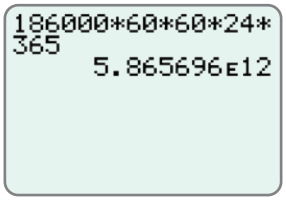
Solution

60 seconds = 1 minute
60 minutes = 1 hour
24 hours = 1 day
365 days = 1 year

Multiplication gives the following display on your calculator.



Thus, a light-year is 5.865696×10^{12}, or 5,865,696,000,000 miles (5 trillion, 865 billion, 696 million miles).

Now work margin exercise 5.

Margin Exercise Answers

1. a. 6.39×10^{7} **b.** 2.45×10^{-6} **2. a.** 1.8×10^{-5} **b.** 1.2×10^{8} **3.** 4.816×10^{24} particles
4. a. 7E4 **b.** 6E12 **5.** 2.592E13 meters

4.2 Exercises

Concept Check

Fill-in-the-Blank. Complete the sentences using information found in this section.

1. In scientific notation, decimal numbers are written as a product of a number greater than or equal to _____ and less than _____, and an integer power of 10.

2. In scientific notation, there is/are _____ digit(s) to the left of the decimal point.

3. The exponent of a number written in scientific notation tells how many places the _____ _____ is to be moved and in what direction.

True/False. Determine whether each statement is true or false. If a statement is false, explain how it can be changed so the statement will be true. (**Note:** There may be more than one acceptable change.)

4. The exponent in the number 1.4×10^{4} indicates that the decimal point should be moved 4 places to the right.

5. The exponent in the number 2.5×10^{-3} indicates that the decimal point should be moved 3 places to the right.

6. The number 3.53×10^{5} is less than 8.72×10^{-4}.

7. The number 4000 written in scientific notation is 0.4×10^{4}.

Practice

Write the following numbers in scientific notation. See Example 1.

1. 86,000

2. 927,000

3. 0.0362

4. 0.0061

5. 18,300,000

6. 376,000,000

7. 0.0000000002368

8. 1,030,000,000

9. 0.0000009

10. 0.0000000571

11. 0.0000000000328

12. 845,300,000

Write the following numbers in decimal form.

13. 4.2×10^{-2}

14. 8.35×10^{-3}

15. 7.56×10^{6}

16. 1.002×10^{-7}

17. 6.132×10^{-5}

18. 8.515×10^{8}

19. 3.067×10^{10}

20. 9.374×10^{7}

21. 7.205×10^{9}

22. 4×10^{11}

23. 6.91×10^{-6}

24. 7.408×10^{-9}

First write each of the numbers in scientific notation. Then perform the indicated operations and leave your answer in scientific notation.

25. $300 \cdot 0.00015$

26. $0.000024 \cdot 40{,}000$

27. $0.0003 \cdot 0.0000025$

28. $0.00005 \cdot 0.00013$

29. $23{,}400{,}000{,}000 \cdot 5{,}500{,}000{,}000$

30. $7{,}800{,}000{,}000 \cdot 0.00000081$

31. $\dfrac{3900}{0.003}$

32. $\dfrac{4800}{12{,}000}$

33. $\dfrac{125}{50{,}000}$

34. $\dfrac{0.0046}{230}$

35. $\dfrac{0.0000000000013}{0.000000026}$

36. $\dfrac{0.02\cdot3900}{0.013}$

37. $\dfrac{0.0084\cdot0.003}{0.21\cdot60}$

38. $\dfrac{0.005\cdot650\cdot3.3}{0.0011\cdot2500}$

39. $\dfrac{5.4\cdot0.003\cdot50}{15\cdot0.0027\cdot200}$

40. $\dfrac{0.00000000039\cdot15{,}000{,}000{,}000}{8{,}000{,}000\cdot0.0000000013}$

41. $\dfrac{\left(1.4\times10^{-2}\right)(922)}{\left(3.5\times10^{3}\right)\left(2.0\times10^{6}\right)}$

42. $\dfrac{(4300)\left(3.0\times10^{2}\right)}{\left(1.5\times10^{-3}\right)\left(860\times10^{-2}\right)}$

43. $\dfrac{(25)\left(3.75\times10^{-5}\right)}{\left(0.4\times10^{11}\right)\left(75\times10^{-7}\right)}$

