

Reteach

Chapter 8

Name _____

What you should learn:

8.1 How to multiply with exponents and use exponential equations to model real-life situations.

Correlation to Pupil's Textbook:

Mid-Chapter Test (p. 425)

Chapter Test (p. 449)

Exercises 1–5, 17, 18, 25, 26

Exercises 1, 5, 9, 13, 24

Examples

Multiplying Powers and Using Powers and Models In Real-Life

Simplify using multiplication properties of exponents.

a. $2^2 \cdot 2^5 = 2^{2+5}$
 $= 2^7$

b. $(5^3)^2 = 5^{3 \cdot 2}$
 $= 5^6$

c. $(-2x)^4 = (-2 \cdot x)^4$
 $= (-2)^4 \cdot x^4$
 $= 16x^4$

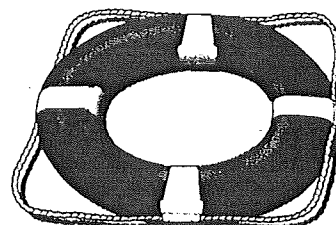
d. $-(2x)^4 = -(2 \cdot x)^4$
 $= -(2^4) \cdot x^4$
 $= -16x^4$

e. $(3a^4)^3 (\frac{1}{3}a^3)^2 = (3 \cdot a^4)^3 (\frac{1}{3} \cdot a^3)^2$
 $= (3)^3 \cdot (a^4)^3 \cdot (\frac{1}{3})^2 \cdot (a^3)^2$
 $= 27a^{12} \cdot \frac{1}{9}a^6$
 $= 3a^{18}$

- f. Your three-year-old brother has a new plastic swimming pool. The pool has a circular base with a radius of 60 centimeters. The height of the pool is 15 centimeters. How many cubic centimeters of water are needed to completely fill the swimming pool?

The volume of a circular cylinder is the height times the area of the circular base. The area of a circle is π times the square of the radius of the circle. Thus, the volume of the pool is:

$$\pi r^2 h = \pi (60)^2 (15) = 54,000\pi \approx 169,646 \text{ cubic centimeters.}$$



Guidelines:

- To multiply powers that have the same base, add the exponents.
- To find a power of a power, multiply the exponents.
- To find a power of a product, find the power of each factor and multiply.
- The general form of an exponential equation is $y = c(a)^x$ where c is an initial amount, a is a "change" factor, and x is the number of times change occurs.

EXERCISES

In Exercises 1–9, simplify (if possible).

1. $7^4 \cdot 7^6$

2. $(-3y^5)^4$

3. $(5x)^3 \cdot (-4x)$

4. $(xy^2)^4 (x^3y)^2$

5. $(-2a^3b)^3 (\frac{1}{2}a)^2$

6. $[(3x+1)^3]^4$

7. $[(-2cd)^3]^2$

8. $(-t)^6 (-t)^5 (-t)$

9. $x^6 y^3$

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What you should learn:

8.2

How to use negative and zero exponents and use powers as models in real-life situations.

Correlation to Pupil's Textbook:

Mid-Chapter Test (p. 425) Chapter Test (p. 449)

Exercises 6–8, 13, 14, 27 Exercises 2–4, 6, 8, 10,
14, 15, 18

Examples

Evaluating Negative and Zero Exponents and Modeling with Powers

a. $3x^{-2} = 3 \cdot \frac{1}{x^2}$
 $= \frac{3}{x^2}$

b. $(3x)^{-2} = \frac{1}{(3x)^2}$ $(3x)^{-2}$ is the reciprocal of $(3x)^2$.
 $= \frac{1}{9x^2}$

c. $\frac{5y^{-3}}{x^{-4}} = \frac{5x^4}{y^3}$ Factors move from denominator to numerator
(or vice versa) to have positive exponents.

d. $(-14x)^0 = 1$ A nonzero number to the zero power is 1.

e. $7^{-3} \cdot 7^3 = 7^{-3+3} = 7^0 = 1$ Use multiplication properties of exponents
and the definition of a zero exponent.

