# Prealgebra Textbook

Second Edition

## Chapter 5 Odd Solutions

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# Contents

*Chapter* $5$

# Decimals

## 5.1 Introduction to Decimals

**1.** The tenths column is the first column after the decimal point, so the correct digit is 0.

**3.** The tenths column is the first column after the decimal point, so the correct digit is 2.

**5.** The ten-thousandths column is the fourth column after the decimal point, so the correct digit is 7.

**7.** The hundredths column is the second column after the decimal point, so the correct digit is 4.

**9.** The hundredths column is the second column after the decimal point, so the correct digit is 1.

**11.** The tenths column is the first column after the decimal point, so the correct digit is 3.

**13.** In expanded form,

$$46.139 = 40 + 6 + \frac{1}{10} + \frac{3}{100} + \frac{9}{1000}$$

**15.** In expanded form,

$$643.19 = 600 + 40 + 3 + \frac{1}{10} + \frac{9}{100}$$

**17.** In expanded form,

$$14.829 = 10 + 4 + \frac{8}{10} + \frac{2}{100} + \frac{9}{1000}$$

**19.** In expanded form,

$$658.71 = 600 + 50 + 8 + \frac{7}{10} + \frac{1}{100}$$

**21.** First we expand 32.187, then we sum whole number and fractional parts over a common denominator.

$$\begin{aligned} 32.187 &= 30 + 2 + \frac{1}{10} + \frac{8}{100} + \frac{7}{1000} \\ &= 32 + \frac{1 \cdot 100}{10 \cdot 100} + \frac{8 \cdot 10}{100 \cdot 10} + \frac{7}{1000} \\ &= 32 + \frac{100}{1000} + \frac{80}{1000} + \frac{7}{1000} \\ &= 32 + \frac{187}{1000} \end{aligned}$$

**23.** First we expand 36.754, then we sum whole number and fractional parts over a common denominator.

$$\begin{aligned} 36.754 &= 30 + 6 + \frac{7}{10} + \frac{5}{100} + \frac{4}{1000} \\ &= 36 + \frac{7 \cdot 100}{10 \cdot 100} + \frac{5 \cdot 10}{100 \cdot 10} + \frac{4}{1000} \\ &= 36 + \frac{700}{1000} + \frac{50}{1000} + \frac{4}{1000} \\ &= 36 + \frac{754}{1000} \end{aligned}$$

**25.** First we expand 596.71, then we sum whole number and fractional parts over a common denominator.

$$\begin{aligned} 596.71 &= 500 + 90 + 6 + \frac{7}{10} + \frac{1}{100} \\ &= 596 + \frac{7 \cdot 10}{10 \cdot 10} + \frac{7}{100} \\ &= 596 + \frac{70}{100} + \frac{1}{100} \\ &= 596 + \frac{71}{100} \end{aligned}$$

**27.** First we expand 527.49, then we sum whole number and fractional parts over a common denominator.

$$\begin{aligned} 527.49 &= 500 + 20 + 7 + \frac{4}{10} + \frac{9}{100} \\ &= 527 + \frac{4 \cdot 10}{10 \cdot 10} + \frac{4}{100} \\ &= 527 + \frac{40}{100} + \frac{9}{100} \\ &= 527 + \frac{49}{100} \end{aligned}$$

**29.** In the number 0.9837, the last digit occurs in the ten-thousandths place. There is no whole number part, so we'll omit pronunciation of the whole number part and the word "and." Pronounce the fractional part as if it were a whole number and end with the word "ten-thousandths." Thus, we pronounce 0.9837 as "nine thousand eight hundred thirty-seven ten-thousandths."

**31.** In the number 0.2653, the last digit occurs in the ten-thousandths place. There is no whole number part, so we'll omit pronunciation of the whole number part and the word "and." Pronounce the fractional part as if it were a whole number and end with the word "ten-thousandths." Thus, we pronounce 0.2653 as "two thousand six hundred fifty-three ten-thousandths."

**33.** In the number 925.47, the last digit occurs in the hundredths place. Pronounce the whole number part, then say "and" for the decimal point. Pronounce the fractional part as if it were a whole number and end with the word "hundredths." Thus, we pronounce 925.47 as "nine hundred twenty-five and forty-seven hundredths."

**35.** In the number 83.427, the last digit occurs in the thousandths place. Pronounce the whole number part, then say "and" for the decimal point. Pronounce the fractional part as if it were a whole number and end with the word "thousandths." Thus, we pronounce 83.427 as "eighty-three and four hundred twenty-seven thousandths."

**37.** In the number 63.729, the last digit occurs in the thousandths place. Pronounce the whole number part, then say "and" for the decimal point. Pronounce the fractional part as if it were a whole number and end with the word "thousandths." Thus, we pronounce 63.729 as "sixty-three and seven hundred twenty-nine thousandths."

**39.** In the number 826.57, the last digit occurs in the hundredths place. Pronounce the whole number part, then say "and" for the decimal point. Pronounce the fractional part as if it were a whole number and end with the word "hundredths." Thus, we pronounce 826.57 as "eight hundred twenty-six and fifty-seven hundredths."

**41.** There is one decimal place after the decimal point, so there will be 1 zero in the denominator of the fractional part. Thus,

$$98.1 = 98\frac{1}{10}$$

**43.** There is one decimal place after the decimal point, so there will be 1 zero in the denominator of the fractional part. Thus,

$$781.7 = 781\frac{7}{10}$$

**45.** There are three decimal places after the decimal point, so there will be 3 zeros in the denominator of the fractional part. Thus,

$$915.239 = 915\frac{239}{1000}$$

**47.** There are three decimal places after the decimal point, so there will be 3 zeros in the denominator of the fractional part. Thus,

$$560.453 = 560\frac{453}{1000}$$

**49.** There are three decimal places after the decimal point, so there will be 3 zeros in the denominator of the fractional part. Thus,

$$414.939 = 414\frac{939}{1000}$$

**51.** There are two decimal places after the decimal point, so there will be 2 zeros in the denominator of the fractional part. Thus,

$$446.73 = 446\frac{73}{100}$$

**53.** There is one decimal place after the decimal point, so so there will be 1 zero in the denominator of the fraction. Thus,

$$8.7 = \frac{87}{10}$$

**55.** There are two decimal places after the decimal point, so so there will be 2 zeros in the denominator of the fraction. Thus,

$$5.47 = \frac{547}{100}$$

**57.** There are three decimal places after the decimal point, so so there will be 3 zeros in the denominator of the fraction. Thus,

$$2.133 = \frac{2133}{1000}$$

**59.** There is one decimal place after the decimal point, so so there will be 1 zero in the denominator of the fraction. Thus,

$$3.9 = \frac{39}{10}$$

**61.** Note that the last digit occurs in the hundredths place. To convert 0.35 to a fraction, we place the number (without the decimal point) over 100 and reduce.

$$\begin{aligned} 0.35 &= \frac{35}{100} && \text{Place over 100.} \\ &= \frac{5 \cdot 7}{2 \cdot 2 \cdot 5 \cdot 5} && \text{Prime factor.} \\ &= \frac{7}{2 \cdot 2 \cdot 5} && \text{Cancel common factors.} \\ &= \frac{7}{20} && \text{Simplify.} \end{aligned}$$

**63.** Note that the last digit occurs in the hundredths place. To convert 0.06 to a fraction, we place the number (without the decimal point) over 100 and reduce.

$$\begin{aligned} 0.06 &= \frac{6}{100} && \text{Place over 100.} \\ &= \frac{2 \cdot 3}{2 \cdot 2 \cdot 5 \cdot 5} && \text{Prime factor.} \\ &= \frac{3}{2 \cdot 5 \cdot 5} && \text{Cancel common factors.} \\ &= \frac{3}{50} && \text{Simplify.} \end{aligned}$$

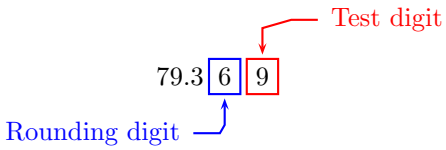
**65.** Note that the last digit occurs in the hundredths place. To convert 0.98 to a fraction, we place the number (without the decimal point) over 100 and reduce.

$$\begin{aligned} 0.98 &= \frac{98}{100} && \text{Place over 100.} \\ &= \frac{2 \cdot 7 \cdot 7}{2 \cdot 2 \cdot 5 \cdot 5} && \text{Prime factor.} \\ &= \frac{7 \cdot 7}{2 \cdot 5 \cdot 5} && \text{Cancel common factors.} \\ &= \frac{49}{50} && \text{Simplify.} \end{aligned}$$

**67.** Note that the last digit occurs in the hundredths place. To convert 0.72 to a fraction, we place the number (without the decimal point) over 100 and reduce.

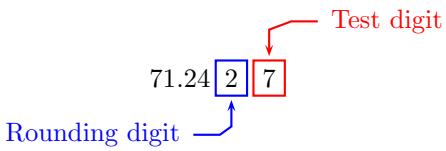
$$\begin{aligned} 0.72 &= \frac{72}{100} && \text{Place over 100.} \\ &= \frac{2 \cdot 2 \cdot 2 \cdot 3 \cdot 3}{2 \cdot 2 \cdot 5 \cdot 5} && \text{Prime factor.} \\ &= \frac{2 \cdot 3 \cdot 3}{5 \cdot 5} && \text{Cancel common factors.} \\ &= \frac{18}{25} && \text{Simplify.} \end{aligned}$$

**69.** Locate the rounding digit in the hundredths place and the test digit in the thousandths place.



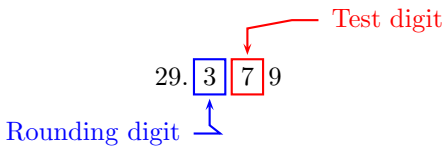

Because the test digit is greater than or equal to 5, add 1 to the rounding digit, then truncate. Hence, to the nearest hundredth, 79.369 is approximately 79.37.

**71.** Locate the rounding digit in the thousandths place and the test digit in the ten-thousandths place.



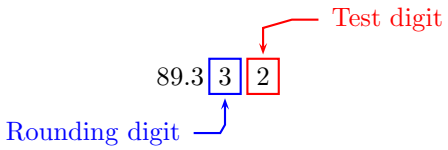
Because the test digit is greater than or equal to 5, add 1 to the rounding digit, then truncate. Hence, to the nearest thousandth, 71.2427 is approximately 71.243.

**73.** Locate the rounding digit in the tenths place and the test digit in the hundredths place.



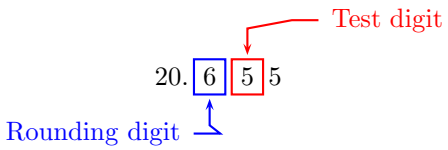

Because the test digit is greater than or equal to 5, add 1 to the rounding digit, then truncate. Hence, to the nearest tenth, 29.379 is approximately 29.4.

**75.** Locate the rounding digit in the thousandths place and the test digit in the ten-thousandths place.



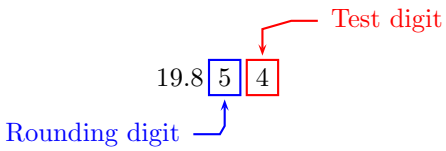

Because the test digit is less than 5, leave the rounding digit alone, then truncate. Hence, to the nearest thousandth, 89.3033 is approximately 89.303.

**77.** Locate the rounding digit in the tenths place and the test digit in the hundredths place.




Because the test digit is greater than or equal to 5, add 1 to the rounding digit, then truncate. Hence, to the nearest tenth, 20.655 is approximately 20.7.

**79.** Locate the rounding digit in the hundredths place and the test digit in the thousandths place.




Because the test digit is less than 5, leave the rounding digit alone, then truncate. Hence, to the nearest hundredth, 19.854 is approximately 19.85.

**81.** The leftmost digit at which these two positive numbers disagree is in the ten-thousandth place. The first number has a larger ten-thousandth digit than the second number, so

$$0.30387617 > 0.3036562$$

**83.** The leftmost digit at which these two negative numbers disagree is in the hundredth place. The first number has a smaller hundredth digit than the second number, so

$$-0.034 > -0.040493$$

**85.** The leftmost digit at which these two negative numbers disagree is in the hundredth place. The first number has a smaller hundredth digit than the second number, so

$$-8.3527 > -8.36553$$

**87.** The leftmost digit at which these two positive numbers disagree is in the thousandth place. The first number has a smaller thousandth digit than the second number, so

$$18.62192 < 18.6293549$$

**89.** The leftmost digit at which these two positive numbers disagree is in the thousandth place. The first number has a larger thousandth digit than the second number, so

$$36.8298 > 36.8266595$$

**91.** The leftmost digit at which these two negative numbers disagree is in the thousandth place. The first number has a larger thousandth digit than the second number, so

$$-15.188392 < -15.187157$$

**93.**

i) The last digit 3 is in the hundredths column. Therefore, we write the number as *seven and 3 hundredths*.

ii) The last digit 5 is in the hundredths column. Therefore, we write the number as *one and seventy-five hundredths*.

iii) The last digit 5 is in the ten-thousandths column. Therefore, we write the number as *nine thousand nine hundred eighty-five ten-thousandths*.

iv) The last non-zero digit 1 is in the ten-thousandths column. Therefore, we write the number as *one ten-thousandths*.

**95.**

i) First, write the decimal as a fraction with the numerator 1.26 and the denominator $1,000,000$ and divide.

$$\frac{1.26}{1,000,000} = 0.00000126$$

Therefore, written as a decimal, 1.26 millionths is 0.00000126.

ii) Writing five millionths as a fraction, and dividing, gives

$$\frac{5}{1,000,000} = 0.000005$$

Therefore, written as a decimal, five millionths is 0.000005

iii) We compare the decimals 0.00000126 and 0.000005 column by column. In the millionths column, $1 < 5$ so $0.00000126 < 0.000005$. Because the theoretical change of 0.00000126 seconds is less than the measurable changes of 0.000005 seconds, scientists are unable to observe the computed change in the length of an Earth day.

## 5.2 Adding and Subtracting Decimals

**1.** Add trailing zeros if necessary to align the decimal points. Then add.

$$\begin{array}{r} 31.9 \\ +\,84.7 \\ \hline 116.6 \end{array}$$

Thus, $31.9 + 84.7 = 116.6$.

**3.** Add trailing zeros if necessary to align the decimal points. Then add.

$$\begin{array}{r} 4.00 \\ +\,97.18 \\ \hline 101.18 \end{array}$$

Thus, $4 + 97.18 = 101.18$.

**5.** Add trailing zeros if necessary to align the decimal points. Then add.

$$\begin{array}{r} 4.000 \\ +\,87.502 \\ \hline 91.502 \end{array}$$

Thus, $4 + 87.502 = 91.502$.

**7.** Add trailing zeros if necessary to align the decimal points. Then add.

$$\begin{array}{r} 95.57 \\ +\,7.88 \\ \hline 103.45 \end{array}$$

Thus, $95.57 + 7.88 = 103.45$.

**9.** Add trailing zeros if necessary to align the decimal points. Then add.

$$\begin{array}{r} 52.671 \\ +\,5.970 \\ \hline 58.641 \end{array}$$

Thus, $52.671 + 5.97 = 58.641$.

**11.** Add trailing zeros if necessary to align the decimal points. Then add.

$$\begin{array}{r} 4.76 \\ +\,2.10 \\ \hline 6.86 \end{array}$$

Thus, $4.76 + 2.1 = 6.86$.

**13.** Add trailing zeros if necessary to align the decimal points. Then subtract the smaller magnitude from the larger magnitude:

$$\begin{array}{r} 9.000 \\ \underline{-\ 2.261} \\ 6.739 \end{array}$$

Finish by prefixing the sign of the decimal with the larger magnitude. Hence,

$$9 - 2.261 = 6.739$$

**15.** Add trailing zeros if necessary to align the decimal points. Then subtract the smaller magnitude from the larger magnitude:

$$\begin{array}{r} 80.9 \\ \underline{-\ 6.0} \\ 74.9 \end{array}$$

Finish by prefixing the sign of the decimal with the larger magnitude. Hence,

$$80.9 - 6 = 74.9$$

**17.** Add trailing zeros if necessary to align the decimal points. Then subtract the smaller magnitude from the larger magnitude:

$$\begin{array}{r} 55.672 \\ \underline{-\ 3.300} \\ 52.372 \end{array}$$

Finish by prefixing the sign of the decimal with the larger magnitude. Hence,

$$55.672 - 3.3 = 52.372$$

**19.** Add trailing zeros if necessary to align the decimal points. Then subtract the smaller magnitude from the larger magnitude:

$$\begin{array}{r} 60.575 \\ \underline{-\ 6.000} \\ 54.575 \end{array}$$

Finish by prefixing the sign of the decimal with the larger magnitude. Hence,

$$60.575 - 6 = 54.575$$

**21.** Add trailing zeros if necessary to align the decimal points. Then subtract the smaller magnitude from the larger magnitude:

$$\begin{array}{r} 39.8 \\ \underline{-\ 4.5} \\ 35.3 \end{array}$$

Finish by prefixing the sign of the decimal with the larger magnitude. Hence,

$$39.8 - 4.5 = 35.3$$

**23.** Add trailing zeros if necessary to align the decimal points. Then subtract the smaller magnitude from the larger magnitude:

$$\begin{array}{r} 8.10 \\ \underline{-\ 2.12} \\ 5.98 \end{array}$$

Finish by prefixing the sign of the decimal with the larger magnitude. Hence,

$$8.1 - 2.12 = 5.98$$

**25.** First rewrite the problem as an addition problem by adding the opposite of the second number:

$$-19.13 - 7 = -19.13 + (-7)$$

In this addition problem, the decimals have like signs. Therefore, start by adding the magnitudes. Include trailing zeros if necessary to align the decimal points.

$$\begin{array}{r} 19.13 \\ \underline{+\ 7.00} \\ 26.13 \end{array}$$

Finish by prefixing the common negative sign. Thus,

$$\begin{aligned} -19.13 - 7 &= -19.13 + (-7) \\ &= -26.13 \end{aligned}$$

**27.** Add trailing zeros if necessary to align the decimal points. Then subtract the smaller magnitude from the larger magnitude.

$$\begin{array}{r} 76.80 \\ \underline{-\ 6.08} \\ 70.72 \end{array}$$

Finish by prefixing the sign of the decimal with the larger magnitude. Hence,

$$6.08 - 76.8 = -70.72$$

**29.** The two decimals are both negative. First add the magnitudes. Include trailing zeros if necessary to align the decimal points.

$$\begin{array}{r} 34.700 \\ +\,56.214 \\ \hline 90.914 \end{array}$$

Finish by prefixing the common negative sign. Hence,

$$-34.7 + (-56.214) = -90.914$$

**31.** The decimals have unlike signs. First subtract the smaller magnitude from the larger magnitude. Include trailing zeros if necessary to align the decimal points.

$$\begin{array}{r} 8.400 \\ -\,6.757 \\ \hline 1.643 \end{array}$$

Finish by prefixing the sign of the decimal with the larger magnitude. Hence,

$$8.4 + (-6.757) = 1.643$$

**33.** The decimals have unlike signs. First subtract the smaller magnitude from the larger magnitude. Include trailing zeros if necessary to align the decimal points.

$$\begin{array}{r} 50.4 \\ -\,7.6 \\ \hline 42.8 \end{array}$$

Finish by prefixing the sign of the decimal with the larger magnitude. Hence,

$$-50.4 + 7.6 = -42.8$$

**35.** The decimals have unlike signs. First subtract the smaller magnitude from the larger magnitude. Include trailing zeros if necessary to align the decimal points.

