Scientific Notation: Guided Notes

1. What pattern do you notice in the table?

2. How can you tell how many zeros are in a number based on the power of 10?

How wide is our universe?

This number is written in _____. When numbers get large, it is easier to write them in _____.

Scientific Notation

Definition: A number is expressed in scientific notation when it is in the form_____ where _____ is between 1 and 10 and _____ is an integer.

Write the width of the universe in scientific notation:

210,000,000,000,000,000,000,000 miles

Where is the decimal point now?

Where would you put the decimal to make this number be between 1 and 10?

How many decimal places did you move the decimal?

When the original number is more than 1, the exponent is _____.

The answer in scientific notation is_____.

Example 1:

Write 28750.9 in scientific notation.

Are these numbers in scientific notation?

1) 42.6×10^{8}

2) 0.96×10^{-2}

3) 4.6×10^{5}

Write these numbers in scientific notation:

- 4) 62,400
- 5) 0.00085
- 6) 1,602,000

Write these numbers in standard notation:

7) 6.72×10^{-5}

8) 5.63×10^{4}

9) 1.2×10^{-3}

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Scientific Notation and Standard Notation

Convert the following numbers into scientific notation:

1) -0.0265

2) 53000

3) - 3400

4) 101000

5) - 45.01

6) 0.00671

7) 392

8) - 0.00361

9) 0.000023

10) - 0.010

11) 1000000

12) - 4.50

Convert the following numbers into standard notation:

1) 1.92×10^{3}

2) 3.51×10^{-7}

3) 2.30×10^{4}

4) 1.901×10^{-2}

5) 9.11×10^{3}

6) 1.76×10^{0}

7) -4.29×10^{5}

8) -2.23×10^{-4}

9) 1.76×10^{-3}

10) 8.65×10^{-1}

11) 5.40×10^{7}

12) 7.4×10^{-5}

Section G: Addition The first step is to make sure the exponents are the same. We do this by changing the main number (making it bigger or smaller) so that the exponent can change (get bigger or smaller). Then we can add the main numbers and keep the exponents the same.

Model: $(3 \times 10^4) + (2 \times 10^3) = (3 \times 10^4) + (0.2 \times 10^4)$
$= 3.2 \times 10^4$ (*same exponent*)
$= 32{,}000$ (*final answer*)

First express the problem with the exponents in the same form, then solve the problem.

same exponent final answer

33) $(4 \times 10^3) + (3 \times 10^2) =$ _____

34) $(9 \times 10^2) + (1 \times 10^4) =$ _____

35) $(8 \times 10^6) + (3.2 \times 10^7) =$ _____

36) $(1.32 \times 10^{-3}) + (3.44 \times 10^{-4}) =$ _____

Section H: Subtraction Just like addition, the first step is to make the exponents the same. Instead of adding the main numbers, they are subtracted. Try to convert so that you will not get a negative answer.

Model: $(3 \times 10^4) - (2 \times 10^3) = (30 \times 10^3) - (2 \times 10^3)$
$= 28 \times 10^3$ (*same exponent*)
$= 2.8 \times 10^4$ (*final answer*)

same exponent final answer

37) $(2 \times 10^2) - (4 \times 10^1) =$ _____ _____

38) $(3 \times 10^{-6}) - (5 \times 10^{-7}) =$ _____ _____

39) $(9 \times 10^{12}) - (8.1 \times 10^9) =$ _____ _____

40) $(2.2 \times 10^{-4}) - (3 \times 10^2) =$ _____ _____

Check Your Understanding

Examples 1 and 2 (p. 306)

Evaluate each expression. Express the result in scientific notation.

