

10-10-18

Aim: SWBAT use the Laws of Exponents to raise a power to a power.

HW: Packet Page 12

Quiz Wednesday (Packet Pages 1 - 23)

Do Now: Packet Page 9

HW: Multiplying Monomials

Express each result as a **power**. Do not evaluate.

1) $x^{12} \cdot x^9 = x^{21}$ 2) $10^4 \cdot 10^{-3} \cdot 10^1 = 10^2$ 3) $23^a \cdot 23^b = 23^{a+b}$

4) $3^3 \cdot 3^7 \cdot 3^1 = 3^{11}$ 5) $5^9 \cdot 5^{-6} = 5^3$ 6) $5^3 \cdot 25 = 5^5$
 5^2

7) $1y^7 \cdot y^8 = y^{15}$ 8) $9^3 \cdot 9^6 \cdot 9^{12} = 9^{21}$ 9) $b^4 \cdot b^4 = b^8$

10) $x^1 \cdot x^1 = x^2$ 11) $10^7 \cdot 10^{-3} = 10^4$ 12) $3^4 \cdot 9 = 3^6$
 3^2

13) $3^7 \cdot 9^2 = 3^{11}$ 14) $5^4 \cdot 5^0 = 5^4$ 15) $4^0 \cdot 4^3 = 4^3$
 $81 = 3^4$

Simplify each of the following using the Laws of Exponents.

16) $2x^1 \cdot x^4 = 2x^5$ 17) $2x^4 \cdot 5x^5 = 10x^9$ 18) $3x^2 \cdot 4x^3 = 12x^5$

19) $9x^5y^3 \cdot -3x^6y^1 = -27x^{11}y^4$ 20) $x(x+y) = x^2 + xy$ 21) $(x+y)(x+y) = x^2 + 1xy + 1xy + y^2$

22) Write eleven squared using exponents. 11^2

23) Write x^5 as a product of the same factor. $x \cdot x \cdot x \cdot x \cdot x$ $x^2 + 2xy + y^2$

24) Write $y \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y$ using exponents y^7

25) The term "cubed" indicates an exponent of 3 .

26) Any number to the zero power, except 0, equals 1 .

27) $0^0 = \text{undefined}$

28) $1^7 = 1$

29) Evaluate $(-2)^3$ 30) Evaluate $(-2)^2$ 31) Evaluate $(4)^3$ 32) Evaluate $2^{-4} \cdot 2^6$

$(-2)(-2)(-2)$ $(-2)(-2)$ $(4)(4)(4)$ $2^{-4+6} = 2^2$

-8 4 64 4

$$\begin{aligned} & (x+y)(x+y) \\ & x^2 + xy + xy + y^2 \\ & x^2 + 2xy + y^2 \end{aligned}$$

Aim: SWBAT Use the Laws of Exponents to Raise a Power to a Power

Do Now:

Simplify using the Laws of Exponents. Write your answer as POWERS.

1) $x^{12} \cdot x$
 x^{13}

2) $(-4)^{10} \cdot (-4)^{21}$
 $(-4)^{31}$

3) $10^{12} \cdot 10^7 \cdot 10^3$
 10^{22}

4) $xy \cdot x^3y^5$
 x^4y^6

5) $7x^3 \cdot 10x^3y^5$
 $70x^6y^5$

6) $9xy^2 \cdot 9x^5y^2$
 $81x^6y^4$

7) $-7m^2n^5 \cdot -9mn^3$
 $63m^3n^8$

8) $(w^0)(4w^7) \quad w \neq 0$
 $4w^7$

9) $(3x^2y^5)(-7xy^2)$
 $-21x^3y^7$

Classwork: Power to a Power

Ex I: $(x^2)^3 = x^2 \cdot x^2 \cdot x^2$ (Why?)
 $= x^6$

Try: 1) $(y^5)^6$ 2) $(6^3)^4$
 $(y^5)(y^5)(y^5)(y^5)(y^5)(y^5)$
 y^{30} 6^{12}

Do you see a pattern or "shortcut"? Explain.

For any number a, and any positive integers m and n:

$(a^m)^n = a^{mn}$

When raising a power to another power: keep the base and multiply the exponents.

Write your answer as a power.