$$\begin{array}{r} 43.3 \\ -\,2.2 \\ \hline 41.1 \end{array}$$

Finish by prefixing the sign of the decimal with the larger magnitude. Hence,

$$-43.3 + 2.2 = -41.1$$

**37.** Add trailing zeros if necessary to align the decimal points. Then subtract the smaller magnitude from the larger magnitude.

$$\begin{array}{r} 0.70 \\ -\,0.19 \\ \hline 0.51 \end{array}$$

Finish by prefixing the sign of the decimal with the larger magnitude. Hence,

$$0.19 - 0.7 = -0.51$$

**39.** First rewrite the problem as an addition problem by adding the opposite of the second number:

$$-7 - 1.504 = -7 + (-1.504)$$

In this addition problem, the decimals have like signs. Therefore, start by adding the magnitudes. Include trailing zeros if necessary to align the decimal points.

$$\begin{array}{r} 7.000 \\ +\,1.504 \\ \hline 8.504 \end{array}$$

Finish by prefixing the common negative sign. Thus,

$$\begin{aligned} -7 - 1.504 &= -7 + (-1.504) \\ &= -8.504 \end{aligned}$$

**41.** The two decimals are both negative. First add the magnitudes. Include trailing zeros if necessary to align the decimal points.

$$\begin{array}{r} 4.47 \\ +\,2.00 \\ \hline 6.47 \end{array}$$

Finish by prefixing the common negative sign. Hence,

$$-4.47 + (-2) = -6.47$$

**43.** First rewrite the problem as an addition problem by adding the opposite of the second number:

$$71.72 - (-6) = 71.72 + 6$$

Then compute the sum. Include trailing zeros if necessary to align the decimal points.

$$\begin{array}{r} 71.720 \\ \underline{+\ 6.000} \\ 77.720 \end{array}$$

Thus,

$$\begin{aligned} 71.72 - (-6) &= 71.72 + 6 \\ &= 77.72 \end{aligned}$$

**45.** First rewrite the problem as an addition problem by adding the opposite of the second number:

$$-9.829 - (-17.33) = -9.829 + 17.33$$

In this addition problem, the decimals have unlike signs. Therefore, start by subtracting the smaller magnitude from the larger magnitude. Include trailing zeros if necessary to align the decimal points.

$$\begin{array}{r} 17.330 \\ \underline{-\ 9.829} \\ 7.501 \end{array}$$

Finish by prefixing the sign of the decimal with the larger magnitude. Thus,

$$\begin{aligned} -9.829 - (-17.33) &= -9.829 + 17.33 \\ &= 7.501 \end{aligned}$$

**47.** Add trailing zeros if necessary to align the decimal points. Then subtract the smaller magnitude from the larger magnitude.

$$\begin{array}{r} 4.202 \\ \underline{-\ 2.001} \\ 2.201 \end{array}$$

Finish by prefixing the sign of the decimal with the larger magnitude. Hence,

$$2.001 - 4.202 = -2.201$$

**49.** Add trailing zeros if necessary to align the decimal points. Then subtract the smaller magnitude from the larger magnitude.

$$\begin{array}{r} 2.99 \\ \underline{-\,2.60} \\ 0.39 \end{array}$$

Finish by prefixing the sign of the decimal with the larger magnitude. Hence,

$$2.6 - 2.99 = -0.39$$

**51.** First rewrite the problem as an addition problem by adding the opposite of the second number:

$$-4.560 - 2.335 = -4.560 + (-2.335)$$

In this addition problem, the decimals have like signs. Therefore, start by adding the magnitudes. Include trailing zeros if necessary to align the decimal points.

$$\begin{array}{r} 4.560 \\ \underline{+\,2.335} \\ 6.895 \end{array}$$

Finish by prefixing the common negative sign. Thus,

$$\begin{aligned} -4.560 - 2.335 &= -4.560 + (-2.335) \\ &= -6.895 \end{aligned}$$

**53.** First rewrite the problem as an addition problem by adding the opposite of the second number:

$$-54.3 - 3.97 = -54.3 + (-3.97)$$

In this addition problem, the decimals have like signs. Therefore, start by adding the magnitudes. Include trailing zeros if necessary to align the decimal points.

$$\begin{array}{r} 54.30 \\ \underline{+\,3.97} \\ 58.27 \end{array}$$

Finish by prefixing the common negative sign. Thus,

$$\begin{aligned} -54.3 - 3.97 &= -54.3 + (-3.97) \\ &= -58.27 \end{aligned}$$

**55.** The two decimals are both negative. First add the magnitudes. Include trailing zeros if necessary to align the decimal points.

$$\begin{array}{r} 6.320 \\ +\,48.663 \\ \hline 54.983 \end{array}$$

Finish by prefixing the common negative sign. Hence,

$$-6.32 + (-48.663) = -54.983$$

**57.** First rewrite the problem as an addition problem by adding the opposite of the second number:

$$-8 - (-3.686) = -8 + 3.686$$

In this addition problem, the decimals have unlike signs. Therefore, start by subtracting the smaller magnitude from the larger magnitude. Include trailing zeros if necessary to align the decimal points.

$$\begin{array}{r} 8.000 \\ -\,3.686 \\ \hline 4.314 \end{array}$$

Finish by prefixing the sign of the decimal with the larger magnitude. Thus,

$$\begin{aligned} -8 - (-3.686) &= -8 + 3.686 \\ &= -4.314 \end{aligned}$$

**59.** The decimals have unlike signs. First subtract the smaller magnitude from the larger magnitude. Include trailing zeros if necessary to align the decimal points.

$$\begin{array}{r} 9.365 \\ -\,5.000 \\ \hline 4.365 \end{array}$$

Finish by prefixing the sign of the decimal with the larger magnitude. Hence,

$$9.365 + (-5) = 4.365$$

**61.** First rewrite the problem as an addition problem by adding the opposite of the second number:

$$2.762 - (-7.3) = 2.762 + 7.3$$

Then compute the sum. Include trailing zeros if necessary to align the decimal points.

$$\begin{array}{r} 2.762 \\ +\,7.300 \\ \hline 10.062 \end{array}$$

Thus,

$$\begin{aligned} 2.762 - (-7.3) &= 2.762 + 7.3 \\ &= 10.062 \end{aligned}$$

**63.** The two decimals are both negative. First add the magnitudes. Include trailing zeros if necessary to align the decimal points.

$$\begin{array}{r} 96.10 \\ +\,9.65 \\ \hline 105.75 \end{array}$$

Finish by prefixing the common negative sign. Hence,

$$-96.1 + (-9.65) = -105.75$$

**65.** Simplify the expression inside the absolute value bars first.

$$\begin{aligned} -12.05 - |17.83 - (-17.16)| &= -12.05 - |17.83 + 17.16| && \text{Subtract: Add the opposite.} \\ &= -12.05 - |34.99| && \text{Add: } 17.83 + 17.16 = 34.99. \\ &= -12.05 - 34.99 && \text{Take absolute value: } |34.99| = 34.99. \\ &= -12.05 + (-34.99) && \text{Subtract: Add the opposite.} \\ &= -47.04 && \text{Add: } -12.05 + (-34.99) = -47.04. \end{aligned}$$

**67.** Simplify the expression inside the absolute value bars first.

$$\begin{aligned} -6.4 + |9.38 - (-9.39)| &= -6.4 + |9.38 + 9.39| && \text{Subtract: Add the opposite.} \\ &= -6.4 + |18.77| && \text{Add: } 9.38 + 9.39 = 18.77. \\ &= -6.4 + 18.77 && \text{Take absolute value: } |18.77| = 18.77. \\ &= 12.37 && \text{Add: } -6.4 + 18.77 = 12.37. \end{aligned}$$

**69.** Simplify the expression inside the parentheses first.

$$\begin{aligned} -19.1-(1.51-(-17.35)) &= -19.1-(1.51+17.35) && \text{Subtract: Add the opposite.}\\ &= -19.1-18.86 && \text{Add: } 1.51+17.35=18.86.\\ &= -19.1+(-18.86) && \text{Subtract: Add the opposite.}\\ &= -37.96 && \text{Add: } -19.1+(-18.86)=-37.96. \end{aligned}$$

**71.** Simplify the expression inside the parentheses first.

$$\begin{aligned} 11.55+(6.3-(-1.9)) &= 11.55+(6.3+1.9) && \text{Subtract: Add the opposite.}\\ &= 11.55+8.2 && \text{Add: } 6.3+1.9=8.2.\\ &= 19.75 && \text{Add: } 11.55+8.2=19.75. \end{aligned}$$

**73.** Simplify the expression inside the parentheses first.

$$\begin{aligned} -1.7-(1.9-(-16.25)) &= -1.7-(1.9+16.25) && \text{Subtract: Add the opposite.}\\ &= -1.7-18.15 && \text{Add: } 1.9+16.25=18.15.\\ &= -1.7+(-18.15) && \text{Subtract: Add the opposite.}\\ &= -19.85 && \text{Add: } -1.7+(-18.15)=-19.85. \end{aligned}$$

**75.** Simplify the expression inside the absolute value bars first.

$$\begin{aligned} 1.2+|8.74-16.5| &= 1.2+|8.74+(-16.5)| && \text{Subtract: Add the opposite.}\\ &= 1.2+|-7.76| && \text{Add: } 8.74+(-16.5)=-7.76.\\ &= 1.2+7.76 && \text{Take absolute value: } |-7.76|=7.76.\\ &= 8.96 && \text{Add: } 1.2+7.76=8.96. \end{aligned}$$

**77.** Simplify the expression inside the absolute value bars first.

$$\begin{aligned} -12.4-|3.81-16.4| &= -12.4-|3.81+(-16.4)| && \text{Subtract: Add the opposite.}\\ &= -12.4-|-12.59| && \text{Add: } 3.81+(-16.4)=-12.59.\\ &= -12.4-12.59 && \text{Take absolute value: } |-12.59|=12.59.\\ &= -12.4+(-12.59) && \text{Subtract: Add the opposite.}\\ &= -24.99 && \text{Add: } -12.4+(-12.59)=-24.99. \end{aligned}$$

**79.** Simplify the expression inside the parentheses first.

$$\begin{aligned} -11.15+(11.6-(-16.68)) &= -11.15+(11.6+16.68) && \text{Subtract: Add the opposite.}\\ &= -11.15+28.28 && \text{Add: } 11.6+16.68=28.28.\\ &= 17.13 && \text{Add: } -11.15+28.28=17.13. \end{aligned}$$

**81.** To find the total dollar value of the nation's four largest banks, line up the decimal points and add like columns. Your answer will be in the billions.

$$124.8 + 85.3 + 61.8 + 56.4 = 328.3$$

Therefore, the dollar value of the nation's four largest banks is \$328.3 billion.

**83.** To find the change in temperature, subtract the earlier temperature from the later temperature.

| Change in Temperature | = | Latter Temperature | − | Former Temperature |
|---|---|---|---|---|
| | = | $60.9^\circ$ F | − | $93.8^\circ$ F |
| | = | $-32.9^\circ$ F | | |

Hence, the change in temperature is $-32.9^\circ$ F.

**85.** To find the net worth, subtract the debts from the assets. Your answer should be in the billions.

| Net Worth | = | Assets | − | Liabilities |
|---|---|---|---|---|
| | = | 29.6 | − | 27 |
| | = | 2.6 | | |

Therefore, General Growth Properties had a net worth of \$2.6 billion.

**87.** To find how many more people lost their jobs than were hired, find the difference between the job loss number and the hired number.

| Net job loss | = | Number jobs lost | − | Number people hired |
|---|---|---|---|---|
| | = | 4.12 | − | 4.08 |
| | = | 0.04 | | |

Therefore, the net number of people who lost their job in January of 2010 was 0.04 million, or four one-hundredths of a million. Remembering that "of" means multiply, we write this as a whole number by multiplying 0.04 and one million. This requires only to move the decimal six places to the right, as in:

$$0.04 \cdot 1,000,000 = 40,000$$

Thus, 40,000 more people lost their jobs in the month of January than were hired.

## 5.3 Multiplying Decimals

**1.** Use vertical format. Since there are a total of 3 digits to the right of the decimal point in the original numbers, the answer also has 3 digits to the right of the decimal point.

$$\begin{array}{r} 6.7 \\ \times\ 0.03 \\ \hline 0.201 \end{array}$$

Thus, $(6.7)(0.03) = 0.201$.

**3.** Use vertical format. Since there are a total of 2 digits to the right of the decimal point in the original numbers, the answer also has 2 digits to the right of the decimal point.

$$\begin{array}{r} 28.9 \\ \times\ 5.9 \\ \hline 26\ 01 \\ 144\ 5\ \ \\ \hline 170.51 \end{array}$$

Thus, $(28.9)(5.9) = 170.51$.

**5.** Use vertical format. Since there are a total of 2 digits to the right of the decimal point in the original numbers, the answer also has 2 digits to the right of the decimal point.

$$\begin{array}{r} 4.1 \\ \times\ 4.6 \\ \hline 2\ 46 \\ 16\ 4\ \ \\ \hline 18.86 \end{array}$$

Thus, $(4.1)(4.6) = 18.86$.

**7.** Use vertical format. Since there are a total of 2 digits to the right of the decimal point in the original numbers, the answer also has 2 digits to the right of the decimal point.

$$\begin{array}{r} 75.3 \\ \times\ 0.4 \\ \hline 30.12 \end{array}$$

Thus, $(75.3)(0.4) = 30.12$.

**9.** Use vertical format. Since there are a total of 3 digits to the right of the decimal point in the original numbers, the answer also has 3 digits to the right of the decimal point.

$$\begin{array}{r} 6.98 \\ \times\ 0.9 \\ \hline 6.282 \end{array}$$

Thus, $(6.98)(0.9) = 6.282$.

**11.** Use vertical format. Since there are a total of 3 digits to the right of the decimal point in the original numbers, the answer also has 3 digits to the right of the decimal point.

$$\begin{array}{r} 57.9 \\ \times\ 3.29 \\ \hline 5\ 211 \\ 11\ 58 \\ 173\ 7 \\ \hline 190.491 \end{array}$$

Thus, $(57.9)(3.29) = 190.491$.

**13.** Use vertical format. Since there are a total of 2 digits to the right of the decimal point in the original numbers, the answer also has 2 digits to the right of the decimal point.

$$\begin{array}{r} 47.3 \\ \times\ 0.9 \\ \hline 42.57 \end{array}$$

Thus, $(47.3)(0.9) = 42.57$.

**15.** Use vertical format. Since there are a total of 2 digits to the right of the decimal point in the original numbers, the answer also has 2 digits to the right of the decimal point.

$$\begin{array}{r} 9.9 \\ \times\ 6.7 \\ \hline 6\ 93 \\ 59\ 4 \\ \hline 66.33 \end{array}$$

Thus, $(9.9)(6.7) = 66.33$.

**17.** Use vertical format. Since there are a total of 2 digits to the right of the decimal point in the original numbers, the answer also has 2 digits to the right of the decimal point.

$$\begin{array}{r} 19.5 \\ \times\ 7.9 \\ \hline 17\,55 \\ 136\,5\ \ \\ \hline 154.05 \end{array}$$

Thus, $(19.5)(7.9) = 154.05$.

**19.** Use vertical format. Since there are a total of 2 digits to the right of the decimal point in the original numbers, the answer also has 2 digits to the right of the decimal point.

$$\begin{array}{r} 6.9 \\ \times\ 0.3 \\ \hline 2.07 \end{array}$$

Thus, $(6.9)(0.3) = 2.07$.

**21.** Use vertical format. Since there are a total of 3 digits to the right of the decimal point in the original numbers, the answer also has 3 digits to the right of the decimal point.

$$\begin{array}{r} 35.3 \\ \times\ 3.81 \\ \hline 353 \\ 28\,24 \\ 105\,9\ \ \\ \hline 134.493 \end{array}$$

Thus, $(35.3)(3.81) = 134.493$.

**23.** Use vertical format. Since there are a total of 4 digits to the right of the decimal point in the original numbers, the answer also has 4 digits to the right of the decimal point.

$$\begin{array}{r} 2.32 \\ \times\ 0.03 \\ \hline 0.0696 \end{array}$$

Thus, $(2.32)(0.03) = 0.0696$.

**25.** Use vertical format. Since there are a total of 3 digits to the right of the decimal point in the original numbers, the answer also has 3 digits to the right of the decimal point.

$$\begin{array}{r} 3.02 \\ \times\ 6.7 \\ \hline 2\ 114 \\ 18\ 12\ \ \\ \hline 20.234 \end{array}$$

Thus, $(3.02)(6.7) = 20.234$.

**27.** Use vertical format. Since there are a total of 3 digits to the right of the decimal point in the original numbers, the answer also has 3 digits to the right of the decimal point.

$$\begin{array}{r} 4.98 \\ \times\ 6.2 \\ \hline 996 \\ 29\ 88\ \ \\ \hline 30.876 \end{array}$$

Thus, $(4.98)(6.2) = 30.876$.

