

9.2 MULTIPLICATION USING EXPONENTS

Multiplication with exponents can be done using the **PRODUCT PROPERTY RULE**. This rule tells us to **add** the exponents when multiplying numbers or letters that have the same base and keep the base the same. $[x^a \cdot x^b = x^{a+b}]$

EXAMPLES:

- $5^3 \times 5^4 = 5^{3+4} = 5^7$
- $y^7 \cdot y^5 \cdot y^3 = y^{7+5+3} = y^{15}$
- $(4x^2)^3 \cdot (4x^2)^6 = (4x^2)^{3+6} = (4x^2)^9$
- $x^5 \cdot y^3 = x^5 \cdot y^3$ or $x^5 y^3$ (The bases are different so we can't add exponents.)
- $(5x^3)(5x^4) = 5^1 \cdot x^3 \cdot 5^1 \cdot x^4 = 5^{1+1} \cdot x^{3+4} = 5^2 x^7$

A. Perform the following multiplications using the Product Property Rule outlined above and leave all your answers in exponential form.

- | | | |
|---------------------------|--------------------------------|---|
| 1. $6^3 \times 6^2$ | 2. $5^3 \times 5^4$ | 3. $(0.2)^3 \times (0.2)^4$ |
| 4. $(x^3)(x^2)(x^3)$ | 5. $(7x)^3 (7x)^4$ | 6. $(x^2y)^4 \cdot (x^2y)^5$ |
| 7. $(-3)^4 (-3)^5$ | 8. $(9^2)(9^3)(9^5)$ | 9. $(2x^3)^3 (2x^3) (2x^3)^4$ |
| 10. $(y^{-8})(y^{-4})$ | 11. $(z)^{-3} (z)^{-4} (z)^7$ | 12. $(\frac{2}{3})^3 (\frac{2}{3})^2 (\frac{2}{3})$ |
| 13. $(m)(m^{-4})$ | 14. $(x^{-5})(x^{-3})(x^{-4})$ | 15. $(5a^5)^5(5a^5)^0$ |
| 16. $(a)(a)(a)(a^0)$ | 17. $(m^{-2})(m^{-3})$ | 18. $(p^2)(p^3)(p^2)$ |
| 19. $(3x^2y)^5 (3x^2y)^7$ | 20. $(-z)^3 (z)^2$ | 21. $4^7 \cdot 4^8 \cdot 4^{-2}$ |

B. Extra Practice. Perform the following multiplications using the Product Property Rule and leave your answers in exponential form.

- | | | |
|---|---|---|
| 1. $(8)(8^2)$ | 2. $(x^6)(x^6)(x^5)$ | 3. $(y^3)(x^2)(a^2)$ |
| 4. $(5y^3)(y^2)(5y^4)$ | 5. $(p^{-2})(p^3)(p^0)$ | 6. $(y^3)(x^3)(y^2)(x^4)$ |
| 7. $2^3 \cdot x^{-3} \cdot 2^4 \cdot x^8$ | 8. $(-5y)^5 (-5y)^{-5}$ | 9. $x^3 y^2 x^2 y^3$ |
| 10. $2x^3 \cdot 2x^4$ | 11. $3x^2 \cdot 3x^3 \cdot 3x^4$ | 12. $(8xy^3) (7y^{-4})$ |
| 13. $(xyz)(x^2y^2z^3)$ | 14. $(\frac{1}{2})^2 (\frac{1}{4})^2 (\frac{1}{2})^3$ | 15. $a^2 b^2 c^3 b^3$ |
| 16. $(-6)^3 (-6)^2 x^2$ | 17. $y^3 y^{-3} y^4 y^{-7}$ | 18. $(3.1)^4 (3.1)^{-3}$ |
| 19. $g^{-6} \cdot g^4 \cdot g^{-4}$ | 20. $3^a \cdot 3^a \cdot 3^a$ | 21. $x^a \cdot x^b \cdot x^c \cdot x^d$ |

D. Write the standard numeral for each of the following.

1. 8^2

2. 5^3

3. 4^{-1}

4. 4^{-2}

5. 4^{-3}

6. $(-3)^4$

7. -3^4

8. $\left[\frac{2}{3}\right]^2$

9. $\frac{2^2}{3}$

10. $\left[-\frac{2}{3}\right]^2$

11. $-\frac{2^2}{3}$

12. $\left[\frac{2}{3}\right]^{-2}$

13. $\frac{2^{-2}}{3}$

14. $\left[\frac{3}{5}\right]^{-3}$

15. $(3.5)^{-1}$

16. 8^0

17. x^0

18. $(5.3)^0$

19. $(-6.5)^2$

20. -6.5^2

D. Write each in expanded exponential form.

1. 356.52

2. 5.000 30

3. 130 004.006

4. 0.003 400

5. 706.5

E. Write the standard numeral for each of the following.

1. $[5 \times 10^2] + [6 \times 10^1] + [4 \times 10^0] + [7 \times 10^{-1}]$

2. $[5 \times 10^4] + [3 \times 10^0] + [6 \times 10^{-1}]$

3. $[4 \times 10^3] + [6 \times 10^{-1}] + [7 \times 10^{-2}] + [8 \times 10^{-3}]$

4. $[3 \times 10^2] + [6 \times 10^1] + [0 \times 10^0] + [6 \times 10^{-1}]$

5. $[9 \times 10^5] + [6 \times 10^4] + [3 \times 10^{-3}]$