Exponents and Roots
> Review 4.1 / Properties of Exponents, Part 1

4.1.1 Product and Power Properties of Exponents

Simplify.

1. 3^3

2. $(-4)^2$

3. -4^2

4. $\left(-\dfrac{3}{5}\right)^2$

5. $6 \cdot 6^2 \cdot 6^3 \cdot 6^2$

6. $\left(2^3\right)^3$

7. $\left(b^4\right)^6 \cdot b$

8. $(3x)^3$

9. $\left(5w^8\right)^2$

10. $\left(-4x^3\right)^4$

11. $-\left(4x^3\right)^4$

12. $\left(p^4q^2\right)^7$

4.1.2 Integer Exponents

13. **Biology** One of the smallest bats is the northern blossom bat, which is found from Southeast Asia to Australia. This bat weighs about 2^{-1} ounce. Simplify this expression.

Simplify.

14. 8^0

15. -9^{-2}

16. $\left(\dfrac{2}{5}\right)^0$

17. 13^{-2}

18. $(-3)^{-1}$

19. $(-4)^2$

20. $\left(\frac{1}{2}\right)^{-2}$

21. -7^{-1}

22. $a^5 \cdot a^0 \cdot a^{-5}$

23. $b \cdot \left(a^3\right)^4 \cdot \left(b^{-2}\right)^3$

24. $x^7 \cdot x^{-6} \cdot y^{-3}$

25. $\left(x^2\right)^{-1}$

26. $\left(x^4\right)^2 \cdot \left(x^{-1}\right)^{-4}$

27. $\left(3^6\right)^0$

28. $\left(x^3 y^4\right)^3 \cdot \left(xy^3\right)^{-2}$

Evaluate each expression for the given value(s) of the variable(s).

29. $\left(\frac{2}{3}v\right)^{-3}$ for $v = 9$

30. $(10 - d)^0$ for $d = 11$

31. $10m^{-1}n^{-5}$
for $m = 10$
and $n = -2$

32. $(3ab)^{-2}$
for $a = \frac{1}{2}$ and $b = 8$

33. $4w^v x^v$ for $w = 3$, $v = 0$, and $x = -5$

Simplify.

34. k^{-4}

35. $2z^{-8}$

36. $\frac{1}{2b^{-3}}$

37. $c^{-2}d$

38. $-5x^{-3}$

39. $4x^{-6}y^{-2}$

40. $\frac{r^{-5}}{s^{-1}}$

41. $\frac{2f^0}{7g^{-10}}$

42. $\frac{s^5}{t^{-12}}$

43. $\frac{3w^{-5}}{x^{-6}}$

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44. b^0c^0 **45.** $\frac{2}{3}m^{-1}n^5$ **46.** $\frac{q^{-2}r^0}{s^0}$ **47.** $\frac{a^{-7}b^2}{c^3d^{-4}}$ **48.** $\frac{h^3k^{-1}}{6m^2}$

4.1.3 Quotient Properties of Exponents

Simplify.

49. $\dfrac{x^8y^3}{x^3y^3}$ **50.** $\dfrac{x^8y^4}{x^9yz}$ **51.** $\left(\dfrac{a^4}{b^2}\right)^3$ **52.** $\left(\dfrac{xy^2}{x^3y}\right)^3$

53. $\left(\dfrac{1}{7}\right)^{-3}$ **54.** $\left(\dfrac{x^2}{y^5}\right)^{-5}$ **55.** $\left(\dfrac{8w^7}{16}\right)^{-1}$ **56.** $\left(\dfrac{1}{4}\right)^{-2}\left(\dfrac{6x}{7}\right)^{-2}$

4.1.4 An Application of Exponents: Scientific Notation

1. **Statistics** At the beginning of the twenty-first century, the population of China was about 1,287,000,000. Write this number in scientific notation.

2. **Biology** The human body is made of about 1×10^{13} cells. Write this number in standard form.

Find the value of each expression.

3. 9.2×10^4

4. 1.25×10^{-7}

5. 42×10^{-5}

6. 0.05×10^7

7. Order the list of numbers from least to greatest.
$2.13 \times 10^{-1}, 3.12 \times 10^2, 1.23 \times 10^{-3}, 2.13 \times 10^1, 1.32 \times 10^{-3}, 3.12 \times 10^{-3}$

Simplify each quotient and write the answer in scientific notation.

8. $\left(4.7 \times 10^{-3}\right) \div \left(9.4 \times 10^3\right)$

9. $\left(8.4 \times 10^9\right) \div \left(4 \times 10^{-5}\right)$

10. $\left(4.2 \times 10^{-5}\right) \div \left(6 \times 10^{-3}\right)$

11. $\left(2.1 \times 10^2\right) \div \left(8.4 \times 10^5\right)$

12. **Geography** Rhode Island is the smallest state in the United States. Its land area is about 2.9×10^{10} square feet. Alaska, the largest state, is about 5.5×10^2 times as large as Rhode Island. What is the land area of Alaska in square feet? Write your answer in scientific notation.

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13. **Astronomy** The mass of Earth is about 3×10^{-3} times the mass of Jupiter. The mass of Earth is about 6×10^{24} kg. What is the mass of Jupiter? Give your answer in scientific notation.