

Practice 8-3

Multiplication Properties of Exponents

Simplify each expression.

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|---------------------------------------|----------------------------------|-------------------------------------|
| 1. $(3d^{-4})(5d^8)$ | 2. $(-8m^4)(4m^8)$ | 3. $n^{-6} \cdot n^{-9}$ |
| 4. $a^3 \cdot a$ | 5. $z^8 \cdot z^5$ | 6. $(3p^{-15})(6p^{11})$ |
| 7. $p^7 \cdot q^5 \cdot p^6$ | 8. $(-1.5a^5b^2)(6a)$ | 9. $(-2a^3e^3)(6a^4e^6)$ |
| 10. $\frac{1}{b^{-7} \cdot b^5}$ | 11. $p^5 \cdot q^2 \cdot p^4$ | 12. $\frac{1}{n^7 \cdot n^{-5}}$ |
| 13. $(8d^4)(4d^7)$ | 14. $x^{-9} \cdot x^3 \cdot x^2$ | 15. $2^3 \cdot 2^2$ |
| 16. $r^7 \cdot s^4 \cdot s \cdot r^3$ | 17. $b^7 \cdot b^{13}$ | 18. $(7p^4)(5p^9)$ |
| 19. $2^8 \cdot 2^{-9} \cdot 2^3$ | 20. $(6r^4s^3)(9rs^2)$ | 21. $4^3 \cdot 4^2$ |
| 22. $m^{12} \cdot m^{-14}$ | 23. $s^7 \cdot t^4 \cdot t^8$ | 24. $(-3xy^6)(3.2x^5y)$ |
| 25. $5^{-7} \cdot 5^9$ | 26. $\frac{1}{h^7 \cdot h^5}$ | 27. $\frac{1}{i^{-5} \cdot i^{-3}}$ |
| 28. $f^5 \cdot f^2 \cdot f^0$ | 29. $r^6 \cdot r^{-13}$ | 30. $5^{-6} \cdot 5^4$ |

Simplify each expression. Write each answer in scientific notation.

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|---|--|--|
| 31. $(7 \times 10^7)(5 \times 10^{-5})$ | 32. $(3 \times 10^8)(3 \times 10^4)$ | 33. $(9.5 \times 10^{-4})(2 \times 10^{-5})$ |
| 34. $(4 \times 10^8)(4.1 \times 10^8)$ | 35. $(7.2 \times 10^{-7})(2 \times 10^{-5})$ | 36. $(5 \times 10^7)(4 \times 10^3)$ |
| 37. $(6 \times 10^{-6})(5.2 \times 10^4)$ | 38. $(4 \times 10^6)(9 \times 10^8)$ | 39. $(6.1 \times 10^8)(8 \times 10^{14})$ |

Practice 8-4

More Multiplication Properties of Exponents

Simplify each expression.

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|-------------------------------|--|------------------------------|
| 1. $(4a^5)^3$ | 2. $(2^{-3})^4$ | 3. $(m^{-3}n^4)^{-4}$ |
| 4. $(x^5)^2$ | 5. $2^5 \cdot (2^4)^2$ | 6. $(4x^4)^3(2xy^3)^2$ |
| 7. $x^4 \cdot (x^4)^3$ | 8. $(x^5y^3)^3(xy^5)^2$ | 9. $(5^2)^2$ |
| 10. $(a^4)^{-5} \cdot a^{13}$ | 11. $(3f^4g^{-3})^3(f^2g^{-2})^{-1}$ | 12. $x^3 \cdot (x^3)^5$ |
| 13. $(a^2)^{-4}$ | 14. $(a^3b^4)^{-2}(a^{-3}b^{-5})^{-4}$ | 15. $(x^2)^4$ |
| 16. $(12b^{-3})^2$ | 17. $(m^{-5})^{-3}$ | 18. $(x^{-4})^5(x^3y^2)^5$ |
| 19. $(y^6)^{-3} \cdot y^{21}$ | 20. $a^6 \cdot (a^{-2})^5$ | 21. $(nr^5)^{-3}(m^4nr^5)^4$ |
| 22. $(a^3)^6$ | 23. $b^{-9} \cdot (b^2)^4$ | 24. $(4^{-1}3^3)^{-2}$ |
| 25. $(5a^3b^5)^4$ | 26. $(b^{-3})^6$ | 27. $(y^6)^3$ |
| 28. $a^{-4} \cdot (a^4b^3)^2$ | 29. $(x^4y)^3$ | 30. $d^3 \cdot (d^2)^5$ |

Simplify. Write each answer in scientific notation.

