Real-World Link

E-mail Every day, nearly 130 billion spam E-mails are sent worldwide! Use the steps below to find out how many are sent each year. The numbers are too large even for your calculator.

1. Express 130 billion in scientific notation.

   1.3×10^{11}

2. Round 365 to the nearest hundred and express it in scientific notation.

   $400; 4 \times 10^2$

3. Write a multiplication expression using the number in Exercises 1 and 2 to represent the total number of spam E-mails sent each year.

   $(1.3 \times 10^{11})(4 \times 10^2)$

scientific notation.

400; 4×10^2

3. Write a multiplication expression using the number in Exercises 1 and 2 to represent the total number of spam E-mails sent each year.

$(1.3 \times 10^{11})(4 \times 10^2)$

4. If you use the Commutative Property of Multiplication, you can rewrite the expression in Exercise 3 as $(1.3 \times 4)(10^{11} \times 10^2)$. Evaluate this expression to find the number of spam E-mails sent in a year. Express the result in both scientific notation and standard form.

5.2×10^{13}; 52,000,000,000,000

Decimal Point

Since, 11.52×10^7 is not written in scientific notation, move the decimal point 1 place to the left and add 1 to the exponent.

$21x$

Show your work.

a. $\underline{2.1 \times 10^9}$

b. $\underline{3.156 \times 10^1}$

Example

Tutor

1. Evaluate $(7.2 \times 10^3)(1.6 \times 10^4)$. Express the result in scientific notation.

$(7.2 \times 10^3)(1.6 \times 10^4) = (7.2 \times 1.6)(10^3 \times 10^4)$ — Commutative and Associative Properties

$= (11.52)(10^3 \times 10^4)$ — Multiply 7.2 by 1.6.

$= 11.52 \times 10^{3+4}$ — Product of Powers

$= 11.52 \times 10^7$ — Add the exponents.

$= 1.152 \times 10^8$ — Write in scientific notation.

Got it? Do these problems to find out.

a. $(8.4 \times 10^2)(2.5 \times 10^6)$

b. $(2.63 \times 10^4)(1.2 \times 10^{-3})$

21×10^8

Real World Example

Tutor

2. In 2010 [icons] ut 6,860,000,000. The

5. $593{,}000 + (7.89 \times 10^6)$

$593{,}000 + (7.89 \times 10^6)$

$= (5.93 \times 10^5) + (7.89 \times 10^6)$ Rewrite 593,000 in scientific notation.

$= \mathbf{(0.593 \times 10^6)} + (7.89 \times 10^6)$ Write 5.93×10^5 as 0.593×10^6

$= (0.593 + 7.89) \times 10^6$ Distributive Property

$= 8.483 \times 10^6$ Add 0.593 and 7.89.

Show your work.

d. 1.0551×10^5

e. 1.24775×10^9

f. 3.33×10^6

Got it? Do these problems to find out.

d. $(8.41 \times 10^3) + (9.71 \times 10^4)$

e. $(1.263 \times 10^9) - (1.525 \times 10^7)$

f. $(6.3 \times 10^5) + 2{,}700{,}000$

Guided Practice

Check ✓

Evaluate each expression. Express the result in scientific notation. (Examples 1 and 2)

1. $(2.6 \times 10^5)(1.9 \times 10^2) = 4.94 \times 10^7$

1×10^5

Evaluate each expression. Express the result in scientific notation. (Examples 1 and 2)

1. $(2.6 \times 10^5)(1.9 \times 10^2) =$ **4.94 × 10⁷**

Show your work.

4.94×10^7

2. $\dfrac{8.37 \times 10^8}{2.7 \times 10^3} =$ **3.1 × 10⁵** 3.1×10^5

3. In 2005, 8.1×10^{10} text messages were sent in the United States. In 2010, the number of annual text messages had risen to 1,810,000,000,000. About how many times as great was the number of text messages in 2010 than 2005?

(Example 2)

20

Evaluate each expression. Express the result in scientific notation. (Examples 3–5)

4. $(8.9 \times 10^9) + (4.2 \times 10^6) =$ **8.9042 × 10⁹**

5. $(9.64 \times 10^8) - (5.29 \times 10^6) =$ **9.5871 × 10⁸**

$964. \times 10^6$

$9 \& 4$

6. $(1.35 \times 10^6) - (117,000) =$ **1.233 × 10⁶**

7. $5,400 + (6.8 \times 10^5) =$ **6.854 × 10⁵**

Rate Yourself!

Are you ready to move on? Shade the section that applies.

8. Building on the Essential Question

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7. $5,400 + (6.8 \times 10^5) =$ __6.854×10^5__

8. **@ Building on the Essential Question** How does scientific notation make it easier to perform computations with very large or very small numbers? __Sample answer:__
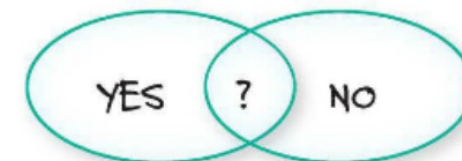
Computing with scientific notation is easier because

you can work with more compact numbers and use

properties of math with powers of 10.

