

Negative Exponents (Pages 347–351)

Negative Exponents

For any nonzero number a and any integer n , $a^{-n} = \frac{1}{a^n}$ and $\frac{1}{a^{-n}} = a^n$.
 Numbers: $4^{-3} = \frac{1}{4^3}$ or $\frac{1}{64}$; $\frac{1}{2^{-3}} = 2^3$ or 8

EXAMPLES

Simplify each expression.

A ab^{-5}

$$ab^{-5} = a \cdot b^{-5}$$

$$= a \cdot \frac{1}{b^5} \quad \text{Definition of negative exponent}$$

$$= \frac{a}{b^5}$$

B $\frac{x^3y^2}{x^{-2}y^4}$

$$\frac{x^3y^2}{x^{-2}y^4} = \frac{x^3}{x^{-2}} \cdot \frac{y^2}{y^4}$$

$$= x^{3 - (-2)} \cdot y^{2 - 4} \quad \text{Quotient of powers}$$

$$= x^5 \cdot y^{-2}$$

$$= x^5 \cdot \frac{1}{y^2} \quad \text{Definition of negative exponent}$$

$$= \frac{x^5}{y^2}$$

PRACTICE

Write each expression using positive exponents. Then evaluate the expression.

1. 3^{-4}

2. 7^{-2}

3. 5^{-3}

4. 10^{-1}

Simplify each expression.

5. $x^{-3}y^0z^{-2}$

6. $\frac{d^{-1}}{d^0}$

7. $\frac{4a}{a^8}$

8. $\frac{n^3}{n^{-1}}$

9. $\frac{g^7h^2}{g^5h^0}$

10. $\frac{5s^3}{40s^4}$

11. $a^2b^{-2}c^{-3}$

12. $\frac{h^{-5}}{h^6}$

13. $m^{-3}n^3$

14. $\frac{26a^3}{-13a^6b^8}$

15. $\frac{18rs^0t^9}{6r^8s^7t^4}$

16. $\frac{35x^{-4}y^{-2}}{5x^2y^{-3}}$

17. **Physics** The wavelength of an X ray, 10^{-8} centimeter, is how many times the wavelength of a gamma ray, 10^{-10} centimeter?



18. **Standardized Test Practice** Simplify $\frac{x^4y^2}{x^{-2}y^2}$.

A $\frac{1}{x^2}$

B x^2

C x^2y

D x^6

Answers: 1. $\frac{3^4}{1}$ 2. $\frac{7^2}{1}$ 3. $\frac{5^3}{1}$ 4. $\frac{10}{1}$ 5. $\frac{x^6y^2}{1}$ 6. $\frac{d}{1}$ 7. $\frac{h^{-1}}{1}$ 8. n^4 9. g^2h^2 10. $\frac{8s}{1}$ 11. $\frac{b^2c^3}{1}$ 12. $\frac{4}{11}$ 13. $\frac{m^3}{n^3}$ 14. $\frac{a^9b^8}{2}$ 15. $\frac{r^3s^7}{3t^5}$ 16. $\frac{7x^8}{2y}$ 17. 100 18. D