- f. An investor deposits \$100,000 in a trust fund with an annual percentage rate of 6%. The balance in the account after t years is given by $A = 100,000(1.06)^t$. Use a calculator to find the balance after 4 years.

$$A = 100,000(1.06)^4 = 100,000(1.26247696) \approx 126,247.70$$

The balance in the account after 4 years is \$126,247.70.

Guidelines:

- a^{-n} is the reciprocal of a^n if a is a nonzero number and n is a positive integer.
- a raised to the zero power is 1 for $a \neq 0$.

EXERCISES

In Exercises 1–9, rewrite the expression using positive exponents.

1. $(14a)^{-1}$

2. $8y^{-3}$

3. $(-5)^0 x^{-1}$

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

5. $\frac{a^{-7}}{3}$

6. $\frac{c^{-2}}{d^{-6}}$

7. $x^{-5} \cdot y^5$

8. $x^{-5} \cdot x^5$

9. $(5x^{-2})^0$

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What you should learn:

8.3 How to divide expressions with exponents and use powers as models in real-life situations.

Correlation to Pupil's Textbook:

Mid-Chapter Test (p. 425) Chapter Test (p. 449)

Exercises 9–12, 15, 16

Exercises 7, 11, 12, 16, 17

Examples

Dividing with Exponents and Using Powers as Models in Real-Life

$$\begin{aligned} \text{a. } \frac{(-5)^7}{(-5)^5} &= (-5)^{7-5} \\ &= (-5)^2 \\ &= 25 \end{aligned}$$

$$\begin{aligned} \text{b. } \left(\frac{3}{4}\right)^{-2} &= \frac{3^{-2}}{4^{-2}} \\ &= \frac{4^2}{3^2} \\ &= \frac{16}{9} \end{aligned}$$

$$\begin{aligned} \text{c. } \frac{5ab^3}{3a^2b} \cdot \frac{12a^4b}{b^5} &= \frac{(5ab^3)(12a^4b)}{(3a^2b)b^5} \\ &= \frac{60a^5b^4}{3a^2b^6} \\ &= 20a^3b^{-2} \\ &= \frac{20a^3}{b^2} \end{aligned}$$

Multiply fractions.

Product of powers property

Quotient of powers property

Write with positive exponents.

- d. If a millimeter is 10^{-3} meters and a kilometer is 10^3 meters, find the ratio of one millimeter to one kilometer.

$$\text{The ratio is } \frac{10^{-3} \text{ meters}}{10^3 \text{ meters}} = \frac{1}{10^6} \text{ or } \frac{1}{1,000,000}.$$

Guidelines:

- Divide powers having the same base by subtracting exponents.
- Find a power of a quotient by finding the power of the numerator and the power of the denominator and dividing.

EXERCISES

In Exercises 1–6, simplify.

$$1. c^8 \cdot \frac{1}{c^2}$$

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

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

$$4. \frac{-10x^2y}{3x^4y^3} \cdot \frac{9x^2y}{2x}$$

$$5. \frac{8a^{-3}b^{-2}}{a^2} \cdot \frac{ab^{-1}}{a^{-1}b}$$

$$6. \left(\frac{xy^{-1}}{x^{-3}y^2}\right)^2 \cdot \left(\frac{x^3y^2}{2yx^{-1}}\right)^{-2}$$

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What you should learn:

8.4

How to write numbers in scientific notation and perform operations using scientific notation.