1. $(2.6 \times 10^5)(1.9 \times 10^2)$
2. $(5.3 \times 10^4)(0.9 \times 10^3)$
3. $(3.7 \times 10^{-2})(1.2 \times 10^3)$
4. $(3.3 \times 10^3)(2.1 \times 10^{-5})$
5. $\frac{8.37 \times 10^8}{2.7 \times 10^3}$
6. $\frac{8.04 \times 10^5}{6.7 \times 10^2}$
7. $\frac{9.72 \times 10^{-9}}{1.8 \times 10^5}$
8. $\frac{4.64 \times 10^{-4}}{2.9 \times 10^{-6}}$

Example 3 (p. 307)

9. **TEXT MESSAGING** In 2005, 8.1×10^{10} text messages were sent in the United States. By 2007, the number of annual text messages had risen to 3.63×10^{11}. About how many times as great was the number of text messages in 2007 than 2005?

Examples 4 and 5 (p. 307)

Evaluate each expression. Express the result in scientific notation.

10. $(5.4 \times 10^3) + (6.8 \times 10^5)$
11. $(8.9 \times 10^9) + (4.2 \times 10^6)$
12. $(13.5 \times 10^5) - (11.7 \times 10^4)$
13. $(9.64 \times 10^8) - (5.29 \times 10^6)$

Practice and Problem Solving

= **Step-by-Step Solutions** begin on page R1.
Extra Practice begins on page EP2.

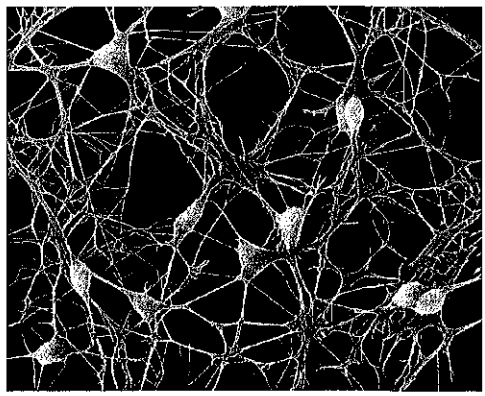
Examples 1 and 2 (p. 306)

Evaluate each expression. Express the result in scientific notation.

14. $(8.5 \times 10^3)(1.1 \times 10^1)$
15. $(3.9 \times 10^2)(2.3 \times 10^6)$
16. $(6.45 \times 10^5)(1.2 \times 10^3)$
17. $(4.18 \times 10^{-4})(0.9 \times 10^{-5})$
18. $(12.6 \times 10^{-8})(0.5 \times 10^6)$
19. $(9.75 \times 10^3)(8.4 \times 10^{-6})$
20. $\frac{8.32 \times 10^7}{1.3 \times 10^5}$
21. $\frac{9.45 \times 10^{10}}{1.5 \times 10^6}$
22. $\frac{4.2 \times 10^8}{1.68 \times 10^2}$
23. $\frac{9.0 \times 10^{-11}}{2.4 \times 10^8}$
24. $\frac{3.24 \times 10^{-4}}{8.1 \times 10^{-7}}$
25. $\frac{11.4 \times 10^5}{4.8 \times 10^{-3}}$

Example 3 (p. 307)

26. **SCIENCE** Neurons are cells in the nervous system that process and transmit information. An average neuron is about 5.0×10^{-6} meter in diameter. A standard table tennis ball is 4.0×10^{-2} meter in diameter. About how many times as great is the diameter of a ball than a neuron?



27. **ASTRONOMY** The Sun burns about 4.4×10^6 tons of hydrogen per second. How much hydrogen does the Sun burn in one year? (*Hint:* one year = 3.16×10^7 seconds)

Examples 4 and 5 (p. 307)

Evaluate each expression. Express the result in scientific notation.

28. $(7.3 \times 10^5) + (2.4 \times 10^6)$

29. $(9.5 \times 10^{11}) + (6.3 \times 10^9)$

30. $(13.57 \times 10^8) + (5.9 \times 10^5)$

31. $(8.64 \times 10^6) + (13.34 \times 10^9)$

32. $(12.1 \times 10^4) - (9.5 \times 10^3)$

33. $(1.03 \times 10^9) - (4.7 \times 10^7)$

34. $(15.4 \times 10^{11}) - (6.94 \times 10^{10})$

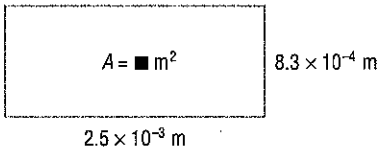
35. $(8.71 \times 10^4) - (6.34 \times 10^1)$

36. MEASUREMENT A circular swimming pool holds 1.22×10^6 cubic inches of water. It is being filled at a rate of 1.5×10^3 cubic inches per minute. About how long will it take to fill the swimming pool?

