

Laws of Exponents

1. $3^2 \cdot 3^5 = 3^7$

2. $7^3 \cdot 7^4 = 7^7$

3. $11^4 \cdot 11^7 = 11^{11}$

4. $2^5 \cdot 2^3 \cdot 2^4 = 2^{12}$

5. $4^6 \cdot 4^3 \cdot 4^5 = 4^{14} = (2^2)^{14} = 2^{28}$

6. $7 \cdot 7^3 \cdot 7^5 = 7^9$

7. $3^2 \cdot 2^3 = 3^2 \cdot 2^3$

8. $5^3 \cdot 2^4 \cdot 5^4 \cdot 2^2 = 5^7 \cdot 2^6$

9. $4 \cdot 3^5 \cdot 4^3 \cdot 3 = 4^4 \cdot 3^6 = (2^2)^4 \cdot 3^6 = 2^8 \cdot 3^6$

10. $x^3 \cdot x^2 = x^5$

11. $x^6 \cdot x^4 = x^{10}$

12. $x^3 \cdot x^4 \cdot x^2 = x^9$

13. $x^3 \cdot y^2 = x^3 \cdot y^2$

14. $x^4 y^5 \cdot x^2 y^3 = x^6 y^8$

15. $x^4 y^2 z^3 \cdot x^2 y^3 z^5 = x^6 y^5 z^8$

16. $3x \cdot 5x = 3 \cdot 5 \cdot x^2$

17. $4x^2 \cdot 5x^3 = 2^2 \cdot 5 \cdot x^5$

18. $3x^2 y^3 \cdot 5x^4 y^2 = 3 \cdot 5 \cdot x^6 y^5$

19. $3^2 x \cdot 3x = 3^3 x^2$

20. $4^3 x^2 \cdot 4^2 x^3 = 4^5 x^5 = (2^2)^5 x^5 = 2^{10} x^5$

21. $5^3 x^4 y^2 \cdot 5^2 x^2 y^6 = 5^5 x^6 y^8$

22. $3^2 x \cdot 4x = 3^2 \cdot 2^2 \cdot x^2$

23. $4^2 x^3 \cdot 5x^2 = (2^2)^2 \cdot 5 \cdot x^5 = 2^4 \cdot 5 \cdot x^5$

24. $3^2 x^5 y^2 \cdot 4^2 x^5 y^3 = 3^2 (2^2)^2 x^{10} y^5 = 3^2 \cdot 2^4 \cdot x^{10} y^5$

25. $(3)^2 = 3^3$

26. $(5^2)^3 = 5^6$

27. $(7^3)^4 = 7^{12}$

28. $(x)^4 = x^4$

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

30. $(x^5)^3 = x^{15}$

31. $(xy)^3 = x^3 y^3$

32. $(x^2 y)^4 = x^8 y^4$

33. $(x^4 y^2)^3 = x^{12} y^6$

34. $(x^5 y^3 z^4)^4 = x^{20} y^{12} z^{16}$

35. $(x^4 yz^2)^3 = x^{12} y^3 z^6$

36. $(5x^2)^3 = 5^3 x^6$

37. $(7x^3 y^2)^4 = 7^4 x^{12} y^8$

38. $(7^2 x^5 y^4)^3 = 7^6 x^{15} y^{12}$

39. $(5^4 x^6 y^3 z)^4 = 5^{16} x^{24} z^4$

40. $(x^2)^3 \cdot (x)^4 = x^6 \cdot x^4 = x^{10}$

41. $(x^4)^3 \cdot (x^2)^4 = x^{12} \cdot x^8 = x^{20}$

42. $(x^3)^2 \cdot (x^5)^3 = x^6 \cdot x^{15} = x^{21}$

43. $(x^2 y^3)^2 \cdot (xy^2)^3 = x^4 y^6 \cdot x^3 y^6 = x^7 y^{12}$

44. $(x^4 y^3 z^2)^2 \cdot (x^2 yz)^4 = x^8 y^6 z^4 \cdot x^8 y^4 z^4 = x^{16} y^{10} z^8$

$$45. (2x)^3 (4x^2)^2 = 2^3 x^3 \cdot 4^2 x^4 = 2^3 x^3 \cdot (2^2)^2 x^4 = 2^3 x^3 \cdot 2^4 x^4 = 2^7 x^7$$

$$46. (3x^2y)^3 \cdot (3^2xy^3)^2 = 3^3 x^6 y^3 \cdot 3^4 x^2 y^6 = 3^7 x^8 y^9$$