**29.** Use vertical format with the unsigned numbers. Since there are a total of 4 digits to the right of the decimal point in the original numbers, the answer also has 4 digits to the right of the decimal point.

$$\begin{array}{r} 9.41 \\ \times\ 0.07 \\ \hline 0.6587 \end{array}$$

Unlike signs give a negative result. Therefore,

$$(-9.41)(0.07) = -0.6587$$

**31.** Use vertical format with the unsigned numbers. Since there are a total of 2 digits to the right of the decimal point in the original numbers, the answer also has 2 digits to the right of the decimal point.

$$\begin{array}{r} 7.4 \\ \times\ 0.9 \\ \hline 6.66 \end{array}$$

Like signs give a positive result. Therefore,

$$(-7.4)(-0.9) = 6.66$$

**33.** Use vertical format with the unsigned numbers. Since there are a total of 2 digits to the right of the decimal point in the original numbers, the answer also has 2 digits to the right of the decimal point.

$$\begin{array}{r} 8.2 \\ \times\ 3.7 \\ \hline 5\ 74 \\ 24\ 6\ \ \\ \hline 30.34 \end{array}$$

Unlike signs give a negative result. Therefore,

$$(-8.2)(3.7) = -30.34$$

**35.** Use vertical format with the unsigned numbers. Since there are a total of 3 digits to the right of the decimal point in the original numbers, the answer also has 3 digits to the right of the decimal point.

$$\begin{array}{r} 9.72 \\ \times\ 9.1 \\ \hline 972 \\ 87\ 48\ \ \\ \hline 88.452 \end{array}$$

Unlike signs give a negative result. Therefore,

$$(9.72)(-9.1) = -88.452$$

**37.** Use vertical format with the unsigned numbers. Since there are a total of 2 digits to the right of the decimal point in the original numbers, the answer also has 2 digits to the right of the decimal point.

$$\begin{array}{r} 6.4 \\ \times\ 2.6 \\ \hline 3\ 84 \\ 12\ 8\ \ \\ \hline 16.64 \end{array}$$

Unlike signs give a negative result. Therefore,

$$(-6.4)(2.6) = -16.64$$

**39.** Use vertical format with the unsigned numbers. Since there are a total of 2 digits to the right of the decimal point in the original numbers, the answer also has 2 digits to the right of the decimal point.

$$\begin{array}{r} 39.3 \\ \times\ 0.8 \\ \hline 31.44 \end{array}$$

Like signs give a positive result. Therefore,

$$(-39.3)(-0.8) = 31.44$$

**41.** Use vertical format with the unsigned numbers. Since there are a total of 3 digits to the right of the decimal point in the original numbers, the answer also has 3 digits to the right of the decimal point.

$$\begin{array}{r} 63.1 \\ \times\ 0.02 \\ \hline 1.262 \end{array}$$

Unlike signs give a negative result. Therefore,

$$(63.1)(-0.02) = -1.262$$

**43.** Use vertical format with the unsigned numbers. Since there are a total of 2 digits to the right of the decimal point in the original numbers, the answer also has 2 digits to the right of the decimal point.

$$\begin{array}{r} 90.8 \\ \times\ 3.1 \\ \hline 9\ 08 \\ 272\ 4\ \ \\ \hline 281.48 \end{array}$$

Unlike signs give a negative result. Therefore,

$$(-90.8)(3.1) = -281.48$$

**45.** Use vertical format with the unsigned numbers. Since there are a total of 2 digits to the right of the decimal point in the original numbers, the answer

also has 2 digits to the right of the decimal point.

$$\begin{array}{r} 47.5 \\ \times\ 82.1 \\ \hline 4\,75 \\ 95\,0 \\ 3800 \\ \hline 3899.75 \end{array}$$

Unlike signs give a negative result. Therefore,

$$(47.5)(-82.1) = -3899.75$$

**47.** Use vertical format with the unsigned numbers. Since there are a total of 2 digits to the right of the decimal point in the original numbers, the answer also has 2 digits to the right of the decimal point.

$$\begin{array}{r} 31.1 \\ \times\ 4.8 \\ \hline 24\,88 \\ 124\,4 \\ \hline 149.28 \end{array}$$

Like signs give a positive result. Therefore,

$$(-31.1)(-4.8) = 149.28$$

**49.** Use vertical format with the unsigned numbers. Since there are a total of 3 digits to the right of the decimal point in the original numbers, the answer also has 3 digits to the right of the decimal point.

$$\begin{array}{r} 2.5 \\ \times\ 0.07 \\ \hline 0.175 \end{array}$$

Like signs give a positive result. Therefore,

$$(-2.5)(-0.07) = 0.175$$

**51.** Use vertical format with the unsigned numbers. Since there are a total of 3 digits to the right of the decimal point in the original numbers, the answer also has 3 digits to the right of the decimal point.

$$\begin{array}{r} 1.02 \\ \times\ 0.2 \\ \hline 0.204 \end{array}$$

Unlike signs give a negative result. Therefore,

$$(1.02)(-0.2) = -0.204$$

**53.** Use vertical format with the unsigned numbers. Since there are a total of 3 digits to the right of the decimal point in the original numbers, the answer also has 3 digits to the right of the decimal point.

$$\begin{array}{r} 7.81 \\ \times\ 5.5 \\ \hline 3\ 905 \\ 39\ 05\ \\ \hline 42.955 \end{array}$$

Unlike signs give a negative result. Therefore,

$$(7.81)(-5.5) = -42.955$$

**55.** Use vertical format with the unsigned numbers. Since there are a total of 3 digits to the right of the decimal point in the original numbers, the answer also has 3 digits to the right of the decimal point.

$$\begin{array}{r} 2.09 \\ \times\ 37.9 \\ \hline 1\ 881 \\ 14\ 63\ \\ 62\ 7\ \ \\ \hline 79.211 \end{array}$$

Unlike signs give a negative result. Therefore,

$$(-2.09)(37.9) = -79.211$$

**57.** Move the decimal point 1 place to the right: $24.264 \cdot 10 = 242.64$

**59.** Move the decimal point 4 places to the right: $53.867 \cdot 10^4 = 538670$

**61.** Move the decimal point 3 places to the right: $5.096 \cdot 10^3 = 5096$

**63.** Move the decimal point 3 places to the right: $37.968 \cdot 10^3 = 37968$

**65.** Move the decimal point 2 places to the right: $61.303 \cdot 100 = 6130.3$

**67.** Move the decimal point 3 places to the right: $74.896 \cdot 1000 = 74896$

**69.** First evaluate exponents, then multiply, and then subtract.

$$\begin{aligned}
(0.36)(7.4) - (-2.8)^2 &= (0.36)(7.4) - 7.84 && \text{Exponents first: } (-2.8)^2 = 7.84. \\
&= 2.664 - 7.84 && \text{Multiply: } (0.36)(7.4) = 2.664. \\
&= 2.664 + (-7.84) && \text{Subtract: Add the opposite.} \\
&= -5.176 && \text{Add: } 2.664 + (-7.84) = -5.176.
\end{aligned}$$

**71.** First evaluate exponents, then multiply, and then subtract.

$$\begin{aligned}
9.4 - (-7.7)(1.2)^2 &= 9.4 - (-7.7)(1.44) && \text{Exponents first: } 1.2^2 = 1.44. \\
&= 9.4 - (-11.088) && \text{Multiply: } (-7.7)(1.44) = -11.088. \\
&= 9.4 + 11.088 && \text{Subtract: Add the opposite.} \\
&= 20.488 && \text{Add: } 9.4 + 11.088 = 20.488.
\end{aligned}$$

**73.** First evaluate exponents, then multiply, and then subtract.

$$\begin{aligned}
5.94 - (-1.2)(-1.8)^2 &= 5.94 - (-1.2)(3.24) && \text{Exponents first: } (-1.8)^2 = 3.24. \\
&= 5.94 - (-3.888) && \text{Multiply: } (-1.2)(3.24) = -3.888. \\
&= 5.94 + 3.888 && \text{Subtract: Add the opposite.} \\
&= 9.828 && \text{Add: } 5.94 + 3.888 = 9.828.
\end{aligned}$$

**75.** First evaluate exponents, then multiply, and then subtract.

$$\begin{aligned}
6.3 - 4.2(9.3)^2 &= 6.3 - 4.2 \cdot 86.49 && \text{Exponents first: } 9.3^2 = 86.49. \\
&= 6.3 - 363.258 && \text{Multiply: } 4.2 \cdot 86.49 = 363.258. \\
&= 6.3 + (-363.258) && \text{Subtract: Add the opposite.} \\
&= -356.958 && \text{Add: } 6.3 + (-363.258) = -356.958.
\end{aligned}$$

**77.** First evaluate exponents, then multiply, and then subtract.

$$\begin{aligned}
(6.3)(1.88) - (-2.2)^2 &= (6.3)(1.88) - 4.84 && \text{Exponents first: } (-2.2)^2 = 4.84.\\
&= 11.844 - 4.84 && \text{Multiply: } (6.3)(1.88) = 11.844.\\
&= 11.844 + (-4.84) && \text{Subtract: Add the opposite.}\\
&= 7.004 && \text{Add: } 11.844 + (-4.84) = 7.004.
\end{aligned}$$

**79.** First evaluate exponents, then multiply, and then subtract.

$$\begin{aligned}
(-8.1)(9.4) - 1.8^2 &= (-8.1)(9.4) - 3.24 && \text{Exponents first: } 1.8^2 = 3.24.\\
&= -76.14 - 3.24 && \text{Multiply: } (-8.1)(9.4) = -76.14.\\
&= -76.14 + (-3.24) && \text{Subtract: Add the opposite.}\\
&= -79.38 && \text{Add: } -76.14 + (-3.24) = -79.38.
\end{aligned}$$

**81.** Substitute $a = -6.24$, $b = 0.4$, and $c = 7.2$ in $a - bc^2$.

$$a - bc^2 = (-6.24) - (0.4)(7.2)^2 \qquad \text{Substitute.}$$

First evaluate exponents, then multiply, and then subtract.

$$\begin{aligned}
&= (-6.24) - (0.4)(51.84) && \text{Exponents first: } (7.2)^2 = 51.84.\\
&= -6.24 - 20.736 && \text{Multiply: } 0.4 \cdot 51.84 = 20.736.\\
&= -6.24 + (-20.736) && \text{Subtract: Add the opposite.}\\
&= -26.976 && \text{Add: } -6.24 + (-20.736) = -26.976.
\end{aligned}$$

**83.** Substitute $a = -2.4$, $b = -2.1$, and $c = -4.6$ in $a - bc^2$.

$$ab - c^2 = (-2.4)(-2.1) - (-4.6)^2 \qquad \text{Substitute.}$$

First evaluate exponents, then multiply, and then subtract.

$$\begin{aligned}
&= (-2.4)(-2.1) - 21.16 && \text{Exponents first: } (-4.6)^2 = 21.16.\\
&= 5.04 - 21.16 && \text{Multiply: } (-2.4)(-2.1) = 5.04.\\
&= 5.04 + (-21.16) && \text{Subtract: Add the opposite.}\\
&= -16.12 && \text{Add: } 5.04 + (-21.16) = -16.12.
\end{aligned}$$

**85.** Substitute $a = -3.21$, $b = 3.5$, and $c = 8.3$ in $a - bc^2$.

$a - bc^2 = (-3.21) - (3.5)(8.3)^2$ Substitute.

First evaluate exponents, then multiply, and then subtract.

$= (-3.21) - (3.5)(68.89)$ Exponents first: $(8.3)^2 = 68.89$.
$= -3.21 - 241.115$ Multiply: $3.5 \cdot 68.89 = 241.115$.
$= -3.21 + (-241.115)$ Subtract: Add the opposite.
$= -244.325$ Add: $-3.21 + (-241.115) = -244.325$.

**87.** Substitute $a = -4.5$, $b = -6.9$, and $c = 4.6$ in $a - bc^2$.

$ab - c^2 = (-4.5)(-6.9) - (4.6)^2$ Substitute.

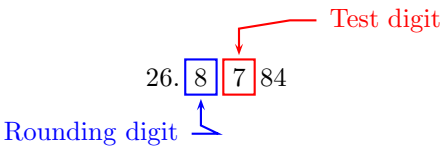
First evaluate exponents, then multiply, and then subtract.

$= (-4.5)(-6.9) - 21.16$ Exponents first: $(4.6)^2 = 21.16$.
$= 31.05 - 21.16$ Multiply: $(-4.5)(-6.9) = 31.05$.
$= 31.05 + (-21.16)$ Subtract: Add the opposite.
$= 9.89$ Add: $31.05 + (-21.16) = 9.89$.

**89.** To find the circumference, use the formula $C = \pi d$. Substitute 3.14 for $\pi$ and 8.56 for $d$, then multiply.

$C = \pi d$ Circumference formula.
$C = 3.14(8.56)$ Substitute: 3.14 for $\pi$, 8.56 for $d$.
$C = 26.8784$ Multiply: $3.14(8.56) = 26.8784$.

To round to the nearest tenth of an inch, locate the rounding digit and the test digit.

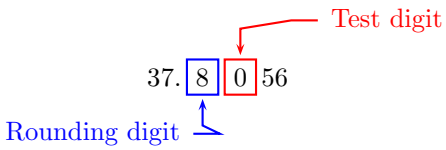



Because the test digit is greater than or equal to 5, add 1 to the rounding digit, then truncate. Thus, to the nearest tenth of an inch, the circumference of the circle is approximately $C \approx 26.9$ inches.

**91.** To find the circumference, use the formula $C = \pi d$. Substitute 3.14 for $\pi$ and 12.04 for $d$, then multiply.

| | |
|---|---|
| $C = \pi d$ | Circumference formula. |
| $C = 3.14(12.04)$ | Substitute: 3.14 for $\pi$, 12.04 for $d$. |
| $C = 37.8056$ | Multiply: $3.14(12.04) = 37.8056$. |

To round to the nearest tenth of an inch, locate the rounding digit and the test digit.




Because the test digit is less than 5, leave the rounding digit alone, then truncate. Thus, to the nearest tenth of an inch, the circumference of the circle is approximately $C \approx 37.8$ inches.

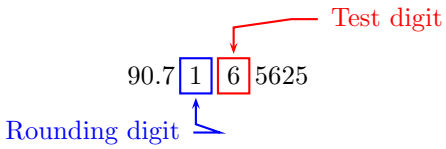
**93.** The first task is to find the radius $r$. But the diameter is twice the radius.

| | |
|---|---|
| $d = 2r$ | The diameter is twice the radius. |
| $10.75 = 2r$ | Substitute: 10.75 for $d$. |
| $\frac{10.75}{2} = \frac{2r}{2}$ | Divide both sides by 2. |
| $5.375 = r$ | Simplify. |

Thus, the radius is $r = 5.375$ inches. To find the area, use the formula $A = \pi r^2$.

| | |
|---|---|
| $A = \pi r^2$ | Area formula. |
| $A = 3.14(5.375)^2$ | Substitute: 3.14 for $\pi$, 5.375 for $r$. |
| $A = 3.14(28.890625)$ | Square: $(5.375)^2 = 28.890625$. |
| $A = 90.7165625$ | Multiply: $3.14(28.890625) = 90.7165625$. |

To round to the nearest hundredth of a square inch, locate the rounding digit and the test digit.




Because the test digit is greater than or equal to 5, add 1 to the rounding digit, then truncate. Thus, to the nearest hundredth of a square inch, the area of the circle is approximately $A \approx 90.72$ inches.

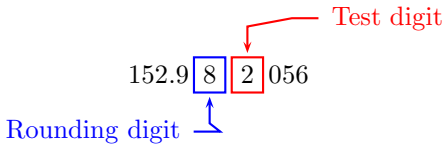
**95.** The first task is to find the radius $r$. But the diameter is twice the radius.

$$\begin{aligned} d &= 2r && \text{The diameter is twice the radius.} \\ 13.96 &= 2r && \text{Substitute: 13.96 for } d. \\ \frac{13.96}{2} &= \frac{2r}{2} && \text{Divide both sides by 2.} \\ 6.98 &= r && \text{Simplify.} \end{aligned}$$

Thus, the radius is $r = 6.98$ inches. To find the area, use the formula $A = \pi r^2$.

$$\begin{aligned} A &= \pi r^2 && \text{Area formula.} \\ A &= 3.14(6.98)^2 && \text{Substitute: 3.14 for } \pi, \text{ 6.98 for } r. \\ A &= 3.14(48.7204) && \text{Square: } (6.98)^2 = 48.7204. \\ A &= 152.982056 && \text{Multiply: } 3.14(48.7204) = 152.982056. \end{aligned}$$

To round to the nearest hundredth of a square inch, locate the rounding digit and the test digit.




Because the test digit is less than 5, leave the rounding digit alone, then truncate. Thus, to the nearest hundredth of a square inch, the area of the circle is approximately $A \approx 152.98$ inches.

**97.** Because the pond has the shape of a cylinder, we can use the formula $V = \pi r^2 h$ to find the volume. Because the diameter of the base is 15 feet, the radius is 7.5 feet (half the diameter). Thus, the volume is

$$\begin{aligned} V &= \pi r^2 h && \text{Formula for volume of a cylinder.} \\ &= (3.14)(7.5)^2(1.5) && \text{Substitute: 3.14 for } \pi, \\ & && 7.5 \text{ for } r, \text{ and 1.5 for } h. \\ &= (3.14)(56.25)(1.5) && \text{Exponent first: } (7.5)^2 = 56.25. \\ &= 264.9375 \end{aligned}$$

Thus, the volume is 264.9375 cubic feet.

**99.**

a) New income:

| New Income | = | Overtime Income | + | Regular Income |
|---|---|---|---|---|
| | = | $32 \cdot 10.30 \cdot 1.5$ | + | $136 \cdot 10.30$ |
| | = | \$494.40 | + | \$1400.80 |
| | = | \$1895.20 | | |

b) This represents an increase over his original (see Exercise **??**) income of \$1730.40.

| Income Increase | = | New Income | − | Old income |
|---|---|---|---|---|
| | = | \$1895.20 | − | \$1730.40 |
| | = | \$164.80 | | |

**101.** To find the dollar amount of grape revenue for one acre, multiply the price per ton of grapes by the number of tons of grapes that can be grown on one acre.

| Revenue | = | Price per ton | · | number of tons |
|---|---|---|---|---|
| | = | $3,414$ | · | 3.5 |
| | = | $11,949$ | | |

Therefore, the dollars generated on one acre of premium cabernet are about $\$11,949$.

**103.**

a) To find the total number of pounds, multiply the number of pigs by the number of pounds for each pig. Since the numbers are all powers of ten, you can move the decimal point the appropriate number of places and add zeros.

| Total pounds of pig | = | number of pigs | · | pounds per pig |
|---|---|---|---|---|
| | = | $1,000$ | · | 100 |
| | = | $100,000$ | | |

Therefore, a typical corporate agribarn houses approximately 100,000 pounds of pig.

b) To find the cash value for the entire warehouse, multiply the total number of pounds by the price per pound.

| Cash value | = | number of pounds | · | price per pound |
|---|---|---|---|---|
| | = | 100,000 | · | 1.29 |
| | = | 129,000 | | |

Therefore, the cash value for one corporate agribarn is about $129,000.

**105.** To find the circumference, use the formula $C = \pi d$. Substitute 3.14 for $\pi$ and 230 for $d$, then multiply.

| | |
|---|---|
| $C = \pi d$ | Circumference formula. |
| $C = 3.14(230)$ | Substitute: 3.14 for $\pi$, 230 for $d$. |
| $C = 722.2$ | Multiply: $3.14(230) = 722.2$. |

Therefore, to the nearest tenth, the circumference of the radio dish is 722.2 feet.

## 5.4 Dividing Decimals

**1.** By long division,

$$\begin{array}{r} 0.75 \\ 52\overline{)39.00} \\ \underline{36\ 4} \\ 2\ 60 \\ \underline{2\ 60} \\ 0 \end{array}$$

Therefore, $\dfrac{39}{52} = 0.75$.

**3.** By long division,

$$\begin{array}{r} 9.1 \\ 83\overline{)755.3} \\ \underline{747} \\ 8\ 3 \\ \underline{8\ 3} \\ 0 \end{array}$$

Therefore, $\dfrac{755.3}{83} = 9.1$.

**5.** By long division,

$$\begin{array}{r} 4.5 \\ 74\overline{)333.0} \\ \underline{296} \\ 37\,0 \\ \underline{37\,0} \\ 0 \end{array}$$

Therefore, $\dfrac{333}{74} = 4.5$.

**7.** By long division,

$$\begin{array}{r} 0.44 \\ 73\overline{)32.12} \\ \underline{29\,2} \\ 2\,92 \\ \underline{2\,92} \\ 0 \end{array}$$

Therefore, $\dfrac{32.12}{73} = 0.44$.

**9.** By long division,

$$\begin{array}{r} 0.53 \\ 71\overline{)37.63} \\ \underline{35\,5} \\ 2\,13 \\ \underline{2\,13} \\ 0 \end{array}$$

Therefore, $\dfrac{37.63}{71} = 0.53$.

**11.** By long division,

$$\begin{array}{r} 1.5 \\ 92\overline{)138.0} \\ \underline{92} \\ 46\,0 \\ \underline{46\,0} \\ 0 \end{array}$$

Therefore, $\dfrac{138}{92} = 1.5$.

**13.** By long division,

$$\begin{array}{r} 0.68 \\ 25\overline{)17.00} \\ \underline{15\ 0} \\ 2\ 00 \\ \underline{2\ 00} \\ 0 \end{array}$$

Therefore, $\dfrac{17}{25} = 0.68$.

**15.** By long division,

$$\begin{array}{r} 4.5 \\ 51\overline{)229.5} \\ \underline{204} \\ 25\ 5 \\ \underline{25\ 5} \\ 0 \end{array}$$

Therefore, $\dfrac{229.5}{51} = 4.5$.