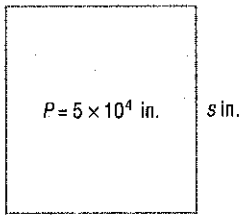
37. PARKS Central Park in New York City is rectangular in shape and measures approximately 1.37×10^4 feet by 2.64×10^2 feet. If one acre is equal to 4.356×10^4 square feet, how many acres does Central Park cover?

MEASUREMENT **Find the missing measure for each figure.**

38.



39.



H.O.T. Problems

40. FIND THE ERROR Enrique is finding $\frac{6.63 \times 10^{-6}}{5.1 \times 10^{-2}}$. Find his mistake and correct it.

$$\frac{6.63 \times 10^{-6}}{5.1 \times 10^{-2}} = \left(\frac{6.63}{5.1}\right)\left(\frac{10^{-6}}{10^{-2}}\right)$$
$$= 1.3 \times 10^{-6-2}$$
$$= 1.3 \times 10^{-8}$$

41. Which One Doesn't Belong? Identify the expression that does not belong with the other three. Explain your reasoning.

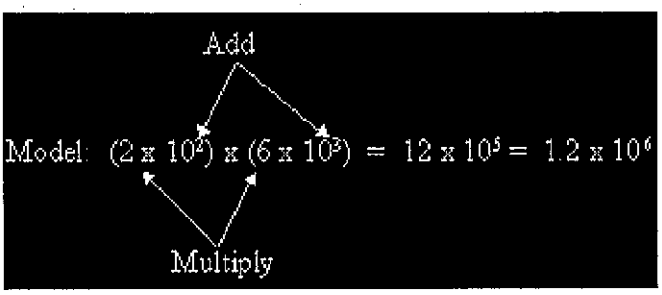
14.28×10^9	$(3.4 \times 10^6)(4.2 \times 10^3)$	1.4×10^9	$(3.4)(4.2) \times 10^{(6+3)}$

42. Write MATH Explain how to estimate the sum of (4.215×10^{-2}) and (3.2×10^{-4}).

More Practice With Scientific Notation

Perform the following operations in scientific notation. Refer to the introduction if you need help.

Section E: Multiplication (the "easy" operation - remember that you just need to multiply the main numbers and add the exponents).

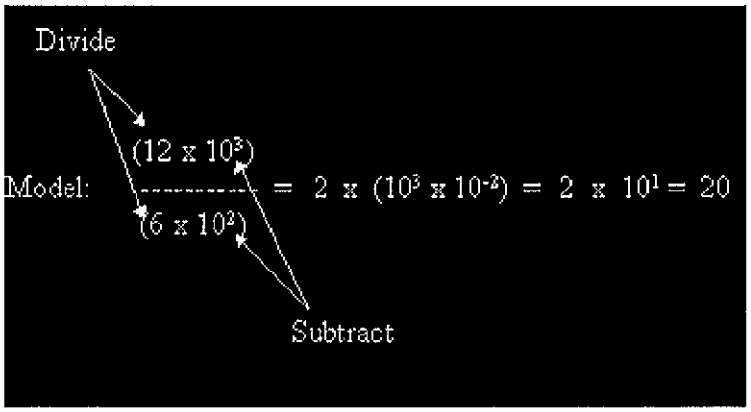


Model: $(2 \times 10^2) \times (6 \times 10^3) = 12 \times 10^5 = 1.2 \times 10^6$

