

# Extra Practice

# 8.1

Name \_\_\_\_\_

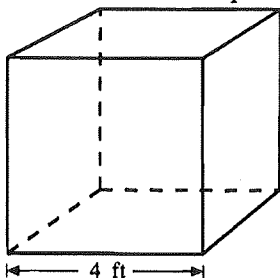
In 1–12, simplify, if possible.

1.  $3^2 \cdot 3^4$
2.  $(2^3)^5$
3.  $x^5 \cdot x^3$
4.  $(y^2)^8$
5.  $(2x)^3$
6.  $(-3x^4)^2$
7.  $(x^2)^7$
8.  $(-2x)^3(-x^2)$
9.  $(xy)^3(z^6)^2$
10.  $(a^2bc^3)^4 \cdot (b^2c)^3$
11.  $(-x)^3(-y^2)^4(xyz^5)^2$
12.  $(2x)^3(2y^2)^4(\frac{1}{2}xy)^5$

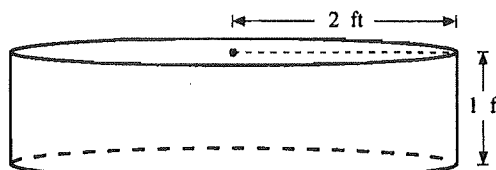
In 13–24, simplify. Then evaluate the expression when  $x = 2$  and  $y = 1$ .

13.  $(x^3)^2$
14.  $(xy^2)^3$
15.  $(x^2y)(3x)$
16.  $(x^4y^2)(y^5)$
17.  $(-2xy)^3$
18.  $(-3x)^2(2y)^3$
19.  $(xy^2)^2(5y^3)$
20.  $(2y)^4(3y^2)^2$
21.  $(-3x)^3(4y^3)^2$
22.  $(-xy)^4(xy^8)^2$
23.  $(x^2y)(xy^2)^2$
24.  $-2x^2y(x^3y^2)^3$

25. **Volume** Find the total volume of four cubic crates identical to the one pictured below.



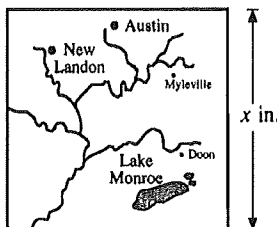
26. **Volume** Find the total volume of two cylindrical tanks identical to the one pictured below.



27. **Savings Account** You put \$100 in an account that pays an annual rate of 4%. The balance in the account,  $A$ , after  $t$  years, is given by  $A = 100(1.04)^t$ . What is the balance after 2 years?

28. **Collecting Pennies** You collect pennies. You start with one penny and double the number of pennies you have each day for 20 days. How many pennies will you have at the end of 20 days? Is it likely that you will be able to collect this many pennies?

29. **Maps** The scale of a square map indicates that each inch on the map corresponds to 5 miles. Write an expression that describes the area of land shown on the map. If the map is 8 inches on one side, what is the area of land shown on the map?



# Extra Practice

# 8.2

Name \_\_\_\_\_

In 1–12, evaluate the expression.

1.  $3^{-3}$

2.  $2^{-5}$

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

4.  $8^0 \cdot 2^{-3}$

5.  $3^5 \cdot 3^{-4}$

6.  $5^{-7} \cdot 5^9$

7.  $9^{-5} \cdot 9^5$

8.  $-4 \cdot (-4)^{-3}$

9.  $\frac{3^0}{2^{-3}}$

10.  $(2^3)^{-2}$

11.  $(6^{-1})^2$

12.  $(-2^3)^{-1}$

In 13–24, rewrite the expression using positive exponents.