1) $(5^2)^4$
 5^8

2) $(9^3)^5$
 9^{15}

3) $(7^4)^6$
 7^{24}

4) $(x^5)^7$
 x^{35}

5) $(y^7)^0$
 $1 \quad y \neq 0$

Ex. II: $(x^3y^5)^4 = x^3y^5 \cdot x^3y^5 \cdot x^3y^5 \cdot x^3y^5$
 $= (x^3)^4 \cdot (y^5)^4$
 $= x^{12}y^{20}$

Try: 1) $(a^2b^7)^5$
 $(a^2)^5 \cdot (b^7)^5$
 $a^{10}b^{35}$

2) $(x^4y^3)^3$
 $(x^4)^3 \cdot (y^3)^3$
 $x^{12}y^9$

**3) $(3x^4y^3)^3$
 $3^3 \cdot (x^4)^3 \cdot (y^3)^3$
 $27x^{12}y^9$

For any numbers a and b and positive integer n:

$$(ab)^n = a^n b^n$$

*When you are raising a monomial to a power, be sure to raise the coefficient to the power too!

Simplify:

1) $(2x^2)^2$
 $2^2 \cdot (x^2)^2$
 $4x^4$

2) $(5x^2y)^3$
 $5^3 \cdot (x^2)^3 \cdot y^3$
 $125x^6y^3$

* 3) $(-2x^3y^4)^5$
 $(-2)^5 \cdot (x^3)^5 \cdot (y^4)^5$
 $-32x^{15}y^{20}$

Ex. III $\left(\frac{2}{3}\right)^3 = \frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3} = \frac{8}{27}$

Simplify:

1) $\left(\frac{a}{b}\right)^2$
 $\frac{a^2}{b^2}$

2) $\left(\frac{2x}{3y}\right)^3 \rightarrow \frac{2^3 x^3}{3^3 y^3}$
 $\rightarrow \frac{8x^3}{27y^3}$

3) $\left(\frac{5ab^4}{7a^2b^3}\right)^2 \rightarrow \frac{5^2 \cdot a^2 \cdot (b^4)^2}{7^2 \cdot (a^2)^2 \cdot (b^3)^2}$
 ?
 $\rightarrow \frac{25a^2b^8}{49a^4b^6}$

Mixed Practice: Simplify each of the following.

1) $(z^5)^3$
 z^{15}

2) $(m^4)^{10}$
 m^{40}

3) $(y^3)^0$ $y \neq 0$
 1

4) $(x^6)^2$
 x^{12}

5) $(x^7)^2$
 x^{14}

6) $(b^8)^3$
 b^{24}

7) $(2x^5)^5$
 $2^5 \cdot (x^5)^5$
 $32x^{25}$

8) $\left(\frac{x^3}{y^5}\right)^4$
 $\rightarrow \frac{(x^3)^4}{(y^5)^4}$

9) $(-6a)^3$
 $(-6)^3 a^3$
 $-216a^3$

10) $(10m^3n^4)^2$
 $10^2 \cdot (m^3)^2 \cdot (n^4)^2$
 $100m^6n^8$

$\rightarrow \frac{x^{12}}{y^{20}}$

Name _____ Date _____

Practice Worksheet 15-4

Powers of Monomials

Simplify.