**17.** Move the decimal point in the divisor and dividend two places to the right:

$$\frac{0.3478}{0.47} = \frac{34.78}{47}$$

Then, by long division,

$$\begin{array}{r} 0.74 \\ 47\overline{)34.78} \\ \underline{32\ 9} \\ 1\ 88 \\ \underline{1\ 88} \\ 0 \end{array}$$

Therefore, $\dfrac{0.3478}{0.47} = 0.74$.

**19.** Move the decimal point in the divisor and dividend one place to the right:

$$\frac{1.694}{2.2} = \frac{16.94}{22}$$

Then, by long division,

$$\begin{array}{r} 0.77 \\ 22\overline{)16.94} \\ \underline{15\ 4} \\ 1\ 54 \\ \underline{1\ 54} \\ 0 \end{array}$$

Therefore, $\dfrac{1.694}{2.2} = 0.77$.

**21.** Move the decimal point in the divisor and dividend one place to the right:

$$\frac{43.61}{4.9} = \frac{436.1}{49}$$

Then, by long division,

$$\begin{array}{r} 8.9 \\ 49\overline{)436.1} \\ \underline{392} \\ 44\ 1 \\ \underline{44\ 1} \\ 0 \end{array}$$

Therefore, $\dfrac{43.61}{4.9} = 8.9$.

**23.** Move the decimal point in the divisor and dividend two places to the right:

$$\frac{1.107}{0.41} = \frac{110.7}{41}$$

Then, by long division,

$$\begin{array}{r} 2.7 \\ 41\overline{)110.7} \\ \underline{82} \\ 28\ 7 \\ \underline{28\ 7} \\ 0 \end{array}$$

Therefore, $\dfrac{1.107}{0.41} = 2.7$.

**25.** Move the decimal point in the divisor and dividend two places to the right:

$$\frac{2.958}{0.51} = \frac{295.8}{51}$$

Then, by long division,

$$\begin{array}{r} 5.8 \\ 51\overline{)295.8} \\ \underline{255} \\ 40\,8 \\ \underline{40\,8} \\ 0 \end{array}$$

Therefore, $\dfrac{2.958}{0.51} = 5.8$.

**27.** Move the decimal point in the divisor and dividend one place to the right:

$$\frac{71.76}{7.8} = \frac{717.6}{78}$$

Then, by long division,

$$\begin{array}{r} 9.2 \\ 78\overline{)717.6} \\ \underline{702} \\ 15\,6 \\ \underline{15\,6} \\ 0 \end{array}$$

Therefore, $\dfrac{71.76}{7.8} = 9.2$.

**29.** Move the decimal point in the divisor and dividend two places to the right:

$$\frac{0.8649}{0.93} = \frac{86.49}{93}$$

Then, by long division,

$$\begin{array}{r} 0.93 \\ 93\overline{)86.49} \\ \underline{83\,7} \\ 2\,79 \\ \underline{2\,79} \\ 0 \end{array}$$

Therefore, $\dfrac{0.8649}{0.93} = 0.93$.

**31.** Move the decimal point in the divisor and dividend two places to the right:

$$\frac{0.6958}{0.71} = \frac{69.58}{71}$$

Then, by long division,

$$\begin{array}{r} 0.98 \\ 71\overline{)69.58} \\ \underline{63\ 9} \\ 5\ 68 \\ \underline{5\ 68} \\ 0 \end{array}$$

Therefore, $\dfrac{0.6958}{0.71} = 0.98$.

**33.** Move the decimal point in the divisor and dividend two places to the right:

$$\frac{1.248}{0.52} = \frac{124.8}{52}$$

Then, by long division,

$$\begin{array}{r} 2.4 \\ 52\overline{)124.8} \\ \underline{104} \\ 20\ 8 \\ \underline{20\ 8} \\ 0 \end{array}$$

Therefore, $\dfrac{1.248}{0.52} = 2.4$.

**35.** Move the decimal point in the divisor and dividend one place to the right:

$$\frac{62.56}{9.2} = \frac{625.6}{92}$$

Then, by long division,

$$\begin{array}{r} 6.8 \\ 92\overline{)625.6} \\ \underline{552} \\ 73\ 6 \\ \underline{73\ 6} \\ 0 \end{array}$$

Therefore, $\dfrac{62.56}{9.2} = 6.8$.

**37.** Move the decimal point in the divisor and dividend one place to the right:

$$\frac{6.278}{8.6} = \frac{62.78}{86}$$

Then, by long division,

$$\begin{array}{r} 0.73 \\ 86\overline{)62.78} \\ \underline{60\ 2} \\ 2\ 58 \\ \underline{2\ 58} \\ 0 \end{array}$$

Therefore, $\dfrac{6.278}{8.6} = 0.73$.

**39.** Move the decimal point in the divisor and dividend one place to the right:

$$\frac{2.698}{7.1} = \frac{26.98}{71}$$

Then, by long division,

$$\begin{array}{r} 0.38 \\ 71\overline{)26.98} \\ \underline{21\ 3} \\ 5\ 68 \\ \underline{5\ 68} \\ 0 \end{array}$$

Therefore, $\dfrac{2.698}{7.1} = 0.38$.

**41.** First divide the magnitudes. Move the decimal point in the divisor and dividend one place to the right:

$$\frac{-11.04}{1.6} = \frac{110.4}{16}$$

Then, by long division,

$$\begin{array}{r} 6.9 \\ 16\overline{)110.4} \\ \underline{96} \\ 14\ 4 \\ \underline{14\ 4} \\ 0 \end{array}$$

Unlike signs give a negative quotient, so $\dfrac{-11.04}{1.6} = -6.9$.

**43.** First divide the magnitudes. Move the decimal point in the divisor and dividend one place to the right:

$$\frac{3.024}{5.6} = \frac{30.24}{56}$$

Then, by long division,

$$\begin{array}{r} 0.54 \\ 56\overline{)30.24} \\ \underline{28\ 0} \\ 2\ 24 \\ \underline{2\ 24} \\ 0 \end{array}$$

Unlike signs give a negative quotient, so $\dfrac{-3.024}{5.6} = -0.54$.

**45.** First divide the magnitudes. Move the decimal point in the divisor and dividend two places to the right:

$$\frac{0.1056}{0.22} = \frac{10.56}{22}$$

Then, by long division,

$$\begin{array}{r} 0.48 \\ 22\overline{)10.56} \\ \underline{8\ 8} \\ 1\ 76 \\ \underline{1\ 76} \\ 0 \end{array}$$

Unlike signs give a negative quotient, so $\dfrac{-0.1056}{0.22} = -0.48$.

**47.** First divide the magnitudes. Move the decimal point in the divisor and dividend two places to the right:

$$\frac{0.3204}{0.89} = \frac{32.04}{89}$$

Then, by long division,

$$\begin{array}{r} 0.36 \\ 89\overline{)32.04} \\ \underline{26\ 7} \\ 5\ 34 \\ \underline{5\ 34} \\ 0 \end{array}$$

Unlike signs give a negative quotient, so $\dfrac{0.3204}{-0.89} = -0.36$.

**49.** First divide the magnitudes. Move the decimal point in the divisor and dividend two places to the right:

$$\frac{1.419}{0.43} = \frac{141.9}{43}$$

Then, by long division,

$$\begin{array}{r} 3.3 \\ 43\overline{)141.9} \\ \underline{129} \\ 12\,9 \\ \underline{12\,9} \\ 0 \end{array}$$

Unlike signs give a negative quotient, so $\dfrac{-1.419}{0.43} = -3.3$.

**51.** First divide the magnitudes. Move the decimal point in the divisor and dividend one place to the right:

$$\frac{-16.72}{-2.2} = \frac{167.2}{22}$$

Then, by long division,

$$\begin{array}{r} 7.6 \\ 22\overline{)167.2} \\ \underline{154} \\ 13\,2 \\ \underline{13\,2} \\ 0 \end{array}$$

Like signs give a positive quotient, so $\dfrac{-16.72}{-2.2} = 7.6$.

**53.** First divide the magnitudes. Move the decimal point in the divisor and dividend two places to the right:

$$\frac{2.088}{0.87} = \frac{208.8}{87}$$

Then, by long division,

$$\begin{array}{r} 2.4 \\ 87\overline{)208.8} \\ \underline{174} \\ 34\,8 \\ \underline{34\,8} \\ 0 \end{array}$$

Like signs give a positive quotient, so $\dfrac{-2.088}{-0.87} = 2.4$.

**55.** First divide the magnitudes. Move the decimal point in the divisor and dividend one place to the right:

$$\frac{1.634}{8.6} = \frac{16.34}{86}$$

Then, by long division,

$$\begin{array}{r} 0.19 \\ 86\overline{)16.34} \\ \underline{8\,6} \\ 7\,74 \\ \underline{7\,74} \\ 0 \end{array}$$

Like signs give a positive quotient, so $\dfrac{-1.634}{-8.6} = 0.19$.

**57.** First divide the magnitudes. Move the decimal point in the divisor and dividend two places to the right:

$$\frac{0.119}{0.85} = \frac{11.9}{85}$$

Then, by long division,

$$\begin{array}{r} 0.14 \\ 85\overline{)11.90} \\ \underline{8\,5} \\ 3\,40 \\ \underline{3\,40} \\ 0 \end{array}$$

Unlike signs give a negative quotient, so $\dfrac{-0.119}{0.85} = -0.14$.

**59.** First divide the magnitudes. Move the decimal point in the divisor and dividend one place to the right:

$$\frac{3.591}{6.3} = \frac{35.91}{63}$$

Then, by long division,

$$\begin{array}{r} 0.57 \\ 63\overline{)35.91} \\ \underline{31\,5} \\ 4\,41 \\ \underline{4\,41} \\ 0 \end{array}$$

Like signs give a positive quotient, so $\dfrac{-3.591}{-6.3} = 0.57$.

**61.** First divide the magnitudes. Move the decimal point in the divisor and dividend one place to the right:

$$\frac{36.96}{-4.4} = \frac{369.6}{44}$$

Then, by long division,

$$\begin{array}{r} 8.4 \\ 44\overline{)369.6} \\ \underline{352} \\ 17\,6 \\ \underline{17\,6} \\ 0 \end{array}$$

Unlike signs give a negative quotient, so $\dfrac{36.96}{-4.4} = -8.4$.

**63.** First divide the magnitudes. Move the decimal point in the divisor and dividend two places to the right:

$$\frac{2.156}{0.98} = \frac{215.6}{98}$$

Then, by long division,

$$\begin{array}{r} 2.2 \\ 98\overline{)215.6} \\ \underline{196} \\ 19\,6 \\ \underline{19\,6} \\ 0 \end{array}$$

Like signs give a positive quotient, so $\dfrac{-2.156}{-0.98} = 2.2$.

**65.** Move the decimal point 2 places to the left:

$$\frac{524.35}{100} = 5.2435$$

**67.** Move the decimal point 3 places to the left:

$$\frac{563.94}{10^3} = 0.56394$$

**69.** Move the decimal point 2 places to the left:

$$\frac{116.81}{10^2} = 1.1681$$

**71.** Move the decimal point 1 places to the left:

$$\frac{694.55}{10} = 69.455$$

**73.** Move the decimal point 3 places to the left:

$$\frac{341.16}{10^3} = 0.34116$$

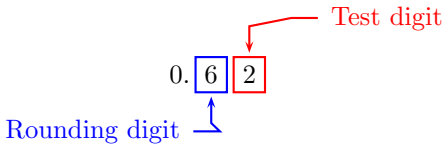
**75.** Move the decimal point 3 places to the left:

$$\frac{113.02}{1000} = 0.11302$$

**77.** First use long division to find the hundredth place of the quotient.

$$\begin{array}{r} 0.62 \\ 83\overline{)52.00} \\ 49\ 8 \\ \hline 2\ 20 \\ 1\ 66 \\ \hline 54 \end{array}$$

Then round to the nearest tenth. Locate the rounding digit in the tenths place and the test digit in the hundredths place.

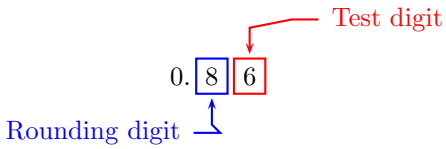



Because the test digit is less than 5, leave the rounding digit alone, then truncate. Hence, rounded to the nearest tenth, $52/83 \approx 0.6$.

**79.** First use long division to find the hundredth place of the quotient.

$$\begin{array}{r} 0.86 \\ 59\overline{)51.00} \\ 47\ 2 \\ \hline 3\ 80 \\ 3\ 54 \\ \hline 26 \end{array}$$

Then round to the nearest tenth. Locate the rounding digit in the tenths place and the test digit in the hundredths place.

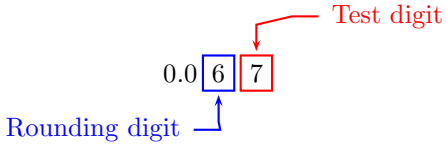



Because the test digit is greater than or equal to 5, add 1 to the rounding digit, then truncate. Hence, rounded to the nearest tenth, $51/59 \approx 0.9$.

**81.** First use long division to find the thousandth place of the quotient.

$$\begin{array}{r} 0.067 \\ 74\overline{)5.000} \\ 4\ 44 \\ \hline 560 \\ 518 \\ \hline 42 \end{array}$$

Then round to the nearest hundredth. Locate the rounding digit in the hundredths place and the test digit in the thousandths place.

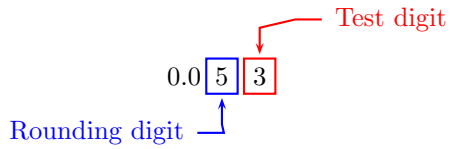



Because the test digit is greater than or equal to 5, add 1 to the rounding digit, then truncate. Hence, rounded to the nearest hundredth, $5/74 \approx 0.07$.

**83.** First use long division to find the thousandth place of the quotient.

$$\begin{array}{r} 0.053 \\ 94\overline{)5.000} \\ \underline{4\ 70} \\ 300 \\ \underline{282} \\ 18 \end{array}$$

Then round to the nearest hundredth. Locate the rounding digit in the hundredths place and the test digit in the thousandths place.

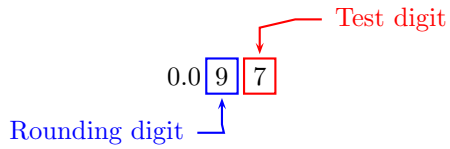



Because the test digit is less than 5, leave the rounding digit alone, then truncate. Hence, rounded to the nearest hundredth, $5/94 \approx 0.05$.

**85.** First use long division to find the thousandth place of the quotient.

$$\begin{array}{r} 0.097 \\ 72\overline{)7.000} \\ \underline{6\ 48} \\ 520 \\ \underline{504} \\ 16 \end{array}$$

Then round to the nearest hundredth. Locate the rounding digit in the hundredths place and the test digit in the thousandths place.

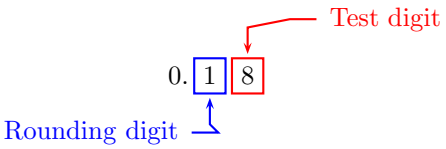



Because the test digit is greater than or equal to 5, add 1 to the rounding digit, then truncate. Hence, rounded to the nearest hundredth, $7/72 \approx 0.10$.

**87.** First use long division to find the hundredth place of the quotient.

$$\begin{array}{r} 0.18 \\ 86\overline{)16.00} \\ \underline{8\,6} \\ 7\,40 \\ \underline{6\,88} \\ 52 \end{array}$$

Then round to the nearest tenth. Locate the rounding digit in the tenths place and the test digit in the hundredths place.




Because the test digit is greater than or equal to 5, add 1 to the rounding digit, then truncate. Hence, rounded to the nearest tenth, $16/86 \approx 0.2$.

**89.** The numerator must be simplified first. This requires multiplying and then subtracting.

$$\begin{aligned} \frac{7.5 \cdot 7.1 - 19.5}{0.54} &= \frac{53.25 - 19.5}{0.54} && \text{Multiply: } 7.5 \cdot 7.1 = 53.25. \\ &= \frac{53.25 + (-19.5)}{0.54} && \text{Subtract: Add the opposite.} \\ &= \frac{33.75}{0.54} && \text{Add: } 53.25 + (-19.5) = 33.75. \\ &= 62.5 && \text{Divide: } 33.75/0.54 = 62.5. \end{aligned}$$

**91.** With a fractional expression, simplify numerator and denominator first, then divide.

$$\begin{aligned} \frac{17.76 - (-11.7)}{0.5^2} &= \frac{17.76 - (-11.7)}{0.25} && \text{Exponents: } 0.5^2 = 0.25. \\ &= \frac{17.76 + 11.7}{0.25} && \text{Subtract: Add the opposite.} \\ &= \frac{29.46}{0.25} && \text{Add: } 17.76 + 11.7 = 29.46. \\ &= 117.84 && \text{Divide: } 29.46/0.25 = 117.84. \end{aligned}$$

**93.** With a fractional expression, simplify numerator and denominator first, then divide.

$$\frac{-18.22-6.7}{14.75-7.75}=\frac{-18.22+(-6.7)}{14.75+(-7.75)}$$ In numerator and denominator, add the opposite.

$$=\frac{-24.92}{7}$$ Numerator: $-18.22+(-6.7)=-24.92$. Denominator: $14.75+(-7.75)=7$.

$$=-3.56$$ Divide: $-24.92/7=-3.56$.

**95.** With a fractional expression, simplify numerator and denominator first, then divide.

$$\frac{-12.9-(-10.98)}{0.5^2}=\frac{-12.9-(-10.98)}{0.25}$$ Exponents: $0.5^2=0.25$.

$$=\frac{-12.9+10.98}{0.25}$$ Subtract: Add the opposite.

$$=\frac{-1.92}{0.25}$$ Add: $-12.9+10.98=-1.92$.

$$=-7.68$$ Divide: $-1.92/0.25=-7.68$.

**97.** The numerator must be simplified first. This requires multiplying and then subtracting.

$$\frac{-9.5\cdot 1.6-3.7}{-3.6}=\frac{-15.2-3.7}{-3.6}$$ Multiply: $-9.5\cdot 1.6=-15.2$.

$$=\frac{-15.2+(-3.7)}{-3.6}$$ Subtract: Add the opposite.

$$=\frac{-18.9}{-3.6}$$ Add: $-15.2+(-3.7)=-18.9$.

$$=5.25$$ Divide: $-18.9/(-3.6)=5.25$.

**99.** With a fractional expression, simplify numerator and denominator first, then divide.

$$\frac{-14.98-9.6}{17.99-19.99}=\frac{-14.98+(-9.6)}{17.99+(-19.99)}$$ In numerator and denominator, add the opposite.

$$=\frac{-24.58}{-2}$$ Numerator: $-14.98+(-9.6)=-24.58$. Denominator: $17.99+(-19.99)=-2$.

$$=12.29$$ Divide: $-24.58/(-2)=12.29$.