13.  $x^{-8}$

14.  $3x^{-5}$

15.  $\frac{1}{7x^{-2}}$

16.  $\frac{9}{x^{-4}}$

17.  $8x^{-7}y^{-8}$

18.  $\frac{1}{6x^{-4}y^{-3}z^5}$

19.  $\frac{3x^0}{y^{-3}}$

20.  $(4x)^{-2}$

21.  $(-2x)^{-4}$

22.  $\frac{1}{(3x)^{-3}}$

23.  $(5x)^0y^{-2}$

24.  $(2x)^{-2} \cdot 3y^5$

25. Sketch the graph of  $y = 3^x$ .

26. Sketch the graph of  $y = \left(\frac{1}{2}\right)^x$ .

27. **Radium Isotope** The half-life of the radium isotope  $Ra^{226}$  is about 1620 years. If there were initially 100 grams of  $Ra^{226}$ , then the number of grams remaining after  $h$  half-life periods is  $W = 100\left(\frac{1}{2}\right)^h$ . Complete the table.

Half-life period, $h$	0	1	2	3	4	5	6
Grams, $W$	?	?	?	?	?	?	?

28. **Endangered Species** Between 1980 and 1990 the population of an endangered species decreased at a rate of 0.1% per year. The population,  $P$ , in year  $t$  is given by  $P = 1200(0.999)^t$  where  $t = 0$  corresponds to 1985. Find the population of the species in 1980, 1985, 1990, and the projected population in the year 2000.

29. **Nobelium Isotope** The half-life of the Nobelium isotope  $No^{257}$  is about 23 seconds. 230 seconds (or 10 half-life periods) after the isotope was released there were 10 grams remaining. The number of grams of  $No^{257}$  after  $h$  half-life periods is  $W = 10\left(\frac{1}{2}\right)^h$  where  $h = 0$  corresponds to 230 seconds after the isotope was released. How much  $No^{257}$  was initially released?

30. **Town Population** Between 1960 and 1990, the population of a town increased at a rate of 0.34% per year. The population,  $P$ , in year  $t$  is given by  $P = 2000(1.0034)^t$  where  $t = 0$  corresponds to 1980. Find the population of the town in 1960, 1970, 1980, and 1990.

# Extra Practice

# 8.3

Name \_\_\_\_\_

In 1–12, evaluate the expression.

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

2.  $\frac{6^5}{6^7}$

3.  $\frac{18^6}{18^6}$

4.  $\frac{(-5)^9}{5^9}$

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

6.  $\frac{4^5 \cdot 4^3}{4^6}$

7.  $\frac{3^2 \cdot 3^4}{3^9}$

8.  $(\frac{2}{3})^3$

9.  $(\frac{4}{5})^2$

10.  $(-\frac{1}{2})^5$

11.  $(\frac{11}{3})^{-1}$

12.  $(\frac{3}{2})^{-2}$

In 13–24, simplify the expression.

13.  $(\frac{x}{3})^4$

14.  $\frac{x^7}{x^2}$

15.  $(\frac{2}{x})^6$

16.  $x^5 \cdot \frac{1}{x^8}$

17.  $x^{12} \cdot \frac{1}{x^3}$

18.  $\frac{2x^2y}{x^3y^2} \cdot \frac{4x^7y^2}{2x^3}$

19.  $\frac{3xy^4}{2x^5y} \cdot \frac{6x^{-3}y^2}{4y}$

20.  $\frac{-8x^6y^{-3}}{3x^{-2}y^{-5}} \cdot \frac{-6x^{-10}y}{-4x}$

21.  $\frac{4x^{-2}y^{-1}}{3x^{-3}} \cdot \frac{6x^{-3}y^{-2}}{8y^{-7}}$

22.  $\frac{(4x^2y^3)^{-1}}{3y} \cdot \frac{(2xy^2)^2}{x^{-3}}$

23.  $(\frac{2x^2y}{3y})^{-3} \cdot (\frac{4y^3}{x^4})^2$

24.  $\frac{5x^{-1}y^3}{xy^{-4}} \cdot \frac{(-2x^2)^{-3}}{y}$

25. **Personal Computers** From 1982 to 1992, the cost of manufacturing a PC has decreased by about the same percentage each year. The cost,  $C$  (in dollars), in year  $t$  can be modeled by  $C = 3000(\frac{5}{6})^t$  where  $t = 0$  corresponds to 1982. Find the ratio of the cost in 1990 to the cost in 1985.

