

Exponents and Polynomials

A. First Law of exponents

1. $y^5 x^{10} \cdot y^3 x^6 = x^{11} y^8$
2. $xy \cdot x^2 y^3 = x^3 y^4$
3. $y \cdot y \cdot y^3 \cdot y \cdot y^2 = y^8$
4. $x^2 x^4 = x^6$
5. $y^3 y^6 y^2 = y^{11}$
6. $x^5 y^2 \cdot x^3 y^4 = x^8 y^6$
7. $3x^2 \cdot 4x^5 = 12x^7$
8. $5^3 x^4 y \cdot 5^2 xy^4 = 5^5 x^5 y^5$
9. $x^2 x^2 y^3 y^6 \cdot x^4 x^6 y^2 y^2 = x^{14} y^{13}$
10. $3^2 \cdot 3 \cdot 5^3 = 3^6$
11. $4x^2 y^3 \cdot 7x^2 y^3 = 28x^4 y^6 = 2^2 \cdot 7x^4 y^6$
12. $11xy^2 \cdot 11x^3 y = 11^2 x^4 y^3$
13. $12w^6 x^3 y \cdot 12^3 w^7 x^2 y^3 = 12^4 w^{13} x^5 y^4 = (2^2 \cdot 3)^4 w^{13} x^5 y^4 = 2^8 3^4 w^{13} x^5 y^4$

B. Second Law of Exponents:

1. $(x^7)^2 = x^{14}$
2. $(y^4)^6 = y^{24}$
3. $(w^3 y^2)^6 = w^{18} y^{12}$
4. $(x^4 y^2)^3 = x^{12} y^6$
5. $(3x^2 y)^3 = 3^3 x^6 y^3$
6. $(4^2 x^3 y^2 z)^3 = 4^6 x^9 y^6 z^3 = (2^2)^6 x^9 y^6 z^3 = 2^{12} x^9 y^6 z^3$
7. $(m^4 yx^3 w^4)^3 = m^{12} y^3 x^9 w^{12}$
8. $(3y^3)^3 = 3^3 y^9$
9. $(5^6 x^3 y^3)^5 = 5^{30} x^{15} y^{15}$
10. $(5xy^2)^{10} = 5^{10} x^{10} y^{20}$
11. $(3x^3 y^2)^2 (3x^2 y^3)^2 = 3^2 x^6 y^4 \cdot 3^2 x^4 y^6 = 3^4 x^{10} y^{10}$
12. $(2wx)^3 (2^2 w^2 x^7)^3 = 2^3 w^3 x^3 \cdot 2^6 w^6 x^{21} = 2^9 w^9 x^{24}$

C. Third Law of Exponents

1. $\frac{y^9}{y^4} = y^5$
2. $\frac{y^4}{y^9} = \frac{1}{y^5}$
3. $\frac{w^6}{w^6} = 1$
4. $\frac{x^7}{x^3} = x^4$
5. $\frac{y^6}{y^{10}} = \frac{1}{y^4}$
6. $\frac{x^5 y^7}{x^2 y^9} = \frac{x^3}{y^2}$
7. $\frac{w^3 v^4}{w^2 v^8} = \frac{w}{v^4}$
8. $\frac{20w^3 y^6}{10w^3 y^3} = 2y^3$
9. $\frac{10x^6 y}{5xy^4} = \frac{2x^5}{y^3}$
10. $\frac{3^4 x^3 y^4}{3^2 x^3 y^2} = 3^2 y^2$
11. $\frac{(x^2 y^4)^4}{(x^3 y^3)^2} = \frac{x^8 y^{16}}{x^6 y^6} = x^2 y^{10}$
12. $\frac{(w^{10} z^4)^2}{(w^8 y^3)^3} = \frac{w^{20} z^8}{w^{24} z^9} = \frac{1}{w^4 z}$
13. $\frac{10^{10} a^3 b^2 c^8}{10^8 a^5 b^7 c^2} = \frac{10^2 c^6}{a^2 b^5}$