**101.** First, substitute $a = -2.21$, $c = 3.3$, and $d = 0.5$ in the given expression.

$$\frac{a-c}{d^2} = \frac{-2.21-3.3}{(0.5)^2} \qquad \text{Substitute.}$$

With a fractional expression, simplify numerator and denominator first, then divide.

$$\begin{aligned}
&= \frac{-2.21-3.3}{0.25} && \text{Exponents: } 0.5^2 = 0.25.\\
&= \frac{-2.21+(-3.3)}{0.25} && \text{Subtract: Add the opposite.}\\
&= \frac{-5.51}{0.25} && \text{Add: } -2.21+(-3.3) = -5.51.\\
&= -22.04 && \text{Divide: } -5.51/0.25 = -22.04.
\end{aligned}$$

**103.** First substitute $a = -5.8$, $b = 10.37$, $c = 4.8$, and $d = 5.64$.

$$\frac{a-b}{c-d} = \frac{-5.8-10.37}{4.8-5.64} \qquad \text{Substitute.}$$

With a fractional expression, simplify numerator and denominator first, then divide.

$$\begin{aligned}
&= \frac{-5.8+(-10.37)}{4.8+(-5.64)} && \text{In numerator and denominator, add the opposite.}\\
&= \frac{-16.17}{-0.84} && \text{Numerator: } -5.8+(-10.37) = -16.17.\\
& && \text{Denominator: } 4.8+(-5.64) = -0.84.\\
&= 19.25 && \text{Divide: } -16.17/(-0.84) = 19.25.
\end{aligned}$$

**105.** First, substitute $a = -1.5$, $b = 4.7$, $c = 18.8$, and $d = -11.75$ in the given expression.

$$\frac{ab-c}{d} = \frac{(-1.5)(4.7)-(18.8)}{-11.75} \qquad \text{Substitute.}$$

The numerator must be simplified first. This requires multiplying and then subtracting.

$$\begin{aligned}
&= \frac{-7.05-18.8}{-11.75} && \text{Multiply: } (-1.5)(4.7) = -7.05.\\
&= \frac{-7.05+(-18.8)}{-11.75} && \text{Subtract: Add the opposite.}\\
&= \frac{-25.85}{-11.75} && \text{Add: } -7.05+(-18.8) = -25.85.\\
&= 2.2 && \text{Divide: } -25.85/(-11.75) = 2.2.
\end{aligned}$$

**107.** To find the average number of biodiesel plants operating in each state, divide the total number of biodiesel plants by the number of states that have biodiesel plants.

| Average biodiesel plants per state | = | Total number biodiesel plants | ÷ | number of states with biodiesel plants |
|---|---|---|---|---|
| | = | 180 | ÷ | 40 |
| | = | 4.5 | | |

Of the states that have biodiesel plants, there is an average of 4.5 plants per state.

**109.** To find the backlog for each examiner, divide the number of applications by the number of examiners.

| Number applications per examiner | = | total applications | ÷ | number examiners |
|---|---|---|---|---|
| | = | 770,000 | ÷ | 6000 |
| | = | 128.33... | | |

To the nearest tenth, each examiner has about 128.3 applications to catch up on.

**111.** To find the average money spent each month, divide the total amount of money spent by the number of months.

| Average spent each month | = | total spent | ÷ | number months |
|---|---|---|---|---|
| | = | 100 | ÷ | 6 |
| | = | 16.666... | | |

To the nearest hundredth of a million, the Pentagon spent about $16.67 million each month defending against cyber-attacks.

**113.** First, we need to find the total cost of the mailing. Add up the costs of each piece of mail.

$$2.77 + 3.16 + 3.94 = 9.87$$

So the total cost of the mailing was $9.87. Now, we need to find the total number of pounds in the mailing. Add up the weights of each piece of mail.

$$2 + 3 + 5 = 10$$

The total weight of the mailing was 10 pounds. Now, to find the average cost per pound, divide the total cost by the total number of pounds of mail.

| cost to mail per pound | = | total cost of mailing | ÷ | total number pounds of mail |
|---|---|---|---|---|
| | = | 9.87 | ÷ | 10 |
| | = | 0.987 | | |

To the nearest penny, it cost about \$0.99 for each pound of mail.

## 5.5 Fractions and Decimals

**1.** The fraction 59/16 is already reduced to lowest terms. The prime factorization of the denominator is $16 = 2 \cdot 2 \cdot 2 \cdot 2$. Since the prime factorization consists of only twos and fives, dividing 59 by 16 will yield a terminating decimal:

$$\frac{59}{16} = 3.6875$$

**3.** The fraction 35/4 is already reduced to lowest terms. The prime factorization of the denominator is $4 = 2 \cdot 2$. Since the prime factorization consists of only twos and fives, dividing 35 by 4 will yield a terminating decimal:

$$\frac{35}{4} = 8.75$$

**5.** The fraction 1/16 is already reduced to lowest terms. The prime factorization of the denominator is $16 = 2 \cdot 2 \cdot 2 \cdot 2$. Since the prime factorization consists of only twos and fives, dividing 1 by 16 will yield a terminating decimal:

$$\frac{1}{16} = 0.0625$$

**7.** First reduce the fraction 6/8 to lowest terms:

$$\begin{aligned} \frac{6}{8} &= \frac{2 \cdot 3}{2 \cdot 2 \cdot 2} && \text{Prime factorization.} \\ &= \frac{3}{2 \cdot 2} && \text{Cancel common factors.} \\ &= \frac{3}{4} && \text{Simplify numerator and denominator.} \end{aligned}$$

The prime factorization of the new denominator is $4 = 2 \cdot 2$. Since the prime factorization consists of only twos and fives, dividing 3 by 4 will yield a terminating decimal:

$$\frac{3}{4} = 0.75$$

**9.** The fraction 3/2 is already reduced to lowest terms. The denominator is the prime number 2. Therefore, since the prime factorization of the denominator consists of only twos and fives, dividing 3 by 2 will yield a terminating decimal:

$$\frac{3}{2} = 1.5$$

**11.** First reduce the fraction 119/175 to lowest terms:

$$\begin{aligned} \frac{119}{175} &= \frac{7 \cdot 17}{5 \cdot 5 \cdot 7} && \text{Prime factorization.} \\ &= \frac{17}{5 \cdot 5} && \text{Cancel common factors.} \\ &= \frac{17}{25} && \text{Simplify numerator and denominator.} \end{aligned}$$

The prime factorization of the new denominator is $25 = 5 \cdot 5$. Since the prime factorization consists of only twos and fives, dividing 17 by 25 will yield a terminating decimal:

$$\frac{17}{25} = 0.68$$

**13.** The fraction 9/8 is already reduced to lowest terms. The prime factorization of the denominator is $8 = 2 \cdot 2 \cdot 2$. Since the prime factorization consists of only twos and fives, dividing 9 by 8 will yield a terminating decimal:

$$\frac{9}{8} = 1.125$$

**15.** First reduce the fraction 78/240 to lowest terms:

$$\begin{aligned} \frac{78}{240} &= \frac{2 \cdot 3 \cdot 13}{2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 \cdot 5} && \text{Prime factorization.} \\ &= \frac{13}{2 \cdot 2 \cdot 2 \cdot 5} && \text{Cancel common factors.} \\ &= \frac{13}{40} && \text{Simplify numerator and denominator.} \end{aligned}$$

The prime factorization of the new denominator is $40 = 2 \cdot 2 \cdot 2 \cdot 5$. Since the prime factorization consists of only twos and fives, dividing 13 by 40 will yield a terminating decimal:

$$\frac{13}{40} = 0.325$$

**17.** First reduce the fraction 25/10 to lowest terms:

$$\begin{aligned} \frac{25}{10} &= \frac{5 \cdot 5}{2 \cdot 5} && \text{Prime factorization.} \\ &= \frac{5}{2} && \text{Cancel common factors.} \\ &= \frac{5}{2} && \text{Simplify numerator and denominator.} \end{aligned}$$

The new denominator is the prime number 2. Therefore, since the prime factorization of the new denominator consists of only twos and fives, dividing 5 by 2 will yield a terminating decimal:

$$\frac{5}{2} = 2.5$$

**19.** First reduce the fraction 9/24 to lowest terms:

$$\begin{aligned} \frac{9}{24} &= \frac{3 \cdot 3}{2 \cdot 2 \cdot 2 \cdot 3} && \text{Prime factorization.} \\ &= \frac{3}{2 \cdot 2 \cdot 2} && \text{Cancel common factors.} \\ &= \frac{3}{8} && \text{Simplify numerator and denominator.} \end{aligned}$$

The prime factorization of the new denominator is $8 = 2 \cdot 2 \cdot 2$. Since the prime factorization consists of only twos and fives, dividing 3 by 8 will yield a terminating decimal:

$$\frac{3}{8} = 0.375$$

**21.** First reduce the fraction 256/180 to lowest terms:

$$\begin{aligned} \frac{256}{180} &= \frac{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}{2 \cdot 2 \cdot 3 \cdot 3 \cdot 5} && \text{Prime factorization.} \\ &= \frac{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}{3 \cdot 3 \cdot 5} && \text{Cancel common factors.} \\ &= \frac{64}{45} && \text{Simplify numerator and denominator.} \end{aligned}$$

The prime factorization of the denominator is $45 = 3 \cdot 3 \cdot 5$. Since the prime factorization does not consist of only twos and fives, dividing 64 by 45 will yield a repeating decimal:

$$\frac{64}{45} = 1.4\overline{2}$$

**23.** First reduce the fraction 364/12 to lowest terms:

$$\begin{aligned}\frac{364}{12} &= \frac{2\cdot 2\cdot 7\cdot 13}{2\cdot 2\cdot 3} && \text{Prime factorization.}\\ &= \frac{7\cdot 13}{3} && \text{Cancel common factors.}\\ &= \frac{91}{3} && \text{Simplify numerator and denominator.}\end{aligned}$$

The prime factorization of the denominator is $3 = 3$. Since the prime factorization does not consist of only twos and fives, dividing 91 by 3 will yield a repeating decimal:

$$\frac{91}{3} = 30.\overline{3}$$

**25.** The fraction 81/110 is already reduced to lowest terms. The prime factorization of the denominator is $110 = 2\cdot 5\cdot 11$. Since the prime factorization does not consist of only twos and fives, dividing 81 by 110 will yield a repeating decimal:

$$\frac{81}{110} = 0.7\overline{36}$$

**27.** The fraction 76/15 is already reduced to lowest terms. The prime factorization of the denominator is $15 = 3\cdot 5$. Since the prime factorization does not consist of only twos and fives, dividing 76 by 15 will yield a repeating decimal:

$$\frac{76}{15} = 5.0\overline{6}$$

**29.** The fraction 50/99 is already reduced to lowest terms. The prime factorization of the denominator is $99 = 3\cdot 3\cdot 11$. Since the prime factorization does not consist of only twos and fives, dividing 50 by 99 will yield a repeating decimal:

$$\frac{50}{99} = 0.\overline{50}$$

**31.** The fraction 61/15 is already reduced to lowest terms. The prime factorization of the denominator is $15 = 3\cdot 5$. Since the prime factorization does not consist of only twos and fives, dividing 61 by 15 will yield a repeating decimal:

$$\frac{61}{15} = 4.0\overline{6}$$

**33.** First reduce the fraction 98/66 to lowest terms:

$$\begin{aligned}\frac{98}{66} &= \frac{2\cdot 7\cdot 7}{2\cdot 3\cdot 11} && \text{Prime factorization.}\\ &= \frac{7\cdot 7}{3\cdot 11} && \text{Cancel common factors.}\\ &= \frac{49}{33} && \text{Simplify numerator and denominator.}\end{aligned}$$

The prime factorization of the denominator is $33 = 3\cdot 11$. Since the prime factorization does not consist of only twos and fives, dividing 49 by 33 will yield a repeating decimal:

$$\frac{49}{33} = 1.\overline{48}$$

**35.** First reduce the fraction 190/495 to lowest terms:

$$\begin{aligned}\frac{190}{495} &= \frac{2\cdot 5\cdot 19}{3\cdot 3\cdot 5\cdot 11} && \text{Prime factorization.}\\ &= \frac{2\cdot 19}{3\cdot 3\cdot 11} && \text{Cancel common factors.}\\ &= \frac{38}{99} && \text{Simplify numerator and denominator.}\end{aligned}$$

The prime factorization of the denominator is $99 = 3\cdot 3\cdot 11$. Since the prime factorization does not consist of only twos and fives, dividing 38 by 99 will yield a repeating decimal:

$$\frac{38}{99} = 0.\overline{38}$$

**37.** The fraction 13/15 is already reduced to lowest terms. The prime factorization of the denominator is $15 = 3\cdot 5$. Since the prime factorization does not consist of only twos and fives, dividing 13 by 15 will yield a repeating decimal:

$$\frac{13}{15} = 0.8\overline{6}$$

**39.** First reduce the fraction 532/21 to lowest terms:

$$\begin{aligned}\frac{532}{21} &= \frac{2\cdot 2\cdot 7\cdot 19}{3\cdot 7} && \text{Prime factorization.}\\ &= \frac{2\cdot 2\cdot 19}{3} && \text{Cancel common factors.}\\ &= \frac{76}{3} && \text{Simplify numerator and denominator.}\end{aligned}$$

The prime factorization of the denominator is $3 = 3$. Since the prime factorization does not consist of only twos and fives, dividing 76 by 3 will yield a repeating decimal:

$$\frac{76}{3} = 25.\overline{3}$$

**41.** First reduce the fraction 26/198 to lowest terms:

$$\begin{aligned} \frac{26}{198} &= \frac{2 \cdot 13}{2 \cdot 3 \cdot 3 \cdot 11} && \text{Prime factorization.} \\ &= \frac{13}{3 \cdot 3 \cdot 11} && \text{Cancel common factors.} \\ &= \frac{13}{99} && \text{Simplify numerator and denominator.} \end{aligned}$$

The prime factorization of the denominator is $99 = 3 \cdot 3 \cdot 11$. Since the prime factorization does not consist of only twos and fives, dividing 13 by 99 will yield a repeating decimal:

$$\frac{13}{99} = 0.\overline{13}$$

**43.** The fraction 47/66 is already reduced to lowest terms. The prime factorization of the denominator is $66 = 2 \cdot 3 \cdot 11$. Since the prime factorization does not consist of only twos and fives, dividing 47 by 66 will yield a repeating decimal:

$$\frac{47}{66} = 0.7\overline{12}$$

**45.** First convert the fraction 7/4 into an equivalent terminating decimal. Then subtract the decimals in the new expression.

$$\begin{aligned} \frac{7}{4} - 7.4 &= 1.75 - 7.4 && \text{Replace } 7/4 \text{ with } 1.75. \\ &= -5.65 && \text{Subtract.} \end{aligned}$$

Thus, $7/4 - 7.4 = -5.65$.

**47.** First convert the fraction 7/5 into an equivalent terminating decimal. Then add the decimals in the new expression.

$$\begin{aligned} \frac{7}{5} + 5.31 &= 1.4 + 5.31 && \text{Replace } 7/5 \text{ with } 1.4. \\ &= 6.71 && \text{Add.} \end{aligned}$$

Thus, $7/5 + 5.31 = 6.71$.

**49.** First convert the fraction 9/10 into an equivalent terminating decimal. Then subtract the decimals in the new expression.

$$\begin{aligned} \frac{9}{10} - 8.61 &= 0.9 - 8.61 && \text{Replace } 9/10 \text{ with } 0.9. \\ &= -7.71 && \text{Subtract.} \end{aligned}$$

Thus, $9/10 - 8.61 = -7.71$.

**51.** First convert the fraction 6/5 into an equivalent terminating decimal. Then subtract the decimals in the new expression.

$$\begin{aligned} \frac{6}{5} - 7.65 &= 1.2 - 7.65 && \text{Replace } 6/5 \text{ with } 1.2. \\ &= -6.45 && \text{Subtract.} \end{aligned}$$

Thus, $6/5 - 7.65 = -6.45$.

**53.** The fraction 7/6 is equivalent to a repeating decimal. Therefore, the strategy is to instead convert the decimal 2.9 into an equivalent fraction, and then subtract the fractions in the new expression.

$$\begin{aligned} \frac{7}{6} - 2.9 &= \frac{7}{6} - \frac{29}{10} && \text{Replace } 2.9 \text{ with } 29/10. \\ &= \frac{7 \cdot 5}{6 \cdot 5} - \frac{29 \cdot 3}{10 \cdot 3} && \text{Equivalent fractions with LCD} = 30. \\ &= \frac{35}{30} - \frac{87}{30} && \text{Simplify numerators and denominators.} \\ &= -\frac{52}{30} && \text{Subtract.} \\ &= -\frac{26}{15} && \text{Reduce to lowest terms.} \end{aligned}$$

Thus,

$$\frac{7}{6} - 2.9 = -\frac{26}{15}$$

**55.** The fraction 4/3 is equivalent to a repeating decimal. Therefore, the strategy is to instead convert the decimal 0.32 into an equivalent fraction, and

then subtract the fractions in the new expression.

$$\begin{aligned} -\frac{4}{3} - 0.32 &= -\frac{4}{3} - \frac{8}{25} && \text{Replace 0.32 with 8/25.} \\ &= -\frac{4 \cdot 25}{3 \cdot 25} - \frac{8 \cdot 3}{25 \cdot 3} && \text{Equivalent fractions with LCD = 75.} \\ &= -\frac{100}{75} - \frac{24}{75} && \text{Simplify numerators and denominators.} \\ &= -\frac{124}{75} && \text{Subtract.} \end{aligned}$$

Thus,

$$-\frac{4}{3} - 0.32 = -\frac{124}{75}$$

**57.** The fraction 2/3 is equivalent to a repeating decimal. Therefore, the strategy is to instead convert the decimal 0.9 into an equivalent fraction, and then add the fractions in the new expression.

$$\begin{aligned} -\frac{2}{3} + 0.9 &= -\frac{2}{3} + \frac{9}{10} && \text{Replace 0.9 with 9/10.} \\ &= -\frac{2 \cdot 10}{3 \cdot 10} + \frac{9 \cdot 3}{10 \cdot 3} && \text{Equivalent fractions with LCD = 30.} \\ &= -\frac{20}{30} + \frac{27}{30} && \text{Simplify numerators and denominators.} \\ &= \frac{7}{30} && \text{Add.} \end{aligned}$$

Thus,

$$-\frac{2}{3} + 0.9 = \frac{7}{30}$$

**59.** The fraction 4/3 is equivalent to a repeating decimal. Therefore, the strategy is to instead convert the decimal 2.6 into an equivalent fraction, and then subtract the fractions in the new expression.

$$\begin{aligned} \frac{4}{3} - 2.6 &= \frac{4}{3} - \frac{13}{5} && \text{Replace 2.6 with 13/5.} \\ &= \frac{4 \cdot 5}{3 \cdot 5} - \frac{13 \cdot 3}{5 \cdot 3} && \text{Equivalent fractions with LCD = 15.} \\ &= \frac{20}{15} - \frac{39}{15} && \text{Simplify numerators and denominators.} \\ &= -\frac{19}{15} && \text{Subtract.} \end{aligned}$$

Thus,

$$\frac{4}{3} - 2.6 = -\frac{19}{15}$$

**61.** The fraction 5/6 is equivalent to a repeating decimal. Therefore, the strategy is to instead convert the decimal 2.375 into an equivalent fraction, and then add the fractions in the new expression.

$$\begin{aligned}
\frac{5}{6} + 2.375 &= \frac{5}{6} + \frac{19}{8} && \text{Replace 2.375 with 19/8.}\\
&= \frac{5\cdot 4}{6\cdot 4} + \frac{19\cdot 3}{8\cdot 3} && \text{Equivalent fractions with LCD = 24.}\\
&= \frac{20}{24} + \frac{57}{24} && \text{Simplify numerators and denominators.}\\
&= \frac{77}{24} && \text{Add.}
\end{aligned}$$

Thus,

$$\frac{5}{6} + 2.375 = \frac{77}{24}$$

**63.** First convert the fraction 11/8 into an equivalent terminating decimal. Then add the decimals in the new expression.

$$\begin{aligned}
\frac{11}{8} + 8.2 &= 1.375 + 8.2 && \text{Replace 11/8 with 1.375.}\\
&= 9.575 && \text{Add.}
\end{aligned}$$

Thus, $11/8 + 8.2 = 9.575$.

