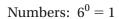
Key Concept and Vocabulary

Zero Exponents

Any nonzero number to the zero power is equal to 1. Zero to the zero power, 0^0 , is undefined.



Algebra: $a^0 = 1$, where $a \neq 0$



Negative Exponents

For any integer n and any number a not equal to 0, a^{-n} is equal to 1 divided by a^n .

Numbers:
$$4^{-2} = \frac{1}{4^2}$$

Algebra:
$$a^{-n} = \frac{1}{a^n}$$
, where $a \neq 0$

Skill Examples

1.
$$5^{-3} = \frac{1}{5^3} = \frac{1}{125}$$

2.
$$3^{-6} \cdot 3^6 = 3^{-6+6} = 3^0 = 1$$

3.
$$\frac{4^2}{4^5} = 4^{2-5} = 4^{-3} = \frac{1}{4^3} = \frac{1}{64}$$

4.
$$\frac{7b^{-4}}{b^3} = 7b^{-4-3} = 7b^{-7} = \frac{7}{b^7}$$

Application Example

5. A faucet leaks water at a rate of 5⁻⁴ liter per second. How many liters of water leak from the faucet in 1 hour?

There are 3600 seconds in 1 hour. Multiply the time by the rate.

$$3600 \times 5^{-4} = 3600 \cdot \frac{1}{5^4}$$

= $3600 \cdot \frac{1}{625}$
= $5\frac{19}{25} = 5.76$

So, 5.76 liters of water leak from the faucet in 1 hour.

Check your answers at BigIdeasMath.com. —

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Evaluate the expression.

6.
$$4^{-4} =$$

9. $9^{-4} \cdot 9^4 =$

7.
$$8^{-2} =$$

10.
$$\frac{2^3}{2^8} =$$

12.
$$\frac{(-4)^4}{(-4)^6} = \underline{\hspace{1cm}}$$

13.
$$\frac{1}{2^{-3}} \cdot \frac{1}{2^7} = \underline{\hspace{1cm}}$$

8.
$$(-5)^{-6} = \underline{\hspace{1cm}}$$

11.
$$\frac{5^3}{5^5} =$$

14.
$$\frac{4^5 \cdot 4^{-2}}{4^4} = \underline{\hspace{1cm}}$$

Simplify. Write the expression using only positive exponents.

15.
$$\frac{3x^4}{x^9} =$$

16.
$$\frac{a^{-5}}{14a^8} =$$

17.
$$\frac{3w^{-4}}{w^{-2}} =$$

METRIC UNITS In Exercises 18–21, use the table.