Determine whether you need an estimate or an exact answer. Then use the four step problem-solving plan to solve.

1. DRIVING While on vacation, the Jacobson family drove 312.8 miles the first day, 177.2 miles the second day, and 209 miles the third day. About how many miles did they travel in all?

**SOLUTION:**

<table>
<thead>
<tr>
<th>Understand</th>
<th>We are given the miles driven for each day. We are asked to find about how many miles the Jacobson family traveled in all. Because the question asks “about how many,” this problem requires an estimate.</th>
</tr>
</thead>
</table>
| Plan       | To find an estimate, round each number to the nearest hundred.  
312.8 ≈ 300  
177.2 ≈ 200  
209 ≈ 200  
Then write an equation. Let T represent the total miles they drove in all.  
total miles = miles on first day + miles on second day + miles on third day  
T = 300 + 200 + 200 |
| Solve      | T = 300 + 200 + 200  
T = 700 miles  
The Jacobsons traveled about 700 miles in all. |
| Check      | Find the exact answer to see if your estimate is reasonable.  
T = 312.8 + 177.2 + 209  
T = 699  
Since the exact answer 699 is close to the estimate, the estimate is reasonable. |

2. PETS Ms. Hernandez boarded her dog at a kennel for 4 days. It cost $18.90 per day, and she had a coupon for $5 off. What was the final cost for boarding her dog?

**SOLUTION:**

<table>
<thead>
<tr>
<th>Understand</th>
<th>We are given the number of days the dog was boarded and the cost of each day. We are also given the value of the coupon she used. We are asked to find the final cost of boarding the dog. We need to find the exact answer.</th>
</tr>
</thead>
</table>
| Plan       | Write an equation. Let C represent the cost of boarding Ms. Hernandez’s dog.  
final cost = number of days × cost per day − coupon  
C = 4 × 18.90 − 5  
The final cost for boarding her dog is $70.60. |
| Solve      | C = 4 × 18.90 − 5  
= 75.60 − 5  
= $70.60  
Since the solution $70.60 is close to the estimate, the answer is reasonable. |
3. **MEASUREMENT** William is using a 1.75-liter container to fill a 14-liter container. About how many times will he need to fill the smaller container?

**SOLUTION:**

<table>
<thead>
<tr>
<th>Understand</th>
<th>We are given the size of the larger container and the size of the smaller container. We are asked to find the approximate number of times William will need to transfer a full amount of water from the smaller container in order to fill the larger container. Because the question asks “about how many,” this problem requires an estimate.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan</td>
<td>To find an estimate, round the capacity of the smaller container to the nearest liter. 1.75 (\approx) 2. Write an equation. Let (t) represent the number of times that William needs to fill the smaller container. number of times to fill = large container (\div) smaller container (t = 14 \div 2)</td>
</tr>
<tr>
<td>Solve</td>
<td>(t = 14 \div 2) (= 7) William will need to fill the smaller container about 7 times to fill the larger container.</td>
</tr>
<tr>
<td>Check</td>
<td>Find the exact answer to see if your estimate is reasonable. (14 \div 1.75 = 8) Since the exact answer 8 is close to the estimate, the estimate is reasonable.</td>
</tr>
</tbody>
</table>

4. **SEWING** Fabric costs $5.15 per yard. The drama department needs 18 yards of the fabric for their new play. About how much should they expect to pay?

**SOLUTION:**

<table>
<thead>
<tr>
<th>Understand</th>
<th>We are given the cost per yard of fabric and the amount of fabric needed. We are asked to find the approximate cost for fabric. Because the question asks “about how much,” this problem requires an estimate.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan</td>
<td>To find an estimate, round the cost per yard to the nearest dollar and the amount of fabric to nearest ten yards. $5.15 (\approx) $5 18 (\approx) 20 Write an equation. Let (c) represent the amount that the drama department will pay. price per yard (\cdot) number of yards = total cost (5 \cdot 20 = c)</td>
</tr>
<tr>
<td>Solve</td>
<td>(c = 5 \cdot 20) (= 100) The drama department should expect to pay about $100.</td>
</tr>
<tr>
<td>Check</td>
<td>Find the exact answer to see if your estimate is reasonable. 5.15 (\cdot) 18 = $92.70 Since the exact answer $92.70 is close to the estimate, the estimate is reasonable.</td>
</tr>
</tbody>
</table>
5. **FINANCIAL LITERACY** The table shows donations to help purchase a new tree for the school. How much money did the students donate in all?