**65.** First convert the fraction 7/10 into an equivalent terminating decimal. Then add the decimals in the new expression.

$$\begin{aligned}
-\frac{7}{10} + 1.2 &= -0.7 + 1.2 && \text{Replace 7/10 with 0.7.}\\
&= 0.5 && \text{Add.}
\end{aligned}$$

Thus, $-7/10 + 1.2 = 0.5$.

**67.** The fraction 11/6 is equivalent to a repeating decimal. Therefore, the strategy is to instead convert the decimal 0.375 into an equivalent fraction, and then add the fractions in the new expression.

$$\begin{aligned}
-\frac{11}{6} + 0.375 &= -\frac{11}{6} + \frac{3}{8} && \text{Replace 0.375 with 3/8.}\\
&= -\frac{11\cdot 4}{6\cdot 4} + \frac{3\cdot 3}{8\cdot 3} && \text{Equivalent fractions with LCD = 24.}\\
&= -\frac{44}{24} + \frac{9}{24} && \text{Simplify numerators and denominators.}\\
&= -\frac{35}{24} && \text{Add.}
\end{aligned}$$

Thus,

$$-\frac{11}{6} + 0.375 = -\frac{35}{24}$$

## 5.6 Equations with Decimals

**1.**

| | |
|---|---|
| $5.57x - 2.45x = 5.46$ | Original equation. |
| $3.12x = 5.46$ | Combine like terms on the left side. |
| $x = 1.75$ | Divide both sides by 3.12. |

**3.**

| | |
|---|---|
| $-5.8x + 0.32 + 0.2x = -6.96$ | Original equation. |
| $-5.6x + 0.32 = -6.96$ | Combine like terms on the left side. |
| $-5.6x = -7.28$ | Add $-0.32$ to both sides. |
| $x = 1.3$ | Divide both sides by $-5.6$. |

**5.**

| | |
|---|---|
| $-4.9x + 88.2 = 24.5$ | Original equation. |
| $-4.9x = -63.7$ | Add $-88.2$ to both sides. |
| $x = 13$ | Divide both sides by $-4.9$. |

**7.**

| | |
|---|---|
| $0.35x - 63.58 = 55.14$ | Original equation. |
| $0.35x = 118.72$ | Add 63.58 to both sides. |
| $x = 339.2$ | Divide both sides by 0.35. |

**9.**

| | |
|---|---|
| $-10.3x + 82.4 = 0$ | Original equation. |
| $-10.3x = -82.4$ | Add $-82.4$ to both sides. |
| $x = 8$ | Divide both sides by $-10.3$. |

**11.**

$$\begin{aligned} -12.5x + 13.5 &= 0 && \text{Original equation.} \\ -12.5x &= -13.5 && \text{Add } -13.5 \text{ to both sides.} \\ x &= 1.08 && \text{Divide both sides by } -12.5. \end{aligned}$$

**13.**

$$\begin{aligned} 7.3x - 8.9 - 8.34x &= 2.8 && \text{Original equation.} \\ -1.04x - 8.9 &= 2.8 && \text{Combine like terms on the left side.} \\ -1.04x &= 11.7 && \text{Add 8.9 to both sides.} \\ x &= -11.25 && \text{Divide both sides by } -1.04. \end{aligned}$$

**15.**

$$\begin{aligned} -0.2x + 2.2x &= 6.8 && \text{Original equation.} \\ 2x &= 6.8 && \text{Combine like terms on the left side.} \\ x &= 3.4 && \text{Divide both sides by 2.} \end{aligned}$$

**17.**

$$\begin{aligned} 6.24x - 5.2 &= 5.2x && \text{Original equation.} \\ -5.2 &= 5.2x - 6.24x && \text{Add } -6.24x \text{ to both sides.} \\ -5.2 &= -1.04x && \text{Combine like terms on the right side.} \\ 5 &= x && \text{Divide both sides by } -1.04. \end{aligned}$$

**19.**

$$\begin{aligned} -0.7x - 2.4 &= -3.7x - 8.91 && \text{Original equation.} \\ -0.7x + 3.7x - 2.4 &= -8.91 && \text{Add } 3.7x \text{ to both sides.} \\ 3x - 2.4 &= -8.91 && \text{Combine like terms on the left side.} \\ 3x &= -8.91 + 2.4 && \text{Add 2.4 to both sides.} \\ 3x &= -6.51 && \text{Combine like terms on the right side.} \\ x &= -2.17 && \text{Divide both sides by 3.} \end{aligned}$$

**21.**

$$\begin{aligned} -4.9x &= -5.4x + 8.4 && \text{Original equation.} \\ -4.9x + 5.4x &= 8.4 && \text{Add } 5.4x \text{ to both sides.} \\ 0.5x &= 8.4 && \text{Combine like terms on the left side.} \\ x &= 16.8 && \text{Divide both sides by 0.5.} \end{aligned}$$

**23.**

$$\begin{aligned} -2.8x &= -2.3x - 6.5 && \text{Original equation.} \\ -2.8x + 2.3x &= -6.5 && \text{Add } 2.3x \text{ to both sides.} \\ -0.5x &= -6.5 && \text{Combine like terms on the left side.} \\ x &= 13 && \text{Divide both sides by } -0.5. \end{aligned}$$

**25.**

$$\begin{aligned} -2.97x - 2.6 &= -3.47x + 7.47 && \text{Original equation.} \\ -2.97x + 3.47x - 2.6 &= 7.47 && \text{Add } 3.47x \text{ to both sides.} \\ 0.5x - 2.6 &= 7.47 && \text{Combine like terms on the left side.} \\ 0.5x &= 7.47 + 2.6 && \text{Add } 2.6 \text{ to both sides.} \\ 0.5x &= 10.07 && \text{Combine like terms on the right side.} \\ x &= 20.14 && \text{Divide both sides by } 0.5. \end{aligned}$$

**27.**

$$\begin{aligned} -1.7x &= -0.2x - 0.6 && \text{Original equation.} \\ -1.7x + 0.2x &= -0.6 && \text{Add } 0.2x \text{ to both sides.} \\ -1.5x &= -0.6 && \text{Combine like terms on the left side.} \\ x &= 0.4 && \text{Divide both sides by } -1.5. \end{aligned}$$

**29.**

$$\begin{aligned} -1.02x + 7.08 &= -2.79x && \text{Original equation.} \\ 7.08 &= -2.79x + 1.02x && \text{Add } 1.02x \text{ to both sides.} \\ 7.08 &= -1.77x && \text{Combine like terms on the right side.} \\ -4 &= x && \text{Divide both sides by } -1.77. \end{aligned}$$

**31.**

$$\begin{aligned} -4.75x - 6.77 &= -7.45x + 3.49 && \text{Original equation.} \\ -4.75x + 7.45x - 6.77 &= 3.49 && \text{Add } 7.45x \text{ to both sides.} \\ 2.7x - 6.77 &= 3.49 && \text{Combine like terms on the left side.} \\ 2.7x &= 3.49 + 6.77 && \text{Add } 6.77 \text{ to both sides.} \\ 2.7x &= 10.26 && \text{Combine like terms on the right side.} \\ x &= 3.8 && \text{Divide both sides by } 2.7. \end{aligned}$$

**33.**

$$\begin{aligned} -4.06x - 7.38 &= 4.94x && \text{Original equation.} \\ -7.38 &= 4.94x + 4.06x && \text{Add } 4.06x \text{ to both sides.} \\ -7.38 &= 9x && \text{Combine like terms on the right side.} \\ -0.82 &= x && \text{Divide both sides by 9.} \end{aligned}$$

**35.**

$$\begin{aligned} 2.3 + 0.1(x + 2.9) &= 6.9 && \text{Original equation.} \\ 2.3 + 0.1x + 0.29 &= 6.9 && \text{Apply the distributive property.} \\ 0.1x + 2.59 &= 6.9 && \text{Combine like terms on the left side.} \\ 0.1x &= 4.31 && \text{Add } -2.59 \text{ to both sides.} \\ x &= 43.1 && \text{Divide both sides by 0.1.} \end{aligned}$$

**37.**

$$\begin{aligned} 0.5(1.5x - 6.58) &= 6.88 && \text{Original equation.} \\ 0.75x - 3.29 &= 6.88 && \text{Apply the distributive property.} \\ 0.75x &= 10.17 && \text{Add 3.29 to both sides.} \\ x &= 13.56 && \text{Divide both sides by 0.75.} \end{aligned}$$

**39.**

$$\begin{aligned} -6.3x - 0.4(x - 1.8) &= -16.03 && \text{Original equation.} \\ -6.3x - 0.4x + 0.72 &= -16.03 && \text{Apply the distributive property.} \\ -6.7x + 0.72 &= -16.03 && \text{Combine like terms on the left side.} \\ -6.7x &= -16.75 && \text{Add } -0.72 \text{ to both sides.} \\ x &= 2.5 && \text{Divide both sides by } -6.7. \end{aligned}$$

**41.**

$$\begin{aligned} 2.4(0.3x + 3.2) &= -11.4 && \text{Original equation.} \\ 0.72x + 7.68 &= -11.4 && \text{Apply the distributive property.} \\ 0.72x &= -19.08 && \text{Add } -7.68 \text{ to both sides.} \\ x &= -26.5 && \text{Divide both sides by 0.72.} \end{aligned}$$

**43.**

$$\begin{aligned} -0.8(0.3x + 0.4) &= -11.3 && \text{Original equation.} \\ -0.24x - 0.32 &= -11.3 && \text{Apply the distributive property.} \\ -0.24x &= -10.98 && \text{Add 0.32 to both sides.} \\ x &= 45.75 && \text{Divide both sides by } -0.24. \end{aligned}$$

**45.**

$$\begin{aligned} -7.57 - 2.42(x + 5.54) &= 6.95 && \text{Original equation.} \\ -7.57 - 2.42x - 13.4068 &= 6.95 && \text{Apply the distributive property.} \\ -2.42x - 20.9768 &= 6.95 && \text{Combine like terms on the left side.} \\ -2.42x &= 27.9268 && \text{Add 20.9768 to both sides.} \\ x &= -11.54 && \text{Divide both sides by } -2.42. \end{aligned}$$

**47.**

$$\begin{aligned} -1.7 - 5.56(x + 6.1) &= 12.2 && \text{Original equation.} \\ -1.7 - 5.56x - 33.916 &= 12.2 && \text{Apply the distributive property.} \\ -5.56x - 35.616 &= 12.2 && \text{Combine like terms on the left side.} \\ -5.56x &= 47.816 && \text{Add 35.616 to both sides.} \\ x &= -8.6 && \text{Divide both sides by } -5.56. \end{aligned}$$

**49.**

$$\begin{aligned} 4.3x - 0.7(x + 2.1) &= 8.61 && \text{Original equation.} \\ 4.3x - 0.7x - 1.47 &= 8.61 && \text{Apply the distributive property.} \\ 3.6x - 1.47 &= 8.61 && \text{Combine like terms on the left side.} \\ 3.6x &= 10.08 && \text{Add 1.47 to both sides.} \\ x &= 2.8 && \text{Divide both sides by 3.6.} \end{aligned}$$

**51.**

$$\begin{aligned} -4.8x + 3.3(x - 0.4) &= -7.05 && \text{Original equation.} \\ -4.8x + 3.3x - 1.32 &= -7.05 && \text{Apply the distributive property.} \\ -1.5x - 1.32 &= -7.05 && \text{Combine like terms on the left side.} \\ -1.5x &= -5.73 && \text{Add 1.32 to both sides.} \\ x &= 3.82 && \text{Divide both sides by } -1.5. \end{aligned}$$

**53.**

$$\begin{aligned}
0.9(6.2x - 5.9) &= 3.4(3.7x + 4.3) - 1.8 && \text{Original equation.}\\
5.58x - 5.31 &= 12.58x + 14.62 - 1.8 && \text{Apply the distributive property on both sides.}\\
5.58x - 5.31 &= 12.58x + 12.82 && \text{Combine like terms on the right side.}\\
-5.31 &= 12.58x - 5.58x + 12.82 && \text{Add } -5.58x \text{ to both sides.}\\
-5.31 &= 7x + 12.82 && \text{Combine like terms on the right side.}\\
-5.31 - 12.82 &= 7x && \text{Add } -12.82 \text{ to both sides.}\\
-18.13 &= 7x && \text{Combine like terms on the left side.}\\
-2.59 &= x && \text{Divide both sides by 7.}
\end{aligned}$$

**55.**

$$\begin{aligned}
-1.8(-1.6x + 1.7) &= -1.8(-3.6x - 4.1) && \text{Original equation.}\\
2.88x - 3.06 &= 6.48x + 7.38 && \text{Apply the distributive property on both sides.}\\
2.88x - 6.48x - 3.06 &= 7.38 && \text{Add } -6.48x \text{ to both sides.}\\
-3.6x - 3.06 &= 7.38 && \text{Combine like terms on the left side.}\\
-3.6x &= 7.38 + 3.06 && \text{Add 3.06 to both sides.}\\
-3.6x &= 10.44 && \text{Combine like terms on the right side.}\\
x &= -2.9 && \text{Divide both sides by } -3.6.
\end{aligned}$$

**57.**

$$\begin{aligned}
0.9(0.4x + 2.5) - 2.5 &= -1.9(0.8x + 3.1) && \text{Original equation.}\\
0.36x + 2.25 - 2.5 &= -1.52x - 5.89 && \text{Apply the distributive property on both sides.}\\
0.36x - 0.25 &= -1.52x - 5.89 && \text{Combine like terms on the left side.}\\
0.36x + 1.52x - 0.25 &= -5.89 && \text{Add } 1.52x \text{ to both sides.}\\
1.88x - 0.25 &= -5.89 && \text{Combine like terms on the left side.}\\
1.88x &= -5.89 + 0.25 && \text{Add 0.25 to both sides.}\\
1.88x &= -5.64 && \text{Combine like terms on the right side.}\\
x &= -3 && \text{Divide both sides by 1.88.}
\end{aligned}$$

**59.** We will follow the *Requirements for Word Problem Solutions.*

1. *Set up a Variable Dictionary.* Let $N$ represent the number of bird houses created.

2. *Set Up an Equation.* Note that

| Fixed costs | plus | Number made | times | Unit cost | is | Total cost |
|---|---|---|---|---|---|---|
| 200 | + | $N$ | · | 3.00 | = | 296.00 |

Hence, our equation is

$$200 + N \cdot 3 = 296.$$

3. *Solve the Equation.* Subtract 200 from each side, then divide the resulting equation by 3.

$$\begin{aligned} 200 + 3N &= 296 && \text{Original equation.} \\ 200 + 3N - 200 &= 296 - 200 && \text{Subtract 200 from both sides.} \\ 3N &= 96 && \text{Simplify: } 296 - 200 = 96. \\ \frac{3N}{3} &= \frac{96}{3} && \text{Divide both sides by 3.} \\ N &= 32 && \text{Divide: } 96/3 = 32. \end{aligned}$$

4. *Answer the Question.* Stacy created 32 bird houses.

5. *Look Back.* 32 bird houses at \$3.00 apiece cost \$96. If we add the fixed costs \$200, the total is \$296.00.

**61.** We will follow the *Requirements for Word Problem Solutions.*

1. *Set up a Variable Dictionary.* Let $N$ represent the number of staplers purchased.

2. *Set Up an Equation.* Note that

| Price per stapler | times | Number of staplers | is | Full Purchase Price |
|---|---|---|---|---|
| 1.50 | · | $N$ | = | 36.00 |

Hence, our equation is

$$1.50N = 36.00.$$

3. *Solve the Equation.* Divide both sides of the equation by 1.50.

$$\begin{aligned} \frac{1.50N}{1.50} &= \frac{36.00}{1.50} && \text{Divide both sides by 1.50.} \\ N &= 24 && \text{Divide. } 36.00/1.50 = 24. \end{aligned}$$

4. *Answer the Question.* The business purchased 24 staplers.

5. *Look Back.* Let's calculate the cost of 24 staplers at \$1.50 apiece.

$$\begin{aligned}\text{Total Cost} &= \text{Number of staplers} \cdot \text{Unit Price}\\ &= 24 \cdot 1.50\\ &= 36.00\end{aligned}$$

Thus, at \$1.50 apiece, 24 staplers will cost \$36.00. Our answer checks.

**63.** We will follow the *Requirements for Word Problem Solutions.*

1. *Set up a Variable Dictionary.* Let $N$ represent the number of table cloths created.

2. *Set Up an Equation.* Note that

| Fixed costs | plus | Number made | times | Unit cost | is | Total cost |
|---|---|---|---|---|---|---|
| 100 | + | $N$ | · | 2.75 | = | 221.00 |

Hence, our equation is

$$100 + N \cdot 2.75 = 221.$$

3. *Solve the Equation.* Subtract 100 from each side, then divide the resulting equation by 2.75.

$$\begin{aligned}100 + 2.75N &= 221 && \text{Original equation.}\\ 100 + 2.75N - 100 &= 221 - 100 && \text{Subtract 100 from both sides.}\\ 2.75N &= 121 && \text{Simplify: } 221 - 100 = 121.\\ \frac{2.75N}{2.75} &= \frac{121}{2.75} && \text{Divide both sides by 2.75.}\\ N &= 44 && \text{Divide: } 121/2.75 = 44.\end{aligned}$$

4. *Answer the Question.* Julie created 44 table cloths.

5. *Look Back.* 44 table cloths at \$2.75 apiece cost \$121. If we add the fixed costs \$100, the total is \$221.00.

**65.** The formula governing the relation between the circumference and diameter of a circle is

$$C = \pi d.$$

The 60 feet of decorative fencing will be the circumference of the circular garden. Substitute 60 for $C$ and 3.14 for $\pi$.

$$60 = 3.14d$$

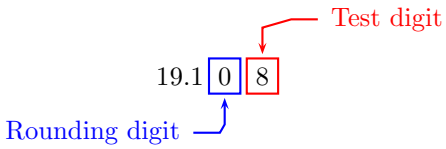
Divide both sides of the equation by 3.14.

$$\frac{60}{3.14} = \frac{3.14d}{3.14}$$
$$\frac{60}{3.14} = d$$

We need to round to the nearest hundredth. This requires that we carry the division one additional place to the right of the hundredths place (i.e., to the thousandths place).

$$d \approx 19.108$$

For the final step, we must round 19.108 to the nearest hundredth. In the schematic that follows, we've boxed the hundredths digit (the "rounding digit") and the "test digit" that follows the "rounding digit."




Because the test digit is greater than or equal to 5, add 1 to the rounding digit, then truncate. Thus, to the nearest hundredth of an foot, the diameter of the circle is approximately $d \approx 19.11$ feet.

**67.** We will follow the *Requirements for Word Problem Solutions.*

1. *Set up a Variable Dictionary.* Let $N$ represent the number of tickets purchased by the YMCA of Sacramento.