$$47. (5xy^3)^2 \cdot (4x^2y)^3 = (5xy^3)^2 \cdot (2^2 x^2 y)^3 = 5^2 x^2 y^6 \cdot 2^6 x^6 y^3 = 2^6 \cdot 5^2 x^8 y^9$$

$$48. (3x^3y^2)^4 \cdot (4x^2y^4)^2 = (3x^3y^2)^4 \cdot (2^2 x^2 y^4)^2 = 3^4 x^{12} y^8 \cdot 2^4 x^4 y^8 = 2^4 \cdot 3^4 x^{16} y^{16}$$

$$49. (5^2 x^3 y^4 z)^3 \cdot (5x^4 y^2 z^2)^4 = 5^6 x^9 y^{12} z^3 \cdot 5^4 x^{16} y^8 z^8 = 5^{10} x^{25} y^{20} z^{11}$$

$$50. (12x^3y^2)^4 \cdot (6xy)^3 = (2^2 \cdot 3x^3y^2)^4 \cdot (2 \cdot 3xy)^3 = 2^8 \cdot 3^4 x^{12} y^8 \cdot 2^3 \cdot 3^3 x^3 y^3 = 2^{11} \cdot 3^7 x^{15} y^{11}$$

$$51. (10x^4y^2z^2)^3 \cdot (20xy^4z^2)^4 = (2 \cdot 5x^4y^2z^2)^3 \cdot (2^2 \cdot 5xy^4z^2)^4 = 2^3 \cdot 5^3 x^{12} y^6 z^6 \cdot 2^8 \cdot 5^4 x^4 y^{16} z^8 = 2^{11} \cdot 5^7 x^{16} y^{22} z^{14}$$

$$52. (15x^3y^2)^3 (75x^2y)^4 = (3 \cdot 5x^3y^2)^3 (3 \cdot 5^2 x^2 y)^4 = 3^3 \cdot 5^3 x^9 y^6 \cdot 3^4 \cdot 5^8 x^8 y^4 = 3^7 \cdot 5^{11} \cdot x^{17} y^{10}$$

$$53. 3^{-1} = \frac{1}{3}$$

$$54. (xy)^{-1} = \frac{1}{xy}$$

$$55. x^{-1}y^2 = \frac{y^2}{x}$$

$$56. x^{-3}y = \frac{y}{x^3}$$

$$57. (5x^{-2}y^3)^2 = 5^2 x^{-4} y^6 = \frac{5^2 y^6}{x^4}$$

$$58. (-7x^4y^{-5})^3 = -7^3 x^{12} y^{-15} = -\frac{7^3 x^{12}}{y^{15}}$$

$$59. (11x^{-2}y^{-3})^2 = 11^2 x^{-4} y^{-6} = \frac{11^2}{x^4 y^6}$$

$$60. (5x^{-3}y^4)^{-2} = 5^{-2} x^6 y^{-8} = \frac{x^6}{5^2 y^8}$$

$$61. (3^{-3}x^{-2}y^4)^{-3} = 3^9 x^6 y^{-12} = \frac{3^9 x^6}{y^{12}}$$

$$62. (x^2y^{-3})^2 (x^{-1}y^2)^3 = x^4 y^{-6} \cdot x^{-3} y^6 = x$$

$$\begin{aligned} & (3^{-2}x^{-4}y^2z^3)^2(9x^2y^3z^{-2})^3 = 3^{-4}x^{-8}y^4z^6 \cdot 9^3x^6y^9z^{-6} = 3^{-4}x^{-8}y^4z^6 \cdot (3^2)^3x^6y^9z^{-6} = \\ 63. & \quad 3^{-4}x^{-2}y^{13} \cdot 3^6 = 3^2x^{-2}y^{13} = \frac{3^2y^{13}}{x^2} \end{aligned}$$

$$\begin{aligned} & (27x^{-4})^2(81^{-2}x)^3(9x^{-2})^{-2} = (3^3x^{-4})^2([3^4]^{-2}x)^3(3^2x^{-2})^{-2} = (3^3x^{-4})^2(3^{-8}x)^3(3^2x^{-2})^{-2} = \\ 64. & \quad 3^6x^{-8} \cdot 3^{-24}x^3 \cdot 3^{-4}x^4 = 3^{-22}x^{-1} = \frac{1}{3^{22}x} \end{aligned}$$

$$65. \quad (125^{-2})^3(625^3)^4(3125)^{-2} = ([5^3]^{-2})^3([5^4]^3)^4(5^5)^{-2} = (5^{-6})^3(5^{12})^4(5^5)^{-2} = 5^{-18} \cdot 5^{48} \cdot 5^{-10} = 5^{20}$$