Remember that your answer should be expressed in two parts, as in the model above. The first part should be a number less than 10 (eg: 1.2) and the second part should be a power of 10 (eg: 10^6). If the first part is a number greater than ten, you will have to convert the first part. In the above example, you would convert your first answer (12×10^5) to the second answer, which has the first part less than ten (1.2×10^6). For extra practice, convert your answer to decimal notation. In the above example, the decimal answer would be 1,200,000

	scientific notation	decimal notation
25) $(1 \times 10^3) \times (3 \times 10^1) =$	_____	_____
26) $(3 \times 10^4) \times (2 \times 10^3) =$	_____	_____
27) $(5 \times 10^{-5}) \times (11 \times 10^4) =$	_____	_____
28) $(2 \times 10^{-4}) \times (4 \times 10^3) =$	_____	_____

Section F: Division (a little harder - we basically solve the problem as we did above, using multiplication. But we need to "move" the bottom (denominator) to the top of the fraction. We do this by writing the negative value of the exponent. Next divide the first part of each number. Finally, add the exponents).



$$\text{Model: } \frac{(12 \times 10^3)}{(6 \times 10^2)} = 2 \times (10^3 \times 10^{-2}) = 2 \times 10^1 = 20$$

Write your answer as in the model; first convert to a multiplication problem, then solve the problem.

	multiplication problem	final answer (in sci. not.)
29) $(8 \times 10^6) / (4 \times 10^3) =$	_____	_____
30) $(3.6 \times 10^8) / (1.2 \times 10^4) =$	_____	_____
31) $(4 \times 10^3) / (8 \times 10^5) =$	_____	_____
32) $(9 \times 10^{21}) / (3 \times 10^{19}) =$	_____	_____

MATH HANDBOOK TRANSPARENCY WORKSHEET 2

Operations with Scientific Notation

Use with Appendix B, Operations with Scientific Notation

1. Perform the following operations and express the answers in scientific notation.

a. $(1.2 \times 10^5) + (5.35 \times 10^6)$

b. $(6.91 \times 10^{-2}) + (2.4 \times 10^{-3})$

c. $(9.70 \times 10^6) + (8.3 \times 10^5)$

d. $(3.67 \times 10^2) - (1.6 \times 10^1)$

e. $(8.41 \times 10^{-5}) - (7.9 \times 10^{-6})$

f. $(1.33 \times 10^5) - (4.9 \times 10^4)$

2. Perform the following operations and express the answers in scientific notation.

a. $(4.3 \times 10^8) \times (2.0 \times 10^6)$

b. $(6.0 \times 10^3) \times (1.5 \times 10^{-2})$

c. $(1.5 \times 10^{-2}) \times (8.0 \times 10^{-1})$

d. $\dfrac{7.8 \times 10^3}{1.2 \times 10^4}$

e. $\dfrac{8.1 \times 10^{-2}}{9.0 \times 10^2}$

f. $\dfrac{6.48 \times 10^5}{(2.4 \times 10^4)(1.8 \times 10^{-2})}$

Name_____ Period_____ Date:_____

Operations with Scientific Notation

Add or Subtract the following numbers that are in scientific notation. Make sure your final answer is in proper scientific notation.

1) $5 \times 10^{3} + 4.3 \times 10^{4} =$

2) $2.3 \times 10^{-4} - 6 \times 10^{-5} =$

3) $4 \times 10^{5} + 3.3 \times 10^{6} =$

4) $7.2 \times 10^{-2} + 5.3 \times 10^{-1}$

5) $9.2 \times 10^{10} - 8.4 \times 10^{11}$

Multiply or Divide the following numbers that are in scientific notation. Make sure your final answer is in proper scientific notation.

1) $(3.5 \times 10^{5}) \times (4 \times 10^{3}) =$

2) $(9 \times 10^{4}) / (3 \times 10^{2}) =$

3) $(5 \times 10^{6}) \times (7 \times 10^{8}) =$

4) $(7.5 \times 10^{5}) / (2.5 \times 10^{3}) =$

5) $(4.5 \times 10^{3}) / (2 \times 10^{6}) =$

Scientific Notation Word Problems

Complete all problems. Show all work.