<table>
<thead>
<tr>
<th>Number of Students</th>
<th>Amount of Each Donation</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>$2.50</td>
</tr>
<tr>
<td>15</td>
<td>$3.25</td>
</tr>
</tbody>
</table>

**SOLUTION:**

<table>
<thead>
<tr>
<th>Understand</th>
<th>Twenty students each donated $2.50, and fifteen students each donated $3.25. We are asked to find the total amount donated. We need to find the exact answer.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan</td>
<td>Write an equation. Let $t$ represent the total amount donated. $t = 20 \times 2.50 + 15 \times 3.25$</td>
</tr>
<tr>
<td></td>
<td>$t = 50 + 48.75$</td>
</tr>
<tr>
<td></td>
<td>$t = 98.75$</td>
</tr>
<tr>
<td></td>
<td>The students donated $98.75.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solve</th>
<th>Use estimation to check your answer. Round the amount of each donation to the nearest dollar. $2.50 \approx 3$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$3.25 \approx 3$</td>
</tr>
<tr>
<td></td>
<td>$20 \times 3 + 15 \times 3 = 60 + 45$</td>
</tr>
<tr>
<td></td>
<td>$= 105$</td>
</tr>
<tr>
<td></td>
<td>Since the solution 98.75 is close to the estimate, the answer is reasonable.</td>
</tr>
</tbody>
</table>

6. **SHOPPING** Is $12 enough to buy a half gallon of milk for $2.30, a bag of apples for $3.99, and four cups of yogurt that cost $0.79 each? Explain.

**SOLUTION:**

<table>
<thead>
<tr>
<th>Understand</th>
<th>We are asked to find if $12 is enough money to purchase the items.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan</td>
<td>To find an estimate, round each price to the nearest dollar. $2.30 \approx 2$</td>
</tr>
<tr>
<td></td>
<td>$3.99 \approx 4$</td>
</tr>
<tr>
<td></td>
<td>$0.79 \approx 1$</td>
</tr>
<tr>
<td></td>
<td>Write an equation. Let $c$ represent the total cost. $c = 2 + 4 + 4 \times 1$</td>
</tr>
<tr>
<td>Solve</td>
<td>$c = 2 + 4 + 4$</td>
</tr>
<tr>
<td></td>
<td>$c = 10$</td>
</tr>
<tr>
<td></td>
<td>The total cost of the items is about $10. Because $12 is more than $10, it is enough to purchase the items.</td>
</tr>
<tr>
<td>Check</td>
<td>Find the exact cost to see if your answer is reasonable. $2.30 + 3.99 + 4(0.79) = 2.30 + 3.99 + 3.16$</td>
</tr>
<tr>
<td></td>
<td>$= 9.45$</td>
</tr>
<tr>
<td></td>
<td>Since the exact answer $9.45 is close to the estimate, the estimate is reasonable.</td>
</tr>
</tbody>
</table>
0-2 Real Numbers

Name the set or sets of numbers to which each real number belongs.

1. $-\sqrt{64}$
   
   **SOLUTION:**
   Because $-\sqrt{64} = -8$, this number is an integer and a rational number.

2. $\frac{8}{3}$
   
   **SOLUTION:**
   Because $8$ and $3$ are integers and $\frac{8}{3} = 2.6666...$, $\frac{8}{3}$, which is a repeating decimal, this number is a rational number.

3. $\sqrt{28}$
   
   **SOLUTION:**
   Because $\sqrt{28} = 5.29150262...$, which is not a repeating or terminating decimal, this number is irrational.

4. $\frac{56}{7}$
   
   **SOLUTION:**
   Because $\frac{56}{7} = 8$, this number is a natural number, a whole number, an integer, and a rational number.

5. $-\sqrt{22}$
   
   **SOLUTION:**
   Because $-\sqrt{22} = -4.6904157598...$, which is not a repeating or terminating decimal, this number is irrational.

6. $\frac{36}{6}$
   
   **SOLUTION:**
   Because $\frac{36}{6} = 6$, this number is a natural number, a whole number, an integer, and a rational number.

7. $-\frac{5}{12}$
   
   **SOLUTION:**
   Because $-\frac{5}{12} = -0.416666...$, $\frac{5}{12}$, which is a repeating decimal, this number is a rational number.

8. $\frac{18}{3}$
   
   **SOLUTION:**
   Because $\frac{18}{3} = 6$, this number is a natural number, a whole number, an integer, and a rational number.

9. $\sqrt{10.24}$
   
   **SOLUTION:**
   Because $\sqrt{10.24} = 3.2$, which is a terminating decimal, this number is a rational number.

10. $\frac{-54}{19}$
    
    **SOLUTION:**
    Because $\frac{-54}{19} = -2.842105263157894736$, which is a repeating decimal, this number is a rational number.

