
- for braiding
- $(-4x^5y^2)$
- heads of hair?

$-12x^8y^3$  dollars

1) Divide coefficients

Simplify. 2) Subtract exponents (factors)

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

11.  $\frac{-x^5y^{-2}}{x^3y^2}$   $\frac{-x^2}{y^4}$

12.  $\frac{(-x)^3y^5}{xy^{-2}}$   $-x^2y^7$

13.  $\frac{-x^7y^{-8}}{-x^2y}$   $\frac{x^5}{y^9}$

14.  $\left(\frac{3x^{10}y^{11}}{x^{10}y}\right)^0 = 1$

15.  $\frac{x^{-3}y^6}{x^{-5}y}$   $x^2y^5$

Solve.

16. The area of a rectangle is  $(32x^4y^{10})$ . If the length of the rectangle is  $(2xy^3)$ , find the width.

$$\frac{32x^4y^{10}}{2xy^3} = \boxed{16x^3y^7}$$

17. The volume of a rectangular prism is  $(100x^{18}y^{12}z^2)$ . If the length of the prism is  $4x^2y^2$  and its width is  $(5x^8y^7z^{-2})$ , find the height of the prism.

$$V = \frac{100x^{18}y^{12}z^2}{(4x^2y^2)(5x^8y^7z^{-2})}$$

$$V = \frac{100x^{18}y^{12}z^2}{20x^{10}y^9z^{-2}} = \boxed{5x^8y^3z^4}$$

$$\frac{V}{wh} = \frac{lwh}{wh} \quad l = \frac{V}{wh}$$