44. $\dfrac{(1.1\times10^{4})(342\times10)}{(17.1\times10^{-11})(5.5\times10^{-14})}$

45. $\dfrac{\left(1.4\times10^{-7}\right)\left(7\times10^{13}\right)}{40}$

46. $\dfrac{\left(1.16\times10^{8}\right)\left(7.2\times10^{12}\right)}{\left(58\times10^{13}\right)\left(2.4\times10^{-15}\right)}$

47. $\dfrac{\left(1.95\times10^{-5}\right)(2650)\left(7.56\times10^{10}\right)}{\left(15\times10^{6}\right)\left(1.3\times10^{-13}\right)}$

48. $\dfrac{(88)\left(1.048\times10^{-5}\right)}{\left(3.2\times10^{7}\right)\left(13.75\times10^{4}\right)(2\times10)}$

Applications

Solve.

49. The mass of a hydrogen atom is approximately 0.00000000000000000000000167 grams. Write this number in scientific notation.

50. The circumference of the earth is approximately 1,580,000,000 inches. Express this circumference in scientific notation.

51. There are approximately 6×10^{13} cells in an adult human body. Express this number in decimal form.

52. The world population is approximately 7.5×10^{9} people. Write this number in decimal form.

53. Earth has a mass of about 5,980,000,000,000,000,000,000,000,000 grams. Write this number in scientific notation.

54. One year is approximately 31,500,000 seconds. Express this time in scientific notation.

55. One light-year is approximately 9.46×10^{15} meters. The distance to a certain star is 4.3 light-years. How many meters is this?

56. Light travels approximately 3×10^{10} centimeters per second. How many centimeters would this be per minute? Per hour? Express your answers in scientific notation.

57. The mass of an atom of gold is approximately 3.25×10^{-22} grams. What would be the mass of 2000 atoms of gold? Express your answer in scientific notation.

58. An ounce of gold contains 5×10^{22} atoms. All the gold ever taken out of the earth is estimated to be 3.0×10^{31} atoms. How many ounces of gold is this?

59. A scientist calculated that her experiment consumed 520,000 joules (J) of energy. She wrote the value as 52×10^{4} J on a report of the experiment. Did she write the value correctly in scientific notation? If not, what should it be?

60. A molecule of table salt weighs approximately 9.704×10^{-23} grams. What would be the weight of 4,000,000 molecules of table salt?

a. Write 4,000,000 in scientific notation.

b. Write an expression to find the weight of 4,000,000 molecules of table salt.

c. Simplify the expression from Part **b.**

d. What does the answer from Part **c.** mean? Write a complete sentence.

Use your calculator (set in scientific notation mode) to evaluate each expression. Leave the answer in scientific notation. See Example 4.

61. $90,000 \div 0.0003$

62. $0.0081 \div 9000$

63. $400 \times 175,000 + 5000 \times 3000$

64. $7000 \times 6000 + 200 \times 450,000$

65. $9.12 \times 10^{13} \div 3.04 \times 10^{-9}$

66. $1.989 \times 10^{-6} \div 6.12 \times 10^{5}$

67. $\left(4 \times 10^{6}\right)\left(1.75 \times 10^{7}\right) + \left(5.1 \times 10^{8}\right)\left(3.01 \times 10^{6}\right)$

68. $\left(2.37 \times 10^{-7}\right)\left(4 \times 10^{-9}\right) + \left(1.45 \times 10^{-8}\right)\left(5 \times 10^{-8}\right)$

69. $\dfrac{5.6 \cdot 0.003 \cdot 5000}{15 \cdot 0.0028 \cdot 20}$

70. $\dfrac{0.0006 \cdot 660 \cdot 40.4}{0.00011 \cdot 3600}$

71. $\dfrac{\left(5.6 \times 10^{7}\right)\left(3 \times 10^{13}\right)\left(5.1 \times 10^{-11}\right)}{\left(1.5 \times 10^{-10}\right)\left(2.8 \times 10^{-8}\right)\left(2 \times 10^{6}\right)}$

72. $\dfrac{\left(6 \times 10^{11}\right)\left(6.6 \times 10^{-6}\right)\left(4.04 \times 10^{7}\right)}{\left(11 \times 10^{-6}\right)\left(3.6 \times 10^{6}\right)}$