(handwritten note): $964. \times 10^6$

Rate Yourself!

Are you ready to move on?
Shade the section that applies.

YES ? NO

For more help, go online to access a Personal Tutor.

Tutor

Independent Practice

Go online for Step-by-Step Solutions

eH

Evaluate each expression. Express the result in scientific notation. (Examples 1 and 2)

1. $(3.9 \times 10^2)(2.3 \times 10^6) =$ **8.97×10^8**

Show your work.

2. $(4.18 \times 10^{-4})(9 \times 10^{-4}) =$ **3.762×10^{-7}**

37.62×10^{-8}

37.62
$= 3.762 \times 10$

3. $(9.75 \times 10^3)(8.4 \times 10^{-6}) =$ **8.19×10^{-2}**

81.9×10^{-3}

4. $\dfrac{9.45 \times 10^{10}}{1.5 \times 10^6} =$ **6.3×10^4**

$6 + 6 = 12$

5. $\dfrac{1.14 \times 10^6}{4.8 \times 10^{-6}} =$ **2.375×10^{11}**

$6 - (-6)$

$.2375 \times 10^{12}$

$.3375 \times 10^{12}$

6. $\dfrac{9 \times 10^{-11}}{2.4 \times 10^8} =$ **3.75×10^{-19}**

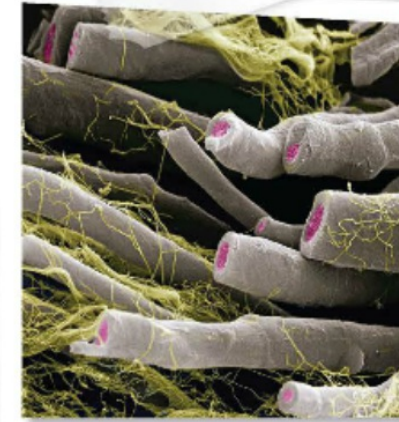10^{-1}
$1/1$

$.2375$
$= 2.375 \times 1$

7. **STEM** Neurons are cells ... ess

7. **STEM** Neurons are cells in the nervous system that process and transmit information. An average neuron is about 5×10^{-6} meter in diameter. A standard table tennis ball is 0.04 meter in diameter. About how many times as great is the diameter of a ball than a neuron? (Example 2)

8,000 times

Evaluate each expression. Express the result in scientific notation.
(Examples 3–5)

8. $(9.5 \times 10^{11}) + (6.3 \times 10^9) =$ **9.563×10^{11}**

9. $(1.03 \times 10^9) - (4.7 \times 10^7) =$ **9.83×10^8**

$$103 \times 10^7 - 4.7 \times 10^7$$
$$98.3 \times 10^7$$

13570×10^5

10. $(1.357 \times 10^9) + 590{,}000 =$ **1.35759×10^9**

5.9×10^5

11. $87{,}100 - (6.34 \times 10^1) =$ **8.70366×10^4**

12. **MP Persevere with Problems** Central Park in New York City is rectangular in shape and measures approximately 1.37×10^4 feet by 2.64×10^2 feet. If one acre is equal to 4.356×10^4 square feet, how many acres does Central Park cover? Round to the nearest hundredth.

about 83.03 acres

🔥 H.O.T. Problems   Higher Order Thinking

13. **MP Find the Error** Enrique is finding $\dfrac{6.63 \times 10^{-6}}{5.1 \times 10^{-2}}$. Circle his mistake and correct it.

$$\frac{6.63 \times 10^{-6}}{5.1 \times 10^{-2}} = \left(\frac{6.63}{5.1}\right)\left(\frac{10^{-6}}{10^{-2}}\right)$$

$$= 1.3 \times 10^{-6-(-2)}$$

$$= 1.3 \times 10^{-4}$$

$$\frac{6.63 \times 10^{-6}}{5.1 \times 10^{-2}} = \left(\frac{6.63}{5.1}\right)\left(\frac{10^{-6}}{10^{-2}}\right)$$

$$= 1.3 \times 10^{-6-2}$$

$$= 1.3 \times 10^{-8}$$

14. (MP) **Which One Doesn't Belong?** Identify the expression that does not belong with the other three. Explain your reasoning.

14.28×10^7	$(3.4 \times 10^6)(4.2 \times 10^3)$	1.4×10^7	$(3.4)(4.2) \times 10^{(6+3)}$

1.4×10^9; **Sample answer: All of the other expressions are equivalent.**

15. (MP) **Persevere with Problems** A *googol* is the number 1 followed by 100 zeros.

a. What is one googol written in scientific notation? 1×10^{100}

b. How many times greater is a googol of meters than a nanometer? 10^{109} **times**

c. There are about 2.5×10^{10} red blood cells in the average adult. About how many adults would it take to have a total of 1 googol red blood cells? **about 4×10^{89} adults**

16. (MP) **Model with Mathematics** Write an addition expression and a subtraction expression, each with a value of 2.4×10^{-3}.

Sample answers: $(2.15 \times 10^{-3}) + (2.5 \times 10^{-4})$; $(2.56 \times 10^{-3}) - (1.6 \times 10^{-4})$