LAWS OF EXPONENTS #18

BASE, EXPONENT, AND VALUE

In the expression 2^5, 2 is the **base**, 5 is the **exponent**, and the **value** is 32.

2^5 means $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32$ $\quad$ x^3 means $x \cdot x \cdot x$

LAWS OF EXPONENTS

Here are the basic patterns with examples:

1)	$x^a \cdot x^b = x^{a+b}$	examples: $x^3 \cdot x^4 = x^{3+4} = x^7$;	$2^7 \cdot 2^4 = 2^{11}$
2)	$\frac{x^a}{x^b} = x^{a-b}$	examples: $x^{10} \div x^4 = x^{10-4} = x^6$;	$\frac{2^4}{2^7} = 2^{-3}$ or $\frac{1}{2^3}$
3)	$(x^a)^b = x^{ab}$	examples: $(x^4)^3 = x^{4 \cdot 3} = x^{12}$;	$(2x^3)^4 = 2^4 \cdot x^{12} = 16x^{12}$
4)	$x^{-a} = \frac{1}{x^a}$ and $\frac{1}{x^{-b}} = x^b$	examples: $3x^{-3}y^2 = \frac{3y^2}{x^3}$;	$\frac{2x^5}{y^{-2}} = 2x^5y^2$
5)	$x^o = 1$	examples: $5^o = 1$;	$(2x)^o = 1$

Example 1

Simplify: $(2xy^3)(5x^2y^4)$

Multiply the coefficients: $2 \cdot 5 \cdot xy^3 \cdot x^2y^4 = 10xy^3 \cdot x^2y^4$

Add the exponents of x, then y: $10x^{1+2}y^{3+4} = 10x^3y^7$

Example 2

Simplify: $\frac{14x^2y^{12}}{7x^5y^7}$

Divide the coefficients: $\frac{(14 \div 7)x^2y^{12}}{x^5y^7} = \frac{2x^2y^{12}}{x^5y^7}$

Subtract the exponents: $2x^{2-5}y^{12-7} = 2x^{-3}y^5$ OR $\frac{2y^5}{x^3}$

Example 3

Simplify: $(3x^2y^4)^3$

Cube each factor: $3^3 \cdot (x^2)^3 \cdot (y^4)^3 = 27(x^2)^3(y^4)^3$

Multiply the exponents: $27x^6y^{12}$

Example 4

Simplify: $3x^{-4}y^{2}z^{-3} \Rightarrow \frac{3y^2}{x^4z^3}$

Simplify each expression:

1. $y^5 \cdot y^7$
2. $b^4 \cdot b^3 \cdot b^2$
3. $8^6 \cdot 8^2$
4. $\left(y^5\right)^2$
5. $(3a)^4$
6. $\frac{m^8}{m^3}$
7. $\frac{12x^9}{4x^4}$
8. $\left(x^3y^2\right)^3$
9. $\frac{\left(y^4\right)^2}{\left(y^3\right)^2}$
10. $\frac{15x^2y^7}{3x^4y^5}$
11. $\left(4c^4\right)\left(ac^3\right)\left(3a^5c\right)$
12. $\left(7x^3y^5\right)^2$
13. $\left(4xy^2\right)(2y)^3$
14. $\left(\frac{4}{x^2}\right)^3$
15. $\frac{\left(2a^7\right)\left(3a^2\right)}{6a^3}$
16. $\left(\frac{5m^3n}{m^5}\right)^3$
17. $\left(3a^2x^3\right)^2\left(2ax^4\right)^3$
18. $\left(\frac{x^3y}{y^4}\right)^4$
19. $\left(\frac{6y^2x^8}{12x^3y^7}\right)^2$
20. $\frac{\left(2x^5y^3\right)^3\left(4xy^4\right)^2}{8x^7y^{12}}$

Write the following expressions without negative exponents.

21. x^{-2}
22. $y^{-3}y^2$
23. $\frac{x^{\smile}}{x^{-2}}$
24. $\left(y^{-2}\right)^{\supset}$

Note: More practice with negative exponents is available in Skill Builder #21.

Answers

1. y^{12}
2. b^9
3. 8^8
4. y^{10}
5. $81a^4$
6. m^5
7. $3x^5$
8. x^9y^6
9. y^2
10. $\frac{5y^2}{x^2}$
11. $12a^6c^8$
12. $49x^6y^{10}$
13. $32xy^5$
14. $\frac{64}{x^6}$
15. a^6
16. $\frac{125n^3}{m^6}$
17. $72a^7x^{18}$
18. $\frac{x^{12}}{y^{12}}$
19. $\frac{x^{10}}{4y^{10}}$
20. $16x^{10}y^5$
21. $\frac{1}{x^2}$
22. $\frac{1}{y}$
23. x^7
24. $\frac{1}{y^{10}}$