- | | | |
|---------------------------------------|---------------------------------------|------------------------------------|
| 31. $10^{-9} \cdot (2 \times 10^2)^2$ | 32. $(3 \times 10^{-6})^3$ | 33. $10^4 \cdot (4 \times 10^8)^3$ |
| 34. $(9 \times 10^7)^2$ | 35. $10^{-3} \cdot (2 \times 10^3)^5$ | 36. $(7 \times 10^5)^3$ |
| 37. $(5 \times 10^5)^4$ | 38. $(2 \times 10^{-3})^3$ | 39. $(5 \times 10^2)^{-3}$ |

Practice 8-5

Division Properties of Exponents

Simplify each expression.

1. $\frac{r^{15}}{c^9}$

2. $\left(\frac{x^3y^{-2}}{z^{-5}}\right)^{-4}$

3. $\frac{x^7y^9z^3}{x^4y^7z^8}$

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

5. $\frac{3^7}{3^4}$

6. $\left(\frac{a^3}{b^5}\right)^4$

7. $\left(\frac{2}{3}\right)^{-2}$

8. $\left(\frac{p^{-3}q^{-2}}{q^{-3}r^5}\right)^4$

9. $\frac{a^6b^{-5}}{a^{-2}b^7}$

10. $\frac{7^{-4}}{7^{-7}}$

11. $\frac{a^7b^6}{a^5b}$

12. $\left(\frac{a^2b^{-4}}{b^2}\right)^5$

13. $\left(\frac{3}{2^8}\right)^{-2}$

14. $\frac{z^7}{z^{-3}}$

15. $\left(\frac{5a^0b^4}{c^{-3}}\right)^2$

16. $\frac{x^4y^{-8}z^{-2}}{x^{-1}y^6z^{-10}}$

17. $\frac{m^6}{m^{10}}$

18. $\left(\frac{2^3m^4n^{-1}}{p^2}\right)^0$

19. $\left(\frac{s^{-4}}{t^{-1}}\right)^{-2}$

20. $\left(\frac{2a^3b^{-2}}{c^3}\right)^5$

21. $\left(\frac{x^{-3}y}{xz^{-4}}\right)^{-2}$

22. $\frac{h^{-13}}{h^{-8}}$

23. $\frac{4^6}{4^8}$

24. $\left(\frac{1}{3}\right)^3$

25. $\frac{x^5y^3}{x^2y^8}$

26. $\left(\frac{m^{-3}n^4}{n^{-2}}\right)^4$

27. $\frac{4^{-1}}{4^2}$

28. $\left(\frac{a^8b^6}{a^{11}}\right)^5$

29. $\frac{n^9}{n^{15}}$

30. $\left(\frac{r^3s^{-1}}{r^2s^6}\right)^{-1}$

31. $\frac{n^{-8}}{n^4}$

32. $\frac{m^8n^3}{m^{10}n^5}$

Simplify each quotient. Write each answer in scientific notation.

33. $\frac{3.54 \times 10^{-9}}{6.15 \times 10^{-3}}$

34. $\frac{9.35 \times 10^{-3}}{3.71 \times 10^{-5}}$

35. $\frac{495 \text{ billion}}{23.9 \text{ million}}$

36. $\frac{8 \times 10^9}{4 \times 10^3}$

37. $\frac{9.5 \times 10^9}{5 \times 10^{12}}$

38. $\frac{6.4 \times 10^9}{8 \times 10^7}$

39. $\frac{298 \text{ billion}}{49 \text{ million}}$

40. $\frac{1.8 \times 10^{-8}}{0.9 \times 10^3}$