- | | | |
|-------------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------------|
| 1. $(4^2)^3$ $4^6 \rightarrow 4096$ | 2. $[(-3)^2]^2$ $(-3)^4 \rightarrow 81$ | 3. $(x^3)^4$ x^{12} |
| 4. $(7d)^3$ $7^3 d^3 \rightarrow 343d^3$ | 5. $(11k)^2$ $11^2 k^2 \rightarrow 121k^2$ | 6. $(-2y)^3$ $(-2)^3 y^3 \rightarrow -8y^3$ |
| 7. $(-6m)^4$ $(-6)^4 m^4 \rightarrow 1296m^4$ | 8. $(-l)^{10}$ l^{10} | 9. $(xy)^4$ $x^4 y^4$ |
| 10. $(rs)^6$ $r^6 s^6$ | 11. $(ab^2)^4$ $a^4 b^8$ | 12. $(c^3 d^5)^2$ $c^6 d^{10}$ |
| 13. $(-3x^2 y^4)^3$ $(-3)^3 x^6 y^{12} \rightarrow -27x^6 y^{12}$ | 14. $(2e^3 f)^4$ $2^4 e^{12} f^4 \rightarrow 16e^{12} f^4$ | 15. $(3a^2 b^3)^2$ $3^2 a^4 b^6 \rightarrow 9a^4 b^6$ |
| 16. $(4g^2 h)^6$ $4^6 g^{12} h^6 \rightarrow 4096g^{12} h^6$ | 17. $(-2jk^3)^4$ $(-2)^4 j^4 k^{12} \rightarrow 16j^4 k^{12}$ | 18. $(-6pq)^4$ $(-6)^4 p^4 q^4 \rightarrow 1296p^4 q^4$ |
| 19. $(-5x^3 z^3)^3$ $(-5)^3 x^9 z^9 \rightarrow -125x^9 z^9$ | 20. $(-2ij)^5$ $(-2)^5 i^5 j^5 \rightarrow -32i^5 j^5$ | 21. $(4x^4 y^3)^3$ $4^3 x^{12} y^9 \rightarrow 64x^{12} y^9$ |
| 22. $(x^7 y^6)^3$ $x^{21} y^{18}$ | 23. $(cat)^2$ $c^2 a^2 t^2$ | 24. $(5m^2 y)^2$ $5^2 m^4 y^2 \rightarrow 25m^4 y^2$ |
| 25. $(-2a^2 b^3)^4$ $(-2)^4 a^8 b^{12} \rightarrow 16a^8 b^{12}$ | 26. $(p^{10} x^7)^4$ $p^{40} x^{28}$ | 27. $(-z^3 y)^3$ $(-z^3)^3 y^3 \rightarrow -z^9 y^3$ |
| 28. $4p(-3p)^2$ $4p \cdot (-3)^2 p^2 \rightarrow 36p^3$ | 29. $2b(2ab)^3$ $2b \cdot 2^3 a^3 b^3 \rightarrow 16a^3 b^4$ | 30. $3y(-2y)^3$ $3y \cdot (-2)^3 y^3 \rightarrow -24y^4$ |
| 31. $3m(-2m)^2$ $3m \cdot (-2)^2 m^2 \rightarrow 12m^3$ | 32. $2e^2(-3e)^3$ $2e^2 \cdot (-3)^3 e^3 \rightarrow -54e^5$ | 33. $-2f(4fg)^2$ $-2f \cdot 4^2 f^2 g^2 \rightarrow -32f^3 g^2$ |

Evaluate each expression if $x = -2$ and $y = -3$.

- | | | |
|----------------------------------------------------------------------------------|---------------------------------------------------------------|------------------------------------------------------------|
| 34. $3xy^2$
$3(-2)(-3)^2$
-54 | 35. $4x^2y$
$4 \cdot (-2)^2 \cdot (-3)$
-48 | 36. $(xy)^2$
$[(-2)(-3)]^2$ |
| 37. $(-2xy^2)^2$
$(-2(-2)(-3)^2)^2$
$(-2(-2)(9))^2$
$(-36)^2$
1296 | 38. $x(y^2)^3$
$-2((-3)^2)^3$
$-2 \cdot 9^3$
-1458 | 39. $(2x^2)^3$
$[2 \cdot (-2)^2]^3$
$(8)^3$
512 |

HW: Raising a Power to a Power
Simplify each expression.

1) $(y^2)^3$

2) $(v^9)^6$

3) $(h^4)^5$

4) $(n^4)^{11}$

5) $(p^2)^5$

6) $(z^3)^6$

7) $(2x^4)^5$

8) $(-5f^5)^3$

9) $(6m^5)^2$

10) $(-2ab)^4$

11) $(-7k)^0$

12) $(6c^2d)^3$

13) $(x^{11}y^{10})^2$

14) $(-3y^5x^{10})^5$

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

16) $\left(\frac{2a^5}{3b^3}\right)^2$

Complete each equation.

17) $(y^3)^{\square} = y^6$

18) $(2x^{11})^{\square} = 1$

19) $(6p^3q^{\square})^2 = 36p^6q^{10}$

20) What is the difference between $x^4 \cdot x^3$ and $(x^4)^3$?

Explain your answer clearly, using the laws of exponents.