2. *Set Up an Equation.* Note that

| Price per Ticket | times | Number of Tickets | is | Full Purchase Price |
|---|---|---|---|---|
| 4.25 | $\cdot$ | $N$ | $=$ | 1,000 |

Hence, our equation is

$$4.25N = 1000.$$

3. *Solve the Equation.* Divide both sides of the equation by 4.25.

$$\begin{aligned} \frac{4.25N}{4.25} &= \frac{1000}{4.25} && \text{Divide both sides by 4.25.} \\ N &\approx 235 && \text{Divide. Truncate to units place.} \end{aligned}$$

4. *Answer the Question.* Because they cannot buy a fractional part of a ticket, we must truncate the answer to the units place. The YMCA of Sacramento can purchase 235 tickets.

5. *Look Back.* Let's calculate the cost of 235 tickets at \$4.25 apiece.

$$\begin{aligned} \text{Cost} &= \text{Number of Tickets} \cdot \text{Ticket Price} \\ &= 235 \cdot 4.25 \\ &= 998.75; \end{aligned}$$

Thus, at \$4.25 apiece, 235 tickets will cost \$998.75. As the YMCA of Sacramento has \$1,000 to purchase tickets, note that they don't have enough money left for another ticket.

**69.** We will follow the *Requirements for Word Problem Solutions.*

1. *Set up a Variable Dictionary.* Let $N$ represent the number of mechanical pencils purchased.

2. *Set Up an Equation.* Note that

| Price per mechanical pencil | | Number of mechanical pencils | | Full Purchase Price |
|---|---|---|---|---|
| 2.25 | $\cdot$ | $N$ | $=$ | 65.25 |

Hence, our equation is

$$2.25N = 65.25.$$

3. *Solve the Equation.* Divide both sides of the equation by 2.25.

$$\begin{aligned} \frac{2.25N}{2.25} &= \frac{65.25}{2.25} && \text{Divide both sides by 2.25.} \\ N &= 29 && \text{Divide. } 65.25/2.25 = 29. \end{aligned}$$

4. *Answer the Question.* The business purchased 29 mechanical pencils.

5. *Look Back.* Let's calculate the cost of 29 mechanical pencils at \$2.25 apiece.

$$\begin{aligned}\text{Total Cost} &= \text{Number of mechanical pencils} \cdot \text{Unit Price}\\ &= 29 \cdot 2.25\\ &= 65.25\end{aligned}$$

Thus, at \$2.25 apiece, 29 mechanical pencils will cost \$65.25. Our answer checks.

**71.** The formula governing the relation between the circumference and diameter of a circle is

$$C = \pi d.$$

The 61 feet of decorative fencing will be the circumference of the circular garden. Substitute 61 for $C$ and 3.14 for $\pi$.

$$61 = 3.14d$$

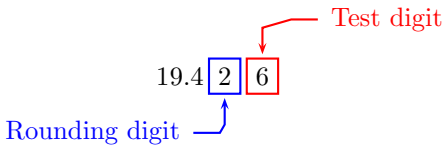
Divide both sides of the equation by 3.14.

$$\begin{aligned}\frac{61}{3.14} &= \frac{3.14d}{3.14}\\ \frac{61}{3.14} &= d\end{aligned}$$

We need to round to the nearest hundredth. This requires that we carry the division one additional place to the right of the hundredths place (i.e., to the thousandths place).

$$d \approx 19.426$$

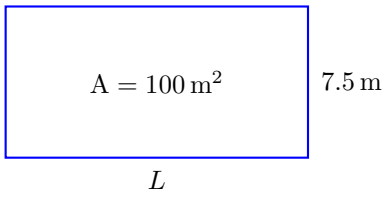
For the final step, we must round 19.426 to the nearest hundredth. In the schematic that follows, we've boxed the hundredths digit (the "rounding digit") and the "test digit" that follows the "rounding digit."




Because the test digit is greater than or equal to 5, add 1 to the rounding digit, then truncate. Thus, to the nearest hundredth of an foot, the diameter of the circle is approximately $d \approx 19.43$ feet.

**73.** We will follow the *Requirements for Word Problem Solutions*.

1. *Set up a Variable Dictionary.* We will use a sketch to define our variables.




   Note that $L$ represents the length of the rectangle.

2. *Set Up an Equation.* The area $A$ of a rectangle is given by the formula

$$A = LW,$$

   where $L$ and $W$ represent the length and width of the rectangle, respectively. Substitute 100 for $A$ and 7.5 for $W$ in the formula to obtain

$$100 = L(7.5),$$

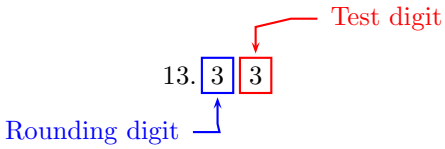
   or equivalently,

$$100 = 7.5L.$$

3. *Solve the Equation.* Divide both sides of the last equation by 7.5, then round your answer to the nearest tenth.

$$\frac{100}{7.5} = \frac{7.5L}{7.5} \qquad \text{Divide both sides by 7.5.}$$
$$13.33 \approx L \qquad \text{Divide.}$$

   To round to the nearest tenth of a meter, identify the rounding and test digits.




   Because the test digit is less than 5, leave the rounding digit alone, then truncate. Thus, to the nearest tenth of a meter, the length of the rectangle is approximately $L \approx 13.3$ meters.

4. *Answer the Question.* To the nearest tenth of a meter, the length of the rectangular plot is $L \approx 13.3$ meters.

5. *Look Back.* We have $L \approx 13.3$ meters and $W = 8.9$ meters. Multiply length and width to find the area.

$$\text{Area} \approx (13.3\,\text{m})(7.5\,\text{m}) \approx 99.75\,\text{m}^2.$$

Note that this is very nearly the exact area of 100 square meters. The discrepancy is due to the fact that we found the length rounded to the nearest tenth of a meter.

**75.** We will follow the *Requirements for Word Problem Solutions.*

1. *Set up a Variable Dictionary.* Let $N$ represent the number of tickets purchased by the Boys and Girls club of Eureka.

2. *Set Up an Equation.* Note that

| Price per Ticket | | times | | Number of Tickets | | is | | Full Purchase Price |
|---|---|---|---|---|---|---|---|---|
| 4.50 | | $\cdot$ | | $N$ | | $=$ | | 1,300 |

Hence, our equation is

$$4.50N = 1300.$$

3. *Solve the Equation.* Divide both sides of the equation by 4.50.

$$\frac{4.50N}{4.50} = \frac{1300}{4.50} \qquad \text{Divide both sides by 4.50.}$$
$$N \approx 288 \qquad \text{Divide. Truncate to units place.}$$

4. *Answer the Question.* Because they cannot buy a fractional part of a ticket, we must truncate the answer to the units place. The Boys and Girls club of Eureka can purchase 288 tickets.

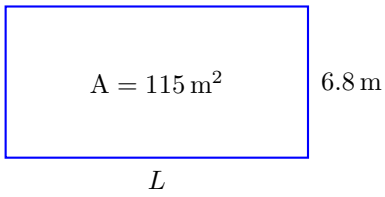
5. *Look Back.* Let's calculate the cost of 288 tickets at \$4.50 apiece.

$$\begin{aligned}\text{Cost} &= \text{Number of Tickets} \cdot \text{Ticket Price}\\ &= 288 \cdot 4.50\\ &= 1296;\end{aligned}$$

Thus, at \$4.50 apiece, 288 tickets will cost \$1296. As the Boys and Girls club of Eureka has \$1,300 to purchase tickets, note that they don't have enough money left for another ticket.

**77.** We will follow the *Requirements for Word Problem Solutions*.

1. *Set up a Variable Dictionary.* We will use a sketch to define our variables.




   Note that $L$ represents the length of the rectangle.

2. *Set Up an Equation.* The area $A$ of a rectangle is given by the formula

$$A = LW,$$

   where $L$ and $W$ represent the length and width of the rectangle, respectively. Substitute 115 for $A$ and 6.8 for $W$ in the formula to obtain

$$115 = L(6.8),$$

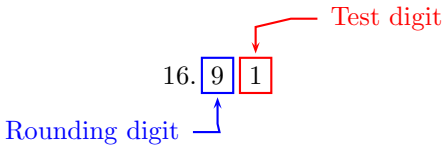
   or equivalently,

$$115 = 6.8L.$$

3. *Solve the Equation.* Divide both sides of the last equation by 6.8, then round your answer to the nearest tenth.

$$\frac{115}{6.8} = \frac{6.8L}{6.8} \qquad \text{Divide both sides by 6.8.}$$
$$16.91 \approx L \qquad \text{Divide.}$$

   To round to the nearest tenth of a meter, identify the rounding and test digits.




   Because the test digit is less than 5, leave the rounding digit alone, then truncate. Thus, to the nearest tenth of a meter, the length of the rectangle is approximately $L \approx 16.9$ meters.

4. *Answer the Question.* To the nearest tenth of a meter, the length of the rectangular plot is $L \approx 16.9$ meters.

5. *Look Back.* We have $L \approx 16.9$ meters and $W = 8.9$ meters. Multiply length and width to find the area.

$$\text{Area} \approx (16.9\,\text{m})(6.8\,\text{m}) \approx 114.92\,\text{m}^2.$$

Note that this is very nearly the exact area of 115 square meters. The discrepancy is due to the fact that we found the length rounded to the nearest tenth of a meter.

**79.** In our solution, we will carefully address each step of the *Requirements for Word Problem Solutions.*

1. *Set up a Variable Dictionary.* We can satisfy this requirement by simply stating "Let $x$ represent crude oil inventories in millions of barrels for the previous week before the decline."

2. *Set up an Equation.* "Crude oil inventories last week experienced a decline and result in the crude oil inventories now" becomes

| Oil inventory last week | minus | decline in inventory | gives | Oil inventory this week |
|---|---|---|---|---|
| $x$ | $-$ | 3.8 | $=$ | 353.9 |

3. *Solve the Equation.* To "undo" the subtraction of 3.8, add both sides of the equation by 3.8.

$$\begin{aligned} x - 3.8 &= 353.9 && \text{Original equation.} \\ x - 3.8 + 3.8 &= 353.9 + 3.8 && \text{Add both sides of the equation by 3.8.} \\ x &= 357.7 && \text{On the left, adding by 3.8 "undoes" the effect of subtracting by 3.8 and returns } x\text{. On the right, } 353.9 + 3.8 = 357.7. \end{aligned}$$

4. *Answer the Question.* The previous week, US crude oil inventories were 357.7 million barrels.

5. *Look Back.* Does an inventory figure of 357.7 million barrels satisfy the words in the original problem? We were told that "Crude oil inventories last week experienced a decline and result in the crude oil inventories now." Well, 357.7 decreased by 3.8 gives 353.9.

**81.** In our solution, we will carefully address each step of the *Requirements for Word Problem Solutions*.

1. *Set up a Variable Dictionary.* We can satisfy this requirement by simply stating "Let $n$ represent the index of refraction of zircon."

2. *Set up an Equation.* "Refraction index of diamond is one and one-quarter times the refraction index of zircon." becomes

| Refractive index of diamond | = | One and one-quarter | times | Refractive index of zircon |
|---|---|---|---|---|
| 2.4 | = | 1.25 | · | $n$ |

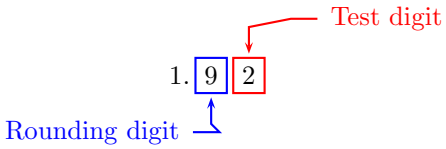
3. *Solve the Equation.* To "undo" the multiplication by 1.25, divide both sides of the equation by 1.25.

$$2.4 = 1.25 \cdot n \quad \text{Original equation.}$$

$$\frac{2.4}{1.25} = \frac{1.25 \cdot n}{1.25} \quad \text{Divide both sides of the equation by 1.25.}$$

$$n = 1.92 \quad \text{On the right, dividing by 1.25 "undoes" the effect of multiplying by 1.25 and returns } n\text{. On the left, } 2.4 \div 1.25 = 1.92.$$

To round to the nearest tenth, identify the rounding and test digits.




Because the test digit is less than 5, leave the rounding digit alone, then truncate. Thus, to the nearest tenth, the refractive index of zircon is approximately $n \approx 1.9$.

4. *Answer the Question.* The index of refraction of a zircon is approximately 1.9.

5. *Look Back.* Does an index of refraction for zircon satisfy the words in the original problem? We were told that "The index of diamond is about one and one-quarter times the index of zircon." Well, 1.25 times 1.9 gives 2.4.

## 5.7 Introduction to Square Roots

**1.** Since $16^2 = 256$ and $(-16)^2 = 256$, the two square roots of 256 are 16 and $-16$.

**3.** Square roots of negative numbers are undefined, so the number $-289$ has no square roots.

**5.** Since $21^2 = 441$ and $(-21)^2 = 441$, the two square roots of 441 are 21 and $-21$.

**7.** Since $18^2 = 324$ and $(-18)^2 = 324$, the two square roots of 324 are 18 and $-18$.

**9.** Since $12^2 = 144$ and $(-12)^2 = 144$, the two square roots of 144 are 12 and $-12$.

**11.** Square roots of negative numbers are undefined, so the number $-144$ has no square roots.

**13.** Since $11^2 = 121$ and $(-11)^2 = 121$, the two square roots of 121 are 11 and $-11$.

**15.** Since $23^2 = 529$ and $(-23)^2 = 529$, the two square roots of 529 are 23 and $-23$.

**17.** Square roots of negative numbers are undefined, so $\sqrt{-9}$ does not exist.

**19.** The two square roots of 576 are 24 and $-24$. Since $\sqrt{576}$ represents the positive square root of 576, it follows that $\sqrt{576} = 24$.

**21.** Square roots of negative numbers are undefined, so $\sqrt{-529}$ does not exist.

**23.** The two square roots of 25 are 5 and $-5$. Since $-\sqrt{25}$ represents the negative square root of 25, it follows that $-\sqrt{25} = -5$.

**25.** The two square roots of 484 are 22 and $-22$. Since $-\sqrt{484}$ represents the negative square root of 484, it follows that $-\sqrt{484} = -22$.

**27.** The two square roots of 196 are 14 and $-14$. Since $-\sqrt{196}$ represents the negative square root of 196, it follows that $-\sqrt{196} = -14$.

**29.** The two square roots of 441 are 21 and $-21$. Since $\sqrt{441}$ represents the positive square root of 441, it follows that $\sqrt{441} = 21$.

**31.** The two square roots of 4 are 2 and $-2$. Since $-\sqrt{4}$ represents the negative square root of 4, it follows that $-\sqrt{4} = -2$.

**33.** Since $9^2 = 81$, it follows that $0.9^2 = 0.81$. Therefore, $\sqrt{0.81} = 0.9$.

**35.** Since $19^2 = 361$, it follows that $1.9^2 = 3.61$. Therefore, $\sqrt{3.61} = 1.9$.

**37.** Since $\left(\frac{15}{4}\right)^2 = \frac{225}{16}$, it follows that $\sqrt{\frac{225}{16}} = \frac{15}{4}$.

**39.** Since $18^2 = 324$, it follows that $1.8^2 = 3.24$. Therefore, $\sqrt{3.24} = 1.8$.

**41.** Since $\left(\frac{11}{7}\right)^2 = \frac{121}{49}$, it follows that $\sqrt{\frac{121}{49}} = \frac{11}{7}$.

**43.** Since $\left(\frac{23}{11}\right)^2 = \frac{529}{121}$, it follows that $\sqrt{\frac{529}{121}} = \frac{23}{11}$.

**45.** Since $17^2 = 289$, it follows that $1.7^2 = 2.89$. Therefore, $\sqrt{2.89} = 1.7$.

**47.** Since $\left(\frac{12}{5}\right)^2 = \frac{144}{25}$, it follows that $\sqrt{\frac{144}{25}} = \frac{12}{5}$.

**49.** Since $\left(\frac{16}{19}\right)^2 = \frac{256}{361}$, it follows that $\sqrt{\frac{256}{361}} = \frac{16}{19}$.

**51.** Since $7^2 = 49$, it follows that $0.7^2 = 0.49$. Therefore, $\sqrt{0.49} = 0.7$.

**53.**

$$\begin{aligned} 6 - \sqrt{576} &= 6 - (24) && \text{Evaluate radicals first.} \\ &= 6 - 24 && \text{Multiply.} \\ &= -18 && \text{Subtract.} \end{aligned}$$

**55.** In this case, the radical acts like grouping symbols, so we must evaluate what is inside the radical first.

$$\begin{aligned} \sqrt{8^2 + 15^2} &= \sqrt{64 + 225} && \text{Exponents first: } 8^2 = 64 \text{ and } 15^2 = 225. \\ &= \sqrt{289} && \text{Add: } 64 + 225 = 289. \\ &= 17 && \text{Take the nonnegative square root: } \sqrt{289} = 17. \end{aligned}$$

**57.**

$$\begin{aligned} 6\sqrt{16} - 9\sqrt{49} &= 6(4) - 9(7) && \text{Evaluate radicals first.} \\ &= 24 - 63 && \text{Multiply.} \\ &= -39 && \text{Subtract.} \end{aligned}$$

**59.** In this case, the radical acts like grouping symbols, so we must evaluate what is inside the radical first.

$$\begin{aligned} \sqrt{5^2 + 12^2} &= \sqrt{25 + 144} && \text{Exponents first: } 5^2 = 25 \text{ and } 12^2 = 144. \\ &= \sqrt{169} && \text{Add: } 25 + 144 = 169. \\ &= 13 && \text{Take the nonnegative square root: } \sqrt{169} = 13. \end{aligned}$$

**61.** In this case, the radical acts like grouping symbols, so we must evaluate what is inside the radical first.

$$\begin{aligned} \sqrt{3^2 + 4^2} &= \sqrt{9 + 16} && \text{Exponents first: } 3^2 = 9 \text{ and } 4^2 = 16. \\ &= \sqrt{25} && \text{Add: } 9 + 16 = 25. \\ &= 5 && \text{Take the nonnegative square root: } \sqrt{25} = 5. \end{aligned}$$

**63.**

$$\begin{aligned} -2\sqrt{324} - 6\sqrt{361} &= -2(18) - 6(19) && \text{Evaluate radicals first.} \\ &= -36 - 114 && \text{Multiply.} \\ &= -150 && \text{Subtract.} \end{aligned}$$

**65.**

$$\begin{aligned} -4 - 3\sqrt{529} &= -4 - 3(23) && \text{Evaluate radicals first.} \\ &= -4 - 69 && \text{Multiply.} \\ &= -73 && \text{Subtract.} \end{aligned}$$

**67.**

$$\begin{aligned} -9\sqrt{484} + 7\sqrt{81} &= -9(22) + 7(9) && \text{Evaluate radicals first.} \\ &= -198 + 63 && \text{Multiply.} \\ &= -135 && \text{Add.} \end{aligned}$$

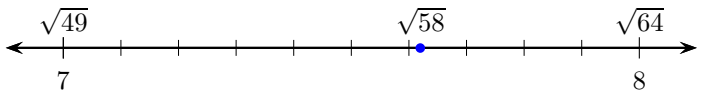
**69.**

$$\begin{aligned} 2 - \sqrt{16} &= 2 - (4) && \text{Evaluate radicals first.} \\ &= 2 - 4 && \text{Multiply.} \\ &= -2 && \text{Subtract.} \end{aligned}$$

**71.**

a) $7^2 = 49$, and $8^2 = 64$, so $\sqrt{58}$ lies between 7 and 8.

b) Since 58 is closer to 64 than to 49, it follows that $\sqrt{57}$ is closer to 8 than to 7.

