Extra Example 4

Evaluate the expression. Write your answer in scientific notation.

a. $(5.7 \times 10^3)(2.6 \times 10^4)$ **1.482×10^8**

b. $(2.4 \times 10^{-4})^2$ **5.76×10^{-8}**

c. $\dfrac{2.4 \times 10^5}{2.5 \times 10^{-4}}$ **9.6×10^8**

Extra Example 5

The radius of a red blood cell is about 4.5×10^{-6} meters. The radius of *Mycoplasma* bacteria is about 1.25×10^{-8} meters.

a. Find the ratio of the radius of a red blood cell to the radius of *Mycoplasma* bacteria. What does the ratio tell you? **360; the radius of the red blood cell is about 360 times that of the *Mycoplasma* bacteria.**

b. Find the ratio of the volumes of the red blood cell and the *Mycoplasma* bacteria. What does the ratio tell you? **46,656,000; the volume of the red blood cell is about 46,656,000 times that of the *Mycoplasma* bacteria.**

Closing the Lesson

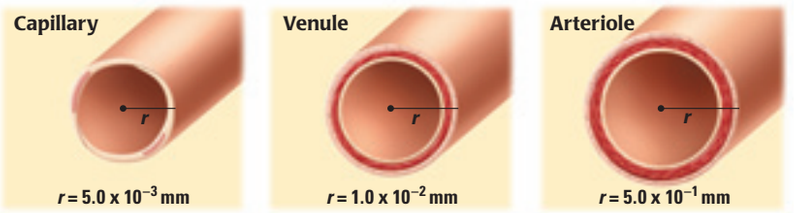
Have students summarize the major points of the lesson and answer the Essential Question: How do you write numbers in scientific notation?

- **A number written in scientific notation is in the form $c \times 10^n$, where $1 \le c < 10$.**

Write a positive number as the product of a decimal from 1 up to 10 and a power of 10. If the original number is greater than 1, the power of 10 has a positive exponent. If the number is between 0 and 1, the exponent is negative.

EXAMPLE 5 Solve a multi-step problem

BLOOD VESSELS Blood flow is partially controlled by the cross-sectional area of the blood vessel through which the blood is traveling. Three types of blood vessels are venules, capillaries, and arterioles.



a. Let r_1 be the radius of a venule, and let r_2 be the radius of a capillary. Find the ratio of r_1 to r_2. What does the ratio tell you?

b. Let A_1 be the cross-sectional area of a venule, and let A_2 be the cross-sectional area of a capillary. Find the ratio of A_1 to A_2. What does the ratio tell you?

c. What is the relationship between the ratio of the radii of the blood vessels and the ratio of their cross-sectional areas?

Solution

a. From the diagram, you can see that the radius of the venule r_1 is 1.0×10^{-2} millimeter and the radius of the capillary r_2 is 5.0×10^{-3} millimeter.

$$\frac{r_1}{r_2} = \frac{1.0 \times 10^{-2}}{5.0 \times 10^{-3}} = \frac{1.0}{5.0} \times \frac{10^{-2}}{10^{-3}} = 0.2 \times 10^1 = 2$$

The ratio tells you that the radius of the venule is twice the radius of the capillary.

ANOTHER WAY
You can also find the ratio of the cross-sectional areas by finding the areas using the values for r_1 and r_2, setting up a ratio, and then simplifying.

b. To find the cross-sectional areas, use the formula for the area of a circle.

$$\frac{A_1}{A_2} = \frac{\pi r_1^2}{\pi r_2^2}$$ Write ratio.

$$= \frac{r_1^2}{r_2^2}$$ Divide numerator and denominator by π.

$$= \left(\frac{r_1}{r_2}\right)^2$$ Power of a quotient property

$$= 2^2 = 4$$ Substitute and simplify.

The ratio tells you that the cross-sectional area of the venule is four times the cross-sectional area of the capillary.

c. The ratio of the cross-sectional areas of the blood vessels is the square of the ratio of the radii of the blood vessels.

GUIDED PRACTICE for Example 5

6. WHAT IF? *Compare* the radius and cross-sectional area of an arteriole with the radius and cross-sectional area of a capillary.

6. The cross-sectional area of the arteriole is 10^4 times larger than the cross-sectional area of the capillary.

Differentiated Instruction

Below Level Some students may need extra practice writing numbers in scientific and standard notation. Have students search the Internet for very large and very small numbers. For example, they can search for astronomical data for large numbers and cellular biology data for small numbers. Suggest that they exchange numbers with partners for more practice.

See also the *Algebra 1 Toolkit* for more strategies.