$$66. \quad \frac{x^2}{x^4} = \frac{1}{x^2} \qquad 67. \quad \frac{x^4}{x^{10}} = \frac{1}{x^6} \qquad 68. \quad \frac{3x^4}{6x^2} = \frac{3x^4}{2 \cdot 3x^2} = \frac{x^2}{2}$$

$$69. \quad \frac{27x^6}{144x^4} = \frac{3^3x^6}{2^4 \cdot 3^2x^4} = \frac{3x^2}{2^4} \qquad 70. \quad \frac{x^4y^7}{x^3y^2} = xy^5$$

$$71. \quad \frac{12x^3y^5z^2}{60x^2y^7z^4} = \frac{2^2 \cdot 3x^3y^5z^2}{2^2 \cdot 3 \cdot 5x^2y^7z^4} = \frac{x}{5y^2z^2} \qquad 72. \quad \frac{x^{-4}}{x^2} = \frac{1}{x^2x^4} = \frac{1}{x^6}$$

$$73. \quad \frac{x^7}{x^{-3}} = x^7x^3 = x^{10} \qquad 74. \quad \frac{x^2y^{-5}}{x^{-4}y^{-8}} = \frac{x^2x^4y^8}{y^5} = x^6y^3$$

$$75. \quad \frac{45x^{-3}y^6}{81x^{-2}y^{-3}} = \frac{3^2 \cdot 5x^2y^6y^3}{3^4x^3} = \frac{5y^9}{3^2x} \qquad 76. \quad \frac{75x^4y^{-5}z^2}{245x^{-3}y^{-7}z^9} = \frac{3 \cdot 5^2x^4x^3y^7z^2}{5 \cdot 7^2y^5z^9} = \frac{3 \cdot 5x^7y^2}{7^2z^7}$$

$$77. \quad \frac{(x^2y^3)^2}{(x^4y)^3} = \frac{x^4y^6}{x^{12}y^3} = \frac{y^3}{x^8} \qquad 78. \quad \frac{(5x^3)^2}{15x^4} = \frac{5^2x^6}{3 \cdot 5 \cdot x^4} = \frac{5x^2}{3}$$

$$79. \quad \frac{(16x^4y^2)^5}{48x^9y^7} = \frac{(2^4x^4y^2)^5}{2^4 \cdot 3x^9y^7} = \frac{2^{20}x^{20}y^{10}}{2^4 \cdot 3x^9y^7} = \frac{2^{16}x^{11}y^3}{3}$$

$$80. \quad \frac{(81x^5y^3)^2}{144x^4y} = \frac{(3^4x^5y^3)^2}{2^4 \cdot 3^2x^4y} = \frac{3^8x^{10}y^6}{2^4 \cdot 3^2x^4y} = \frac{3^6x^6y^5}{2^4}$$

$$81. \frac{625x^6y^7}{(35x^4y)^5} = \frac{5^4x^6y^7}{(5 \cdot 7x^4y)^5} = \frac{5^4x^6y^7}{5^5 \cdot 7^5x^{20}y^5} = \frac{y^2}{5 \cdot 7^5x^{14}}$$

$$82. \frac{(12x^4y^3)^2}{(20xy^2)^4} = \frac{(2^2 \cdot 3x^4y^3)^2}{(2^2 \cdot 5xy^2)^4} = \frac{2^4 \cdot 3^2x^8y^6}{2^8 \cdot 5^4x^4y^8} = \frac{3^2x^4}{2^4 \cdot 5^4y^2}$$

$$83. \frac{(80x^6y^3z^2)^3}{(32x^3y^5z^4)^2} = \frac{(2^4 \cdot 5x^6y^3z^2)^3}{(2^5x^3y^5z^4)^2} = \frac{2^{12} \cdot 5^3x^{18}y^9z^6}{2^{10}x^6y^{10}z^8} = \frac{2^2 \cdot 5^3x^{12}}{yz^2}$$

$$84. \frac{(120x^4z^2)^4}{(90x^2z^3)^3} = \frac{(2^3 \cdot 3 \cdot 5x^4z^2)^4}{(2 \cdot 3^2 \cdot 5x^2z^3)^3} = \frac{2^{12} \cdot 3^4 \cdot 5^4x^{16}z^8}{2^3 \cdot 3^6 \cdot 5^3x^6z^9} = \frac{2^9 \cdot 5x^{10}}{3^2z}$$