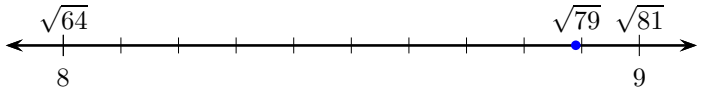



c) By experimentation, $7.6^2 = 57.76$ and $7.7^2 = 59.29$, so 7.6 is the best estimate of $\sqrt{58}$ to the nearest tenth.

**73.**

a) $8^2 = 64$, and $9^2 = 81$, so $\sqrt{79}$ lies between 8 and 9.

b) Since 79 is closer to 81 than to 64, it follows that $\sqrt{79}$ is closer to 9 than to 8.

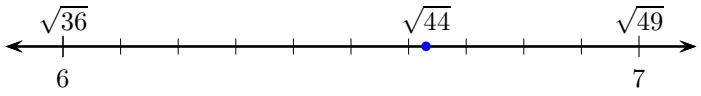



c) By experimentation, $8.8^2 = 77.44$ and $8.9^2 = 79.21$, so 8.9 is the best estimate of $\sqrt{79}$ to the nearest tenth.

**75.**

a) $6^2 = 36$, and $7^2 = 49$, so $\sqrt{44}$ lies between 6 and 7.

b) Since 44 is closer to 49 than to 36, it follows that $\sqrt{44}$ is closer to 7 than to 6.




c) By experimentation, $6.6^2 = 43.56$ and $6.7^2 = 44.89$, so 6.6 is the best estimate of $\sqrt{44}$ to the nearest tenth.

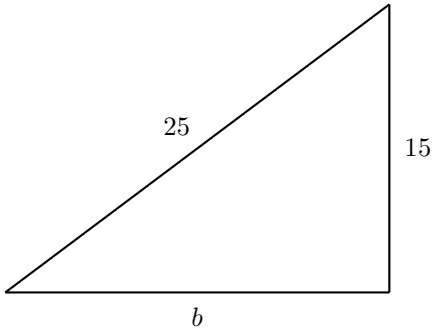
**77.** Using a 10-digit calculator, $\sqrt{469} \approx 21.65640783$. Rounded to the nearest tenth, $\sqrt{469} \approx 21.7$.

**79.** Using a 10-digit calculator, $\sqrt{615} \approx 24.79919354$. Rounded to the nearest tenth, $\sqrt{615} \approx 24.8$.

**81.** Using a 10-digit calculator, $\sqrt{444} \approx 21.07130751$. Rounded to the nearest tenth, $\sqrt{444} \approx 21.1$.

## 5.8 The Pythagorean Theorem

**1.** The first step is to sketch a right triangle with one leg measuring 15 meters, and the hypotenuse measuring 25 meters. Let $b$ represent the length of the other leg.

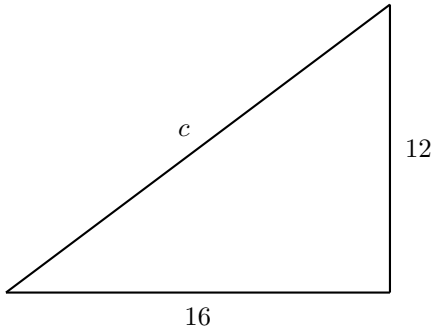


By the Pythagorean Theorem, $15^2 + b^2 = 25^2$. Now solve this equation for $b$.

| | |
|---|---|
| $15^2 + b^2 = 25^2$ | The Pythagorean equation. |
| $225 + b^2 = 625$ | Exponents first: $15^2 = 225$ and $25^2 = 625$. |
| $b^2 = 400$ | Subtract 225 from both sides. |
| $b = 20$ | Take the nonnegative square root of 400. |

Thus, the length of the other leg is 20 meters.

**3.** The first step is to sketch a right triangle with legs measuring 12 meters and 16 meters. Let $c$ represent the length of the hypotenuse.

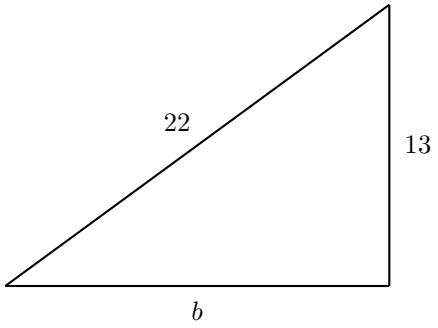



By the Pythagorean Theorem, $12^2 + 16^2 = c^2$. Now solve this equation for $c$.

| | |
|---|---|
| $12^2 + 16^2 = c^2$ | The Pythagorean equation. |
| $144 + 256 = c^2$ | Exponents first: $12^2 = 144$ and $16^2 = 256$. |
| $400 = c^2$ | Simplify the left side. |
| $20 = c$ | Take the nonnegative square root of 400. |

Thus, the length of the hypotenuse is 20 meters.

**5.** The first step is to sketch a right triangle with one leg measuring 13 meters, and the hypotenuse measuring 22 meters. Let $b$ represent the length of the other leg.

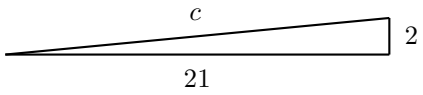



By the Pythagorean Theorem, $13^2 + b^2 = 22^2$. Now solve this equation for $b$.

$$\begin{aligned} 13^2 + b^2 &= 22^2 && \text{The Pythagorean equation.} \\ 169 + b^2 &= 484 && \text{Exponents first: } 13^2 = 169 \text{ and } 22^2 = 484. \\ b^2 &= 315 && \text{Subtract 169 from both sides.} \\ b &= \sqrt{315} && \text{Take the nonnegative square root of 315.} \end{aligned}$$

Since 315 is not a perfect square, the final answer is $\sqrt{315}$ meters.

**7.** The first step is to sketch a right triangle with legs measuring 2 meters and 21 meters. Let $c$ represent the length of the hypotenuse.

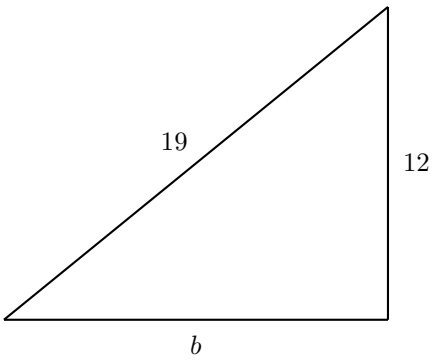



By the Pythagorean Theorem, $2^2 + 21^2 = c^2$. Now solve this equation for $c$.

$$\begin{aligned} 2^2 + 21^2 &= c^2 && \text{The Pythagorean equation.} \\ 4 + 441 &= c^2 && \text{Exponents first: } 2^2 = 4 \text{ and } 21^2 = 441. \\ 445 &= c^2 && \text{Simplify the left side.} \\ \sqrt{445} &= c && \text{Take the nonnegative square root of 445.} \end{aligned}$$

Since 445 is not a perfect square, the final answer is $\sqrt{445}$ meters.

**9.** The first step is to sketch a right triangle with one leg measuring 12 meters, and the hypotenuse measuring 19 meters. Let $b$ represent the length of the other leg.

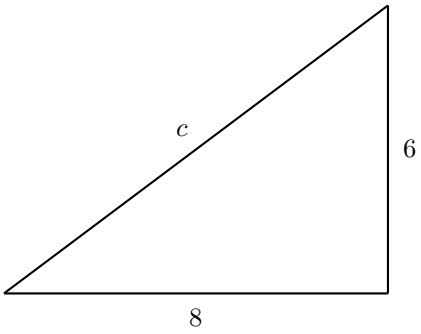



By the Pythagorean Theorem, $12^2 + b^2 = 19^2$. Now solve this equation for $b$.

| | |
|---|---|
| $12^2 + b^2 = 19^2$ | The Pythagorean equation. |
| $144 + b^2 = 361$ | Exponents first: $12^2 = 144$ and $19^2 = 361$. |
| $b^2 = 217$ | Subtract 144 from both sides. |
| $b = \sqrt{217}$ | Take the nonnegative square root of 217. |

Since 217 is not a perfect square, the final answer is $\sqrt{217}$ meters.

**11.** The first step is to sketch a right triangle with legs measuring 6 meters and 8 meters. Let $c$ represent the length of the hypotenuse.

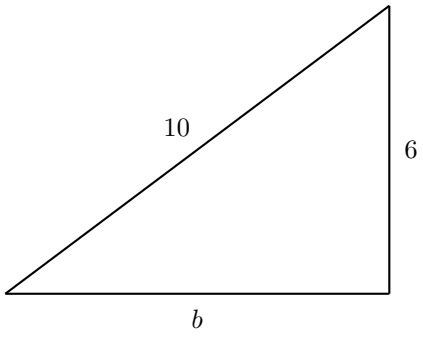



By the Pythagorean Theorem, $6^2 + 8^2 = c^2$. Now solve this equation for $c$.

| | |
|---|---|
| $6^2 + 8^2 = c^2$ | The Pythagorean equation. |
| $36 + 64 = c^2$ | Exponents first: $6^2 = 36$ and $8^2 = 64$. |
| $100 = c^2$ | Simplify the left side. |
| $10 = c$ | Take the nonnegative square root of 100. |

Thus, the length of the hypotenuse is 10 meters.

**13.** The first step is to sketch a right triangle with one leg measuring 6 meters, and the hypotenuse measuring 10 meters. Let $b$ represent the length of the other leg.

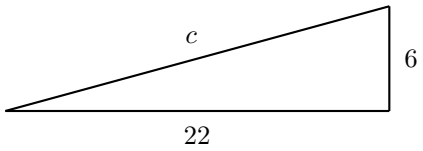



By the Pythagorean Theorem, $6^2 + b^2 = 10^2$. Now solve this equation for $b$.

| | |
|---|---|
| $6^2 + b^2 = 10^2$ | The Pythagorean equation. |
| $36 + b^2 = 100$ | Exponents first: $6^2 = 36$ and $10^2 = 100$. |
| $b^2 = 64$ | Subtract 36 from both sides. |
| $b = 8$ | Take the nonnegative square root of 64. |

Thus, the length of the other leg is 8 meters.

**15.** The first step is to sketch a right triangle with legs measuring 6 meters and 22 meters. Let $c$ represent the length of the hypotenuse.

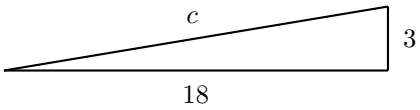



By the Pythagorean Theorem, $6^2 + 22^2 = c^2$. Now solve this equation for $c$.

| | |
|---|---|
| $6^2 + 22^2 = c^2$ | The Pythagorean equation. |
| $36 + 484 = c^2$ | Exponents first: $6^2 = 36$ and $22^2 = 484$. |
| $520 = c^2$ | Simplify the left side. |
| $\sqrt{520} = c$ | Take the nonnegative square root of 520. |

Since 520 is not a perfect square, the final answer is $\sqrt{520}$ meters.

**17.** The first step is to sketch a right triangle with legs measuring 3 meters and 18 meters. Let $c$ represent the length of the hypotenuse.

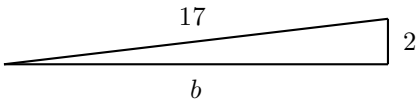



By the Pythagorean Theorem, $3^2 + 18^2 = c^2$. Now solve this equation for $c$.

| | |
|---|---|
| $3^2 + 18^2 = c^2$ | The Pythagorean equation. |
| $9 + 324 = c^2$ | Exponents first: $3^2 = 9$ and $18^2 = 324$. |
| $333 = c^2$ | Simplify the left side. |
| $\sqrt{333} = c$ | Take the nonnegative square root of 333. |

Using a calculator, $\sqrt{333} \approx 18.2482875908947$. Rounded to the nearest hundredth, $\sqrt{333} \approx 18.25$ meters.

**19.** The first step is to sketch a right triangle with one leg measuring 2 meters, and the hypotenuse measuring 17 meters. Let $b$ represent the length of the other leg.

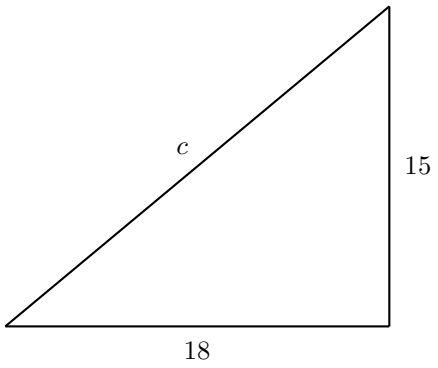



By the Pythagorean Theorem, $2^2 + b^2 = 17^2$. Now solve this equation for $b$.

| | |
|---|---|
| $2^2 + b^2 = 17^2$ | The Pythagorean equation. |
| $4 + b^2 = 289$ | Exponents first: $2^2 = 4$ and $17^2 = 289$. |
| $b^2 = 285$ | Subtract 4 from both sides. |
| $b = \sqrt{285}$ | Take the nonnegative square root of 285. |

Using a calculator, $\sqrt{285} \approx 16.8819430161341$. Rounded to the nearest tenth, $\sqrt{285} \approx 16.9$ meters.

**21.** The first step is to sketch a right triangle with legs measuring 15 feet and 18 feet. Let $c$ represent the length of the hypotenuse.




By the Pythagorean Theorem, $15^2 + 18^2 = c^2$. Now solve this equation for $c$.

$15^2 + 18^2 = c^2$ The Pythagorean equation.

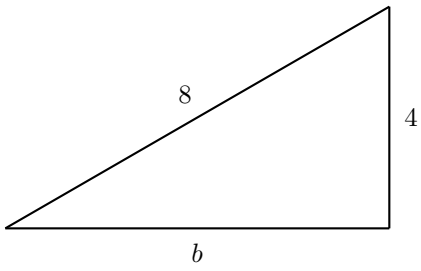
$225 + 324 = c^2$ Exponents first: $15^2 = 225$ and $18^2 = 324$.

$549 = c^2$ Simplify the left side.

$\sqrt{549} = c$ Take the nonnegative square root of 549.

Using a calculator, $\sqrt{549} \approx 23.43074902772$. Rounded to the nearest hundredth, $\sqrt{549} \approx 23.43$ feet.

**23.** The first step is to sketch a right triangle with one leg measuring 4 meters, and the hypotenuse measuring 8 meters. Let $b$ represent the length of the other leg.




By the Pythagorean Theorem, $4^2 + b^2 = 8^2$. Now solve this equation for $b$.

$4^2 + b^2 = 8^2$ The Pythagorean equation.

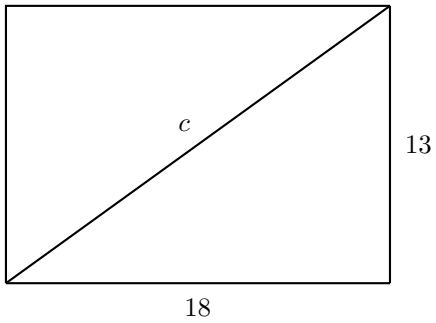
$16 + b^2 = 64$ Exponents first: $4^2 = 16$ and $8^2 = 64$.

$b^2 = 48$ Subtract 16 from both sides.

$b = \sqrt{48}$ Take the nonnegative square root of 48.

Using a calculator, $\sqrt{48} \approx 6.92820323027551$. Rounded to the nearest hundredth, $\sqrt{48} \approx 6.93$ meters.

**25.** Sketch a rectangle with sides of length 13 and 18, and connect two opposite corners to form a diagonal. A right triangle is formed by two sides and the diagonal. Let $c$ represent the length of the hypotenuse (the diagonal).

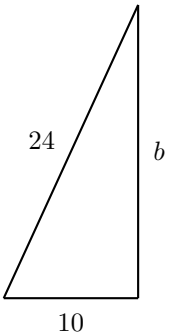



By the Pythagorean Theorem, $13^2 + 18^2 = c^2$. Now solve this equation for $c$.

$$13^2 + 18^2 = c^2 \qquad \text{The Pythagorean equation.}$$
$$169 + 324 = c^2 \qquad \text{Exponents first: } 13^2 = 169 \text{ and } 18^2 = 324.$$
$$493 = c^2 \qquad \text{Simplify the left side.}$$
$$\sqrt{493} = c \qquad \text{Take the nonnegative square root of 493.}$$

Using a calculator, $\sqrt{493} \approx 22.2036033111745$. Rounded to the nearest hundredth, $\sqrt{493} \approx 22.20$ meters.

**27.** The guy wire, the telephone pole, and the ground form a right triangle with the right angle between the pole and the ground. Therefore, the first step is to sketch a right triangle with the hypotenuse (the guy wire) measuring 24 meters, and one leg (the ground) measuring 10 meters. Let $b$ represent the length of the other leg (the pole).

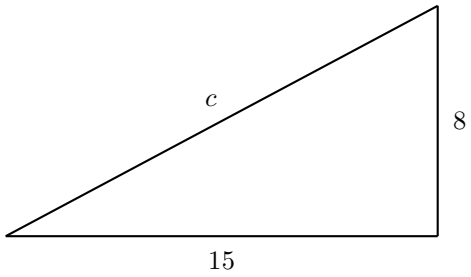


By the Pythagorean Theorem, $10^2 + b^2 = 24^2$. Now solve this equation for $b$.

| | |
|---|---|
| $10^2 + b^2 = 24^2$ | The Pythagorean equation. |
| $100 + b^2 = 576$ | Exponents first: $10^2 = 100$ and $24^2 = 576$. |
| $b^2 = 476$ | Subtract 100 from both sides. |
| $b = \sqrt{476}$ | Take the nonnegative square root of 476. |

Using a calculator, $\sqrt{476} \approx 21.8174242292714$. Rounded to the nearest hundredth, $\sqrt{476} \approx 21.82$ meters.

**29.** The trail is approximately in the shape of a right triangle. The part of the trail going south is one leg, the part of the trail going west is another leg. To find the entire length of the trail, we must find the length of the portion of the trail that is represented by the hypoteneuse. So, the first step is to sketch a right triangle with legs measuring 8 kilometers and 15 kilometers. Let $c$ represent the length of the hypotenuse. We must first find the length $c$, and then sum all the sides together.

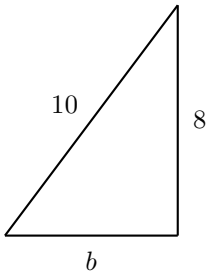



By the Pythagorean Theorem, $8^2 + 15^2 = c^2$. Now solve this equation for $c$.

| | |
|---|---|
| $8^2 + 15^2 = c^2$ | The Pythagorean equation. |
| $64 + 225 = c^2$ | Exponents first: $8^2 = 64$ and $15^2 = 225$. |
| $289 = c^2$ | Simplify the left side. |
| $17 = c$ | Take the nonnegative square root of 289. |

The length of the hypotenuse is 17 kilometers. Therefore, the entire trail runs $8 + 15 + 17 = 40$ kilometers.

**31.** The situation is modeled with a right triangle. Sketch a right triangle with one leg measuring 8 feet, and the hypotenuse measuring 10 feet. Let $b$ represent the length of the other leg.




By the Pythagorean Theorem, $8^2 + b^2 = 10^2$. Now solve this equation for $b$.

| | |
|---|---|
| $8^2 + b^2 = 10^2$ | The Pythagorean equation. |
| $64 + b^2 = 100$ | Exponents first: $8^2 = 64$ and $10^2 = 100$. |
| $b^2 = 36$ | Subtract 64 from both sides. |
| $b = 6$ | Take the nonnegative square root of 36. |

Leg $b$ has a length of 6 feet. Therefore, the ladder must be 6 feet from the wall to reach the 8-foot window.