D. Simplify the following:

$$1. \frac{(4^2 a^3 b^4)^2 (4^5 a^3 b^2)^3}{(4a^3 b^2)^{10}} = \frac{([2^2]^2 a^3 b^4)^2 ([2^2]^5 a^3 b^2)^3}{([2^2]^1 a^3 b^2)^{10}} = \frac{(2^4 a^3 b^4)^2 (2^{10} a^3 b^2)^3}{(2^2 a^3 b^2)^{10}} =$$

$$\frac{2^8 a^6 b^8 \cdot 2^{30} a^9 b^6}{2^{20} a^{30} b^{20}} = \frac{2^{38} a^{15} b^{14}}{2^{20} a^{30} b^{20}} = \frac{2^{18}}{a^{15} b^6}$$

$$2. \frac{(4a^2 bc^3)^4 (4^3 a^2 b^5 c)^2}{(4^3 a^6 b^7 c^3)^2} = \frac{([2^2]^4 a^2 bc^3)^4 ([2^2]^3 a^2 b^5 c)^2}{([2^2]^3 a^6 b^7 c^3)^2} = \frac{(2^2 a^2 bc^3)^4 (2^6 a^2 b^5 c)^2}{(2^6 a^6 b^7 c^3)^2} =$$

$$\frac{2^8 a^8 b^4 c^{12} \cdot 2^{12} a^4 b^{10} c^6}{2^{12} a^{12} b^{14} c^6} = \frac{2^{20} a^{12} b^{14} c^{18}}{2^{12} a^{12} b^{14} c^6} = 2^8 c^{12}$$

$$3. 7^{2x} \cdot 7^{3x} = 7^{5x}$$

$$4. 2^a \cdot 2^b = 2^{a+b}$$

$$5. 7^x \cdot 11^x = 7^x \cdot 11^x$$

$$6. (x^z)^5 = x^{5z}$$

$$7. (3^{2c})^c = 3^{2c^2}$$

$$8. (2^{2x+1})^{3x-1} = 2^{6x^2-2x+3x-1} = 2^{6x^2+x-1}$$

$$9. (x^{\frac{3}{7}})^4 = x^{\frac{12}{7}}$$

$$10. (x^{\frac{5}{3}} y^{\frac{4}{7}})^5 = x^{\frac{25}{3}} y^{\frac{20}{7}}$$

$$11. 2^{4x^2-7x+3} \cdot 2^{3x^2+5x+4} = 2^{7x^2-2x+7}$$

$$12. \frac{3^{5x-5}}{3^{4x+7}} = 3^{(5x-5)-(4x+7)} = 3^{5x-5-4x-7} = 3^{x-12}$$

$$13. \frac{x^{\frac{4}{2}}}{x^{\frac{7}{10}}} = \frac{x^{\frac{28}{10}}}{x^{\frac{18}{10}}} = x^{\frac{10}{10}}$$

$$14. x^{-7} = \frac{1}{x^7}$$

$$15. (5x^2 - 2x + 3)^0 = 1$$

$$16. \frac{2x^{-7}}{-3y^{-4}} = -\frac{2y^4}{3x^7}$$

$$17. (2x^{-6} y^{-4})^{-5} = 2^{-5} x^{30} y^{20} = \frac{x^{30} y^{20}}{2^5}$$

$$18. \frac{3x^{-8} y^{-5}}{2x^{-3} y^{-7}} = \frac{3x^3 y^7}{2x^8 y^5} = \frac{3y^2}{2x^5}$$

$$19. \frac{(12x^{-3} y)^3 (3x^{-5} y^2)^{-3}}{(4x^{-1} y^4)^{-2}} = \frac{(2^2 \cdot 3x^{-3} y)^3 (3x^{-5} y^2)^{-3}}{(2^2 x^{-1} y^4)^{-2}} = \frac{2^6 \cdot 3^3 x^{-9} y^3 \cdot 3^{-3} x^{15} y^{-6}}{2^{-4} x^2 y^{-8}} =$$

$$\frac{2^6 \cdot 2^4 \cdot 3^3 y^3 x^{15} y^8}{3^3 x^9 x^2 y^6} = \frac{2^{10} \cdot 3^3 x^{15} y^{11}}{3^3 x^{11} y^6} = 2^{10} x^4 y^5$$