8.4 EXERCISES

HOMEWORK KEY

- ○ = **WORKED-OUT SOLUTIONS** on p. WS1 for Exs. 3, 17, and 53
- ★ = **STANDARDIZED TEST PRACTICE** Exs. 2, 15, 48, 49, 54, and 59
- ◆ = **MULTIPLE REPRESENTATIONS** Ex. 58

SKILL PRACTICE

A

1. VOCABULARY Is 0.5×10^6 written in scientific notation? *Explain* why or why not. **No; 0.5 is not a number greater than or equal to 1.0 and less than 10.**

2. ★ WRITING Is 7.89×10^6 between 0 and 1 or greater than 1? *Explain* how you know. **Greater than 1; the exponent is positive.**

EXAMPLE 1 on p. 512 for Exs. 3–15

WRITING IN SCIENTIFIC NOTATION **Write the number in scientific notation.**

3. 8.5 **8.5×10^1**
4. 0.72 **7.2×10^{-1}**
5. 82.4 **8.24×10^1**
6. 0.005 **5×10^{-3}**
7. 72,000,000 **7.2×10^7**
8. 0.00406 **4.06×10^{-3}**
9. 1,065,250 **1.06525×10^6**
10. 0.000045 **4.5×10^{-5}**
11. 1,060,000,000 **1.06×10^9**
12. 0.00000526 **5.26×10^{-6}**
13. 900,000,000,000,000 **9×10^{14}**
14. 0.00000007008 **7.008×10^{-8}**

15. ★ MULTIPLE CHOICE Which number represents 54,004,000,000 written in scientific notation? **C**

(A) 54004×10^6
(B) 54.004×10^9
(C) 5.4004×10^{10}
(D) 0.54004×10^{11}

EXAMPLE 2 on p. 512 for Exs. 16–28

WRITING IN STANDARD FORM **Write the number in standard form.**

16. 2.6×10^3 **2600**
17. 7.5×10^7 **75,000,000**
18. 1.11×10^2 **111**
19. 3.03×10^4 **30,300**
20. 4.709×10^6 **4,709,000**
21. 1.544×10^{10} **15,440,000,000**
22. 6.1×10^{-3} **0.0061**
23. 4.4×10^{-10} **0.00000000044**
24. 2.23×10^{-6} **0.00000223**
25. 8.52×10^{-8} **0.0000000852**
26. 6.4111×10^{-10} **0.00000000064111**
27. 1.2034×10^{-6} **0.0000012034**

28. ERROR ANALYSIS *Describe* and correct the error in writing 1.24×10^{-3} in standard form.

$1.24 \times 10^{-3} = 1240$ ✗

The decimal point should be moved to the left, not the right; $1.24 \times 10^{-3} = 0.00124$.

EXAMPLE 3 B on p. 513 for Exs. 29–32

ORDERING NUMBERS **Order the numbers from least to greatest.**

29. 45,000; 6.7×10^3; 12,439; 2×10^4 **6.7×10^3; 12,439; 2×10^4; 45,000**

30. 65,000,000; 6.2×10^6; 3.557×10^7; 55,004,000; 6.07×10^6

31. 0.0005; 9.8×10^{-6}; 5×10^{-3}; 0.00008; 0.04065; 8.2×10^{-3}

32. 0.0000395; 0.00010068; 2.4×10^{-5}; 5.08×10^{-6}; 0.000005
0.000005; 5.08×10^{-6}; 2.4×10^{-5}; 0.0000395; 0.00010068

COMPARING NUMBERS **Copy and complete the statement using <, >, or =.**

33. 5.6×10^3 ? 56,000 **<**
34. 404,000.1 ? 4.04001×10^5 **<**
35. 9.86×10^{-3} ? 0.00986 **=**
36. 0.003309 ? 3.309×10^{-3} **=**
37. 2.203×10^{-4} ? 0.0000203 **>**
38. 604,589,000 ? 6.04589×10^7 **>**

30. 6.07×10^6; 6.2×10^6; 3.557×10^7; 55,004,000; 65,000,000

31. 9.8×10^{-6}; 0.00008; 0.0005; 5×10^{-3}; 8.2×10^{-3}; 0.04065

Differentiated Instruction

Kinesthetic Learners In mathematics, a left-shift is associated with negative numbers, and a right-shift is associated with positive numbers. Another way to complete **Exercises 3–14** is as follows. To write 93,000,000 in scientific notation, place the decimal point to the right of 9 and count 7 places right to the last 0 to get 9.3×10^7. Similarly, place the decimal point to the right of 1 in 0.0017 and count 3 places to the left to the last 0 to get 1.7×10^{-3}.

See also the *Algebra 1 Toolkit* for more strategies.

4 PRACTICE AND APPLY

Assignment Guide

Answer Transparencies available for all exercises

Basic:
Day 1: EP p. 939 Exs. 32–37
pp. 514–518
Exs. 1–28
Day 2: pp. 514–518
Exs. 29–36, 39–41, 51–56, 61–74

Average:
Day 1: pp. 514–518
Exs. 1, 2, 6–15, 19–28, 39–44
Day 2: pp. 514–518
Exs. 29–38, 45–49, 51–59, 62–74 even

Advanced:
Day 1: pp. 514–518
Exs. 1, 2, 8–15, 21–27, 39–47
Day 2: pp. 514–518
Exs. 29–38, 48–60*, 64, 67, 68, 71

Block:
pp. 514–518
Exs. 1, 2, 6–15, 19–49, 51–59, 62–74 even

Differentiated Instruction

See *Algebra 1 Best Practices Toolkit* for suggestions on addressing the needs of a diverse classroom.

Homework Check

For a quick check of student understanding of key concepts, go over the following exercises:

Basic: 8, 20, 29, 53, 54

Average: 10, 24, 42, 51, 55

Advanced: 12, 26, 45, 52, 55

Extra Practice

- Student Edition, p. 945
- Chapter 8 Resource Book: Practice levels A, B, C, pp. 39–41

Practice Worksheet

An easily-readable reduced practice page (with answers) for this lesson can be found on p. 486C.