26. **Assembly Speed** An assembly line worker increases the speed at which he can work by approximately the same percentage for the first 7 months of employment. The speed,  $s$  (in parts assembled per hour), in  $t$  months can be modeled by  $s = 10(1.01)^t$  where  $t = 0$  corresponds to the month a worker is hired. Find the ratio of the speed of a worker after 7 months of experience to the speed of a worker after 4 months of experience.

27. **Grade Point Average** From Carmen's freshman year to her senior year, her grade-point average (GPA) increased by approximately the same percentage each year. Carmen's GPA in year  $t$  can be modeled by  $\text{GPA} = 2(\frac{6}{5})^t$  where  $t = 0$  corresponds to her freshman year. Complete the table showing Carmen's GPA throughout her high school career.

Year, $t$	0	1	2	3
GPA	?	?	?	?

28. **Memory** Suppose that you memorized a list of 100 German vocabulary words. Each week you forget  $\frac{1}{8}$  of the words you knew the previous week. The number of vocabulary words,  $V$ , you remember after  $t$  weeks can be modeled by  $V = 100(\frac{7}{8})^t$ . Complete the table showing the number of words you remember each week.

Week, $t$	0	5	10	15	20	25	30
Words, $V$	?	?	?	?	?	?	?

# Extra Practice

# 8.4

Name \_\_\_\_\_

In 1–9, rewrite the scientific notation in decimal form.

- |                         |                           |                          |
|-------------------------|---------------------------|--------------------------|
| 1. $2.03 \times 10^3$   | 2. $3.4578 \times 10^4$   | 3. $6.43 \times 10^1$    |
| 4. $7.2 \times 10^5$    | 5. $5.2 \times 10^0$      | 6. $4.68 \times 10^{-2}$ |
| 7. $1.3 \times 10^{-6}$ | 8. $8.497 \times 10^{-3}$ | 9. $9.8 \times 10^{-4}$  |

In 10–18, rewrite the decimal in scientific notation.

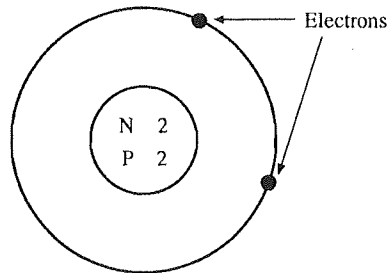
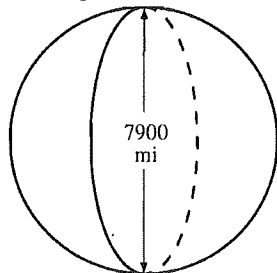
- |             |                 |               |
|-------------|-----------------|---------------|
| 10. 25,000  | 11. 36.41       | 12. 4,000,000 |
| 13. 564,200 | 14. 9.32        | 15. 0.15      |
| 16. 0.0083  | 17. 0.000000718 | 18. 0.0673    |

In 19–27, evaluate the expression without a calculator. Write the answer in scientific notation.

- |  |   |   |
|--|---|---|
| 19. $2 \times 10^3 \cdot 3 \times 10^8$    | 20. $3 \times 10^{-4} \cdot 3 \times 10^{-5}$ | 21. $2 \times 10^{-5} \cdot 3 \times 10^7$    |
| 22. $4 \times 10^{-6} \cdot 2 \times 10^5$ | 23. $3 \times 10^6 \cdot 4 \times 10^3$       | 24. $7 \times 10^{-3} \cdot 5 \times 10^{-1}$ |
| 25. $3 \times 10^5 \cdot 8 \times 10^{-2}$ | 26. $12 \times 10^3 \cdot 3 \times 10^{-6}$   | 27. $6 \times 10^{-8} \cdot 7 \times 10^6$    |

In 28–33, write the number in scientific notation.