1) In 2000, the top attendance at an amusement park in the United States was 15,400,000 people. Write the number of people in scientific notation.

2) The planet Mercury is an estimated 3.598×10^7 miles from the Sun. Write the distance Mercury is from the Sun in Standard form.

3) In 2000, an estimated 7.7×10^7 people spoke French as their first language and an estimated 1×10^8 people spoke standard German as their first language. In 2000, which language had more speakers?

4) In 2000, and estimated 1.664×10^8 dollars in 1000-dollar bills were in circulation. How many 1000-dollar bills were in circulation in 2000?

5) During its orbit around the Sun, Mercury gets as close as 4.8×10^7 miles from Earth and as far as 1.38×10^8 miles from Earth. What is the product between these distances?

6) Divide 2.4×10^8 by 1.2×10^5 .Write your answer in scientific notation.

Name_____Date_____Period____

Recognizing Scientific Notation Is each number written in scientific notation?

1. 56.29×10^{12} 2. 0.84×10^{-3} 3. 6.11×10^{5}

4. In Scientific notation, you use positive exponents to write numbers

_____ and negative exponents to write numbers _____.

Writing Numbers in Scientific Notation

6. 56,900,000

7. 0.0985

8. 267,000

9. 0.0000000009

Writing numbers in Standard Notation

10. 1.55×10^{6}

11. 2×10^{-11}

12. 5.07×10^{4}

13. 5.6×10^{-4}

Using Scientific Notation to order Numbers

14. 0.052×10^{7} 5.12×10^{5} 5.32×10^{3} 5.34×10^{3} – Order from least to greatest

15. 60.2×10^{-5} 63×10^{4} 0.067×10 61×10^{-2} - Order from greatest to least

Adding and Subtracting Values in Scientific Notation

16. $(1.34\text{x}10^{14})+ (1.3\text{x}10^{12})=$

17. $(9.7821 \text{ x } 10^{-17}) + (3.14 \text{ x } 10^{-18}) =$

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18. $(4.2x10^3) - (1.34x10^2) =$

19. $(5.23x10^{25}) - (6.32x10^{22}) + (1.34x10^{24}) =$

Multiplying and Dividing Values in Scientific Notation

20. $(7 \times 10^{2})(4 \times 10^{5})$

21. $(3.2 \times 10^{-3})(1.3 \times 10^{5})$

22. $\frac{9.3 \times 10^4}{3.1 \times 10^{-2}}$

23. $\frac{1.2 \times 10^{-2}}{4.1 \times 10^4}$

Problem Solving using Values in Scientific Notation

24. In 2005, the population was about 2.87×10^8. Spending for health care was about $5745 per person. About how much did the US spend on health care in 2005? Express your answer in scientific notation

25. A computer can perform 4.66×10^8 instructions per second. How many instructions is that per hour? Use scientific notation.

26. If you were writing a report about the national debt in Mr. Eyre's class, would you use scientific notation or standard notation to express the debt amount? Explain why.

Name_____ Date_____ Period____

27. The world population in 2025 may reach 7.84×10^9. This is about 3 times the world population in 1950. What was the world population in 1950?

28. Simplify $90(1.2 \times 10^{-5})$. Write the answer in scientific notation.
A. 1.08×10^{-7} B. 108.0×10^{-5} C. 108.0×10^{-3} D. 1.08×10^{-3}

29. Which answer has the states in the table at the right ordered from least to greatest projected population?
F. New York, Florida, Virginia, Vermont
G. Vermont, Virginia, New York, Florida
H. Vermont, Virginia, Florida, New York
I. Florida, New York, Virginia, Vermont

Projected Population in 2025

State	Population
Florida	2.07×10^7
Virginia	8.47×10^6
Vermont	6.78×10^5
New York	1.98×10^7

30. Which equals 275 million?
A. 275×10^5 B. 2.75×10^6
C. 2.75×10^8 D. 275×10^9