Correlation to Pupil's Textbook:

Mid-Chapter Test (p. 425) Chapter Test (p. 449)

Exercises 19–24, 28

Exercises 19–22

Examples

Using Scientific Notation

- a. Write 6.7239×10^{-4} in decimal form.

$$6.7239 \times 10^{-4} = 0.00067239 \quad \text{Move decimal point 4 places to the left.}$$

- b. Write 1.884×10^5 in decimal form.

$$1.884 \times 10^5 = 188,400.0 \quad \text{Move decimal point 5 places to the right.}$$

- c. Write 26,645 in scientific notation.

$$26,645 = 2.6645 \times 10^4 \quad \text{Move decimal point 4 places to the left.}$$

- d. Write 0.00829 in scientific notation.

$$0.00829 = 8.29 \times 10^{-3} \quad \text{Move decimal point 3 places to the right.}$$

- e. Use properties of exponents to evaluate $(2.6 \times 10^6)(4.7 \times 10^{-2})$.

$$\begin{aligned}(2.6 \times 10^6)(4.7 \times 10^{-2}) &= (2.6 \times 4.7)(10^6 \cdot 10^{-2}) \\ &= 12.22 \times (10^4) \\ &= 1.222 \times 10^5\end{aligned}$$

Guidelines:

- Scientific notation uses powers of ten to express decimal numbers.
- Numbers in scientific notation are written $c \times 10^n$ where c is a decimal number greater than or equal to 1 and less than 10.
- To multiply, divide or find powers of numbers in scientific notation, use the properties of exponents.

EXERCISES

In Exercises 1–3, rewrite the scientific notation in decimal form.

1. 9.33×10^{-6}

2. 2.78×10^0

3. 4.57×10^7

In Exercises 4–6, rewrite the decimal in scientific notation.

4. 13,400,000,000

5. 0.000035

6. 75.2

In Exercises 7–9, use a calculator to evaluate. Write the result in scientific notation.

7. $0.000525 \cdot 134,000$

8. $(3.88 \times 10^{-5})^4$

9. $9,220,000 \times 0.0046$

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What you should learn:

8.5

How to use scientific notation to solve real-life problems.

Correlation to Pupil's Textbook:

Chapter Test (p. 449)

Exercise 23

Examples

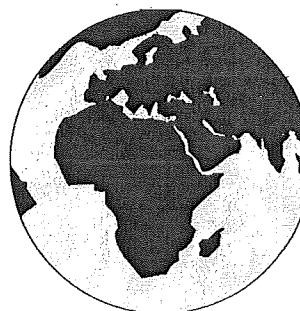
Using Scientific Notation in Real Life

- a. The planet Earth is 93 million miles from the sun. The planet Pluto is 3.7 billion miles from the sun. Find the ratio of Earth's distance from the sun to Pluto's distance from the sun.



Express the distances in scientific notation and find the ratio.

$$\begin{aligned}\frac{9.3 \times 10^7}{3.7 \times 10^9} &\approx 2.5 \times 10^{-2} \\ &= 0.025 \\ &= \frac{25}{1000} \\ &= \frac{1}{40}\end{aligned}$$



- b. The mass of the sun is approximately 1.99×10^{30} kilograms. The mass of the moon is approximately 7.36×10^{22} kilograms. The mass of the sun is approximately how many times that of the moon?

$$\begin{aligned}\frac{1.99 \times 10^{30}}{7.36 \times 10^{22}} &\approx 0.27 \times 10^8 \\ &= 2.7 \times 10^7\end{aligned}$$

The mass of the sun is about 27,000,000 times the mass of the moon.

Guidelines:

- Use scientific notation when solving problems with very large or very small numbers.

EXERCISES

1. A nanosecond is one billionth of a second and a megasecond is one million seconds. Find the ratio of a nanosecond to a megasecond.
2. The world's worst inflation occurred in Hungary in 1946. One gold pengő was worth 130 million million million paper pengős. Express the 1946 value of one paper pengő in scientific notation.
3. The Pacific Ocean covers 166,241,000 square kilometers. The Baltic Sea covers 414,400 square kilometers. The Pacific Ocean is approximately how many times as large as the Baltic Sea?

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What you should learn:

8.6 How to use the formula for compound interest and models for exponential growth.

Correlation to Pupil's Textbook:

Chapter Test (p. 449)

Exercise 25

Examples

Computing Compound Interest and Exponential Growth

- a. \$325 is deposited in an account that pays $6\frac{1}{2}\%$ interest compounded yearly. What is the balance after 7 years?