- |  |   |
|--|---|
| 28. <b>Earth to Pluto</b> As the planets orbit the sun, the closest Pluto gets to Earth is approximately 2,700,000,000 miles.  | 29. <b>Red Blood Cells</b> The thickness of a red blood cell is approximately 0.0003125 inch.   |
| 30. <b>Human Cells</b> The body of a human has more than 1,000,000,000,000 cells.  | 31. <b>Speed of Light</b> The speed of light in a vacuum is approximately 186,000 miles per second.   |
| 32. <b>Earth's Diameter</b> The polar diameter of Earth is approximately 7,900 miles. There are approximately 161,000 cm in one mile. What is the polar diameter of Earth in cm? | 33. <b>Mass of Helium Atom</b> A proton (P) and a neutron (N) each weigh $1.67 \times 10^{-24}$ gram. An electron weighs $9.11 \times 10^{-28}$ gram. Find the mass of one helium atom. |



34. **Surface Area** The total surface area of Earth is about  $1.97 \times 10^8$  square miles. The surface area of land on Earth is about  $5.73 \times 10^7$  square miles. Find the ratio of surface area of land to that of the entire planet.

# Extra Practice

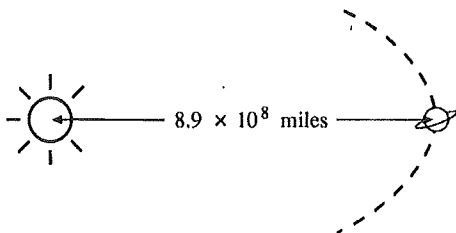
# 8.5

Name \_\_\_\_\_

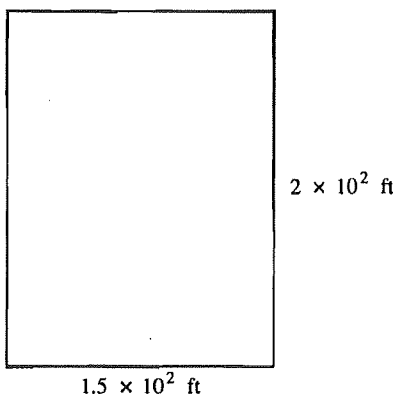
1. **Population Density** In 1990 there were approximately  $7 \times 10^6$  people living in New York City. New York City has an area of approximately  $8.31 \times 10^2$  square kilometers. What was the population density (people per square kilometers) of New York City in 1990?

3. **Typing a Novel** A typist can type 80 words per minute. How long will it take to type an 830-page novel that has an average of 100 words per page?

5. **Speed of Light** The distance between Saturn and the sun is approximately  $8.9 \times 10^8$  miles. The speed of light is approximately  $1.9 \times 10^5$  miles per second. How long does it take light to travel from the sun to Saturn?



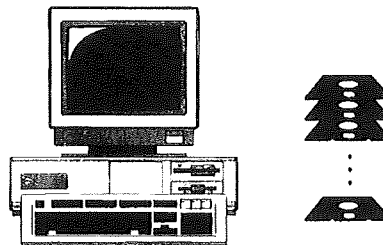
7. **Cost of Land** In 1992, the lot of land shown below cost  $\$1.1 \times 10^4$ . Find the area (in square feet) of the lot. What was the price of the land per square foot?



2. **National Debt** The population of the United States is approximately  $2.5 \times 10^8$ . The national debt is approximately  $\$1 \times 10^{12}$ . How much money would each person have to pay to eliminate the debt?

4. **Ballpark Hotdogs** There are  $3 \times 10^4$  fans in a stadium watching a game. A hotdog vendor sells  $\$3000$  worth of hotdogs at  $\$1.50$  each. What was the ratio of hotdogs sold to the number of fans?

6. **Computer Backup** A computer has a hard drive that stores approximately  $8.4 \times 10^7$  bytes. A high density  $5\frac{1}{4}$ -inch floppy disk holds approximately  $1.3 \times 10^6$  bytes. How many floppies are needed to back up the hard drive?



8. **Volume of a Virus** A certain virus is shaped like a sphere. The radius of the virus is  $9.2 \times 10^{-6}$  cm. Find the volume of the virus. (Hint: The volume of a sphere is  $V = \frac{4}{3}\pi r^3$ )