$$85. \frac{(6x^2y)^3(9x^3y^4)^2}{(108x^2y)^4} = \frac{(2 \cdot 3x^2y)^3(3^2x^3y^4)^2}{(2^2 \cdot 3^3x^2y)^4} = \frac{2^3 \cdot 3^3x^6y^3 \cdot 3^4x^6y^8}{2^8 \cdot 3^{12}x^8y^4} = \frac{2^3 \cdot 3^7x^{12}y^{11}}{2^8 \cdot 3^{12}x^8y^4} = \frac{x^4y^7}{2^5 \cdot 3^5}$$

$$86. \frac{(10x^4y^2)^4(25x^3y^5)^2}{(45x^3y^3)^3} = \frac{(2 \cdot 5x^4y^2)^4(5^2x^3y^5)^2}{(3^2 \cdot 5x^3y^3)^3} = \frac{2^4 \cdot 5^4x^{16}y^8 \cdot 5^4x^6y^{10}}{3^9 \cdot 5^3x^9y^9} = \frac{2^4 \cdot 5^8x^{22}y^{18}}{3^9 \cdot 5^3x^9y^9} = \frac{2^4 \cdot 5^5x^{13}y^9}{3^9}$$

$$87. \frac{(2x^{-3}y)^2(8x^2y^{-4})^3}{(20x^{-4}y^{-5})^2} = \frac{(2x^{-3}y)^2(2^2x^2y^{-4})^3}{(2^2 \cdot 5x^{-4}y^{-5})^2} = \frac{2^2x^{-6}y^2 \cdot 2^6x^6y^{-12}}{2^4 \cdot 5^2x^{-8}y^{-10}} = \frac{2^2 \cdot 2^6x^6x^8y^2y^{10}}{2^4 \cdot 5^2x^6y^{12}} =$$

$$\frac{2^8x^{14}y^{12}}{2^4 \cdot 5^2x^6y^{12}} = \frac{2^4x^8}{5^2}$$

$$88. \frac{(6x^4y^{-2})^{-4}(36x^{-3}y^5)^3}{(48x^2y)^2} = \frac{(2 \cdot 3x^4y^{-2})^{-4}(2^2 \cdot 3^2x^{-3}y^5)^3}{(2^4 \cdot 3x^2y)^2} = \frac{2^{-4} \cdot 3^{-4}x^{-16}y^8 \cdot 2^6 \cdot 3^6x^{-9}y^{15}}{2^8 \cdot 3^2x^4y^2} =$$

$$\frac{2^6 \cdot 3^6y^8y^{15}}{2^4 \cdot 2^8 \cdot 3^2 \cdot 3^4x^{16}x^9x^4y^2} = \frac{2^6 \cdot 3^6y^{23}}{2^{12} \cdot 3^6x^{29}y^2} = \frac{y^{21}}{2^6x^{29}}$$

$$89. \frac{(x^{-2}yz^{-3})^4(x^5y^{-3}z^4)^2}{(x^6y^{-5}z^{-1})^3} = \frac{x^{-8}y^4z^{-12} \cdot x^{10}y^{-6}z^8}{x^{18}y^{-15}z^{-3}} = \frac{x^{10}y^4y^{15}z^8z^3}{x^8x^{18}y^6z^{12}} = \frac{x^{10}y^{19}z^{11}}{x^{26}y^6z^{12}} = \frac{y^{13}}{x^{16}z}$$

$$90. \left[\frac{(24x^{-3}y^2)(72x^2y^{-4})}{(96x^{-5}y^3)(120x^3y^{-3})} = \frac{(2^3 \cdot 3x^{-3}y^2)(2^3 \cdot 3^2x^2y^{-4})}{(2^5 \cdot 3x^{-5}y^3)(2^3 \cdot 3 \cdot 5x^3y^{-3})} = \frac{2^3 \cdot 3x^{-3}y^2 \cdot 2^3 \cdot 3^2x^2y^{-4}}{2^5 \cdot 3x^{-5}y^3 \cdot 2^3 \cdot 3 \cdot 5x^3y^{-3}} = \right. \\ \left. \frac{2^3 \cdot 2^3 \cdot 3 \cdot 3^2x^2x^5y^2y^3}{2^5 \cdot 2^3 \cdot 3 \cdot 3 \cdot 5x^3x^3y^4y^3} = \frac{2^5 \cdot 3^3x^7y^5}{2^8 \cdot 3^2x^6y^7} = \frac{3x}{2^3y^2} \right]$$