Use the compound interest formula, $A = P(1 + r)^t$ where $P = 325$, $r = 0.065$, and $t = 7$.

$$\begin{aligned} A &= P(1 + r)^t \\ &= 325(1 + 0.065)^7 \\ &= 325(1.065)^7 \\ &\approx 505.05 \end{aligned}$$

The balance after 7 years is \$505.05.

- b. The population of Augusta, Georgia, increased by 1.7% from 1970 to 1988. In 1970, the population was 291,000. Write an exponential growth model that gives the population, P , in terms of the year, t . Let $t = 0$ represent 1970. (Source: Bureau of the Census)

Use the exponential growth model $y = C(a)^x$ where $C = 291,000$, $a = 1.017$, and $x = t$.

$$y = 291,000(1.017)^t$$

Guidelines:

- Compound interest is paid on the original investment, called principal, and on interest added to the account.
- The compound interest formula $A = P(1 + r)^t$ is an example of an exponential growth model where the growth factor is $(1 + r)$.

EXERCISES

1. How much less would the value of the account be in Example a, if the interest rate is $5\frac{1}{2}\%$ compounded yearly?
2. Estimate the population of Augusta, Georgia, in the year 1995 using the exponential growth model created in Example b.

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What you should learn :

8.7 How to use models for exponential growth and decay.

Correlation to Pupil's Textbook:

Chapter Test (p. 449)

Exercise 25

Examples

Using Exponential Models

- a. The population of Czechoslovakia increased 0.3% per year from 1980 to 1990. In 1980, the population was 15,255,000. Estimate the population in 1990.

Let P be the population in year t , with $t = 0$ corresponding to 1980. Use the exponential growth model $P = C(1 + r)^t$ where $C = 15,255,000$, $r = 0.003$, and $t = 10$. Then

$$P = 15,255,000(1.003)^{10}$$

$$P \approx 15,718,878.$$

The estimated population in 1990 was 15,718,878.



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- b. A women's clothing store opened in 1982 and earned a net profit of \$105,000. Its sales decreased, resulting in profit decreasing by $4\frac{1}{2}\%$ each year for five years. Write an exponential decay model for the profit, P , in year t , with $t = 0$ corresponding to 1982. What was the store's profit in 1987?

Use the exponential decay model $P = C(1 - r)^t$ where $C = 105,000$ and $r = 0.045$.

$$P = 105,000(0.955)^t \quad \text{Profit model}$$

In 1987, $t = 5$.

$$P = 105,000(0.955)^5$$

$$\approx 83,408$$

The store's profit in 1987 was approximately \$83,408.



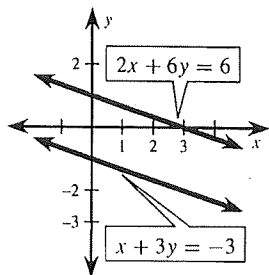
Guidelines:

- Exponential growth occurs when the initial amount increases by the same percent, r , for each time period.
- Exponential decay occurs when the initial amount decreases by the same percent, r , for each time period

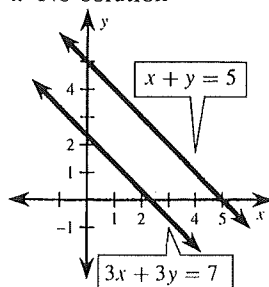
EXERCISES

1. Use the exponential decay model in Example b to estimate the clothing store profit for the year 1992. How much did the profit decrease in 10 years?
2. Rework Example b to estimate the profit in 1987 if profits increased by $4\frac{1}{2}\%$ each year for five years.

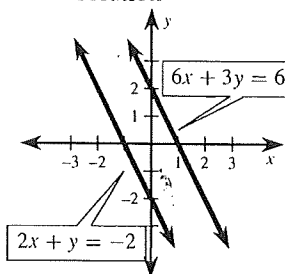
3. No solution



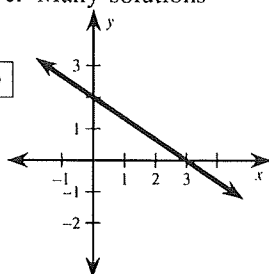
4. No solution



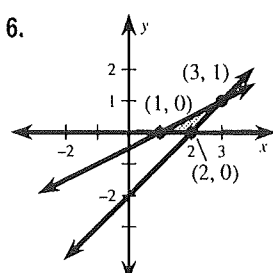
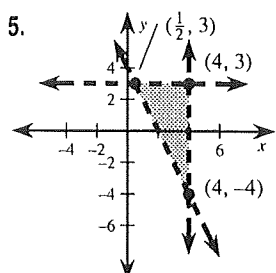
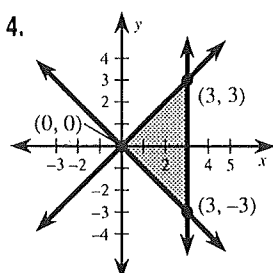
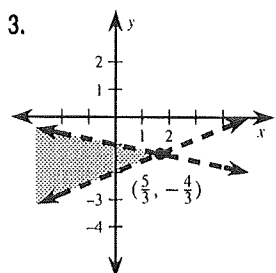
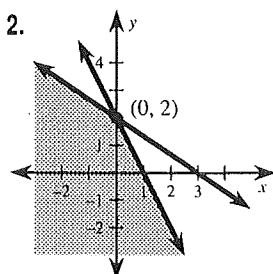
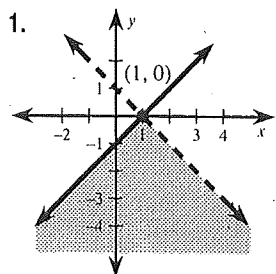
5. No solution



6. Many solutions



Lesson 7.6



Lesson 7.7

- Minimum: $C = 0$; Maximum: $C = 12$
- Minimum: $C = 6$; Maximum: $C = 29$
- Minimum: $C = 0$; Maximum: $C = 17$

Lesson 8.1

- 7^{10}
- $81y^{20}$
- $-500x^4$
- $x^{10}y^{10}$
- $-2a^{11}b^3$
- $(3x + 1)^{12}$
- $64c^6d^6$
- t^{12}
- Cannot be further simplified.

Lesson 8.2

- $\frac{1}{14a}$
- $\frac{8}{y^3}$
- $\frac{1}{x}$
- $7b^4$
- $\frac{1}{3a^7}$
- $\frac{d^6}{c^2}$
- $\frac{y^5}{x^5}$
- 1, if $x \neq 0$
- 1

Lesson 8.3

- c^6
- $\frac{64x^3}{27y^3}$
- $\frac{b^2}{a^2}$
- $\frac{-15}{xy}$
- $\frac{8}{a^3b^4}$
- $\frac{4}{y^8}$

Lesson 8.4

- 0.00000933
- 2.78
- 45,700,000
- 1.34×10^{10}
- 3.5×10^{-5}
- 7.52×10^1
- 7.035×10^1
- $\approx 2.27 \times 10^{-18}$
- 4.24×10^4

Lesson 8.5

- 1.0×10^{-15}
- $\approx 7.69 \times 10^{-21}$
- $\approx 4.0 \times 10^2$

Lesson 8.6

- \$32.28 less
- $\approx 443,524$

Lesson 8.7

- \$38,744
- \$130,849

Lesson 9.1

- 12
- 0.5
- ≈ 3.61
- $-\frac{1}{3}$
- $\pm \frac{6}{13}$
- $\frac{11}{14}$
- 26
- ≈ 9.90

Lesson 9.2

- $\pm \frac{1}{3}$
- ± 9
- ± 10
- $\approx \pm 4.90$
- $\approx \pm 0.87$
- $\approx \pm 2.24$
- ≈ 1.43 seconds

Lesson 9.3