11. $\frac{82}{20}$
    
    **SOLUTION:**
    Because $\sqrt{\frac{82}{20}} = \sqrt{4.1} = 2.0248456731...$, which is not a repeating or terminating decimal, this number is irrational.

12. $-\frac{72}{8}$
    
    **SOLUTION:**
    Because $-\frac{72}{8} = -9$, this number is an integer, and a rational number.
Graph each set of numbers on a number line. Then order the numbers from least to greatest.

13. \( \left\{ \frac{7}{5}, -\frac{3}{5}, \frac{3}{4}, -\frac{6}{5} \right\} \)

**SOLUTION:**
- \( \frac{7}{5} = 1.4 \)
- \( -\frac{3}{5} = -0.6 \)
- \( \frac{3}{4} = 0.75 \)
- \( -\frac{6}{5} = -1.2 \)

Use the decimal values to list the numbers from least to greatest.

\(-\frac{6}{5}, -\frac{3}{5}, \frac{3}{4}, 1.4\)

14. \( \left\{ \frac{1}{2}, -\frac{7}{9}, \frac{1}{9}, -\frac{4}{9} \right\} \)

**SOLUTION:**
- \( \frac{1}{2} = 0.50 \)
- \( -\frac{7}{9} = -0.78 \)
- \( \frac{1}{9} = 0.11 \)
- \( -\frac{4}{9} = -0.44 \)

Use the decimal values to list the numbers from least to greatest.

\(-\frac{7}{9}, -\frac{4}{9}, \frac{1}{9}, 0.50\)

15. \( \left\{ 2\frac{1}{4}, \sqrt{7}, 2.33, \sqrt{8} \right\} \)

**SOLUTION:**
- \( 2\frac{1}{4} = 2.25 \)
- \( \sqrt{7} = 2.65 \)
- \( 2.33 = 2.33 \)
- \( \sqrt{8} = 2.83 \)

Use the decimal values to list the numbers from least to greatest.

\( 2\frac{1}{4}, 2.33, \sqrt{7}, \sqrt{8} \)

16. \( \left\{ \frac{4}{5}, \sqrt{2}, 0.\overline{1}, \sqrt{3} \right\} \)

**SOLUTION:**
- \( \frac{4}{5} = 0.80 \)
- \( \sqrt{2} = 1.41 \)
- \( 0.\overline{1} = 0.11 \)
- \( \sqrt{3} = 1.73 \)

Use the decimal values to list the numbers from least to greatest.

\( 0.11, \frac{4}{5}, \sqrt{2}, \sqrt{3} \)
0-2 Real Numbers

17. \( \left\{ \frac{-3.5}{5}, -\frac{15}{5}, -\sqrt{10}, -\frac{33}{4} \right\} \)

**SOLUTION:**
- \( -3.5 = -3.5 \)
- \( -\frac{15}{5} = -3.00 \)
- \( -\sqrt{10} = -3.16 \)
- \( -\frac{33}{4} = -3.75 \)

Use the decimal values to list the numbers from least to greatest.

\[ -3.8, -3.6, -3.4, -3.2, -3.0, -3.16, -3.75 \]

18. \( \left\{ \sqrt{64}, \frac{8}{3}, \frac{26}{7}, \frac{8}{7} \right\} \)

**SOLUTION:**
- \( \sqrt{64} = 8.00 \)
- \( \frac{26}{3} = 8.67 \)
- \( \frac{8}{7} = 1.142857... \)
- \( \frac{8}{7} = 1.142857... \)

Use the decimal values to list the numbers from least to greatest.

\[ \sqrt{64}, \frac{8}{7}, \frac{26}{3}, \frac{8}{7}, 8.8 \]

---

Write each repeating decimal as a fraction in simplest form.

19. 0.\( \overline{5} \)

**SOLUTION:**

**Step 1**
The tenths place digit is repeated, so find 10N.

\[ N = 0.555... \]
\[ 10N = 5.555... \]
\[ 9N = 5 \]
\[ N = \frac{5}{9} \]

20. 0.\( \overline{4} \)

**SOLUTION:**

**Step 1**
The tenths place digit is repeated, so find 10N.

\[ N = 0.444... \]
\[ 10N = 4.444... \]
\[ 9N = 4 \]
\[ N = \frac{4}{9} \]
21. $0.\overline{13}$

**SOLUTION:**

**Step 1**
The hundredths place digit is repeated, so find $100N$.

\[
N = 0.1313...
\]

\[
100N = 100(0.1313...)\]

\[
100N = 13.1313...
\]

**Step 2**
Subtract $N$ from $100N$ to eliminate the part of the number that repeats.

\[
100N = 13.1313...
\]

\[
-N = -0.1313...
\]

\[
99N = 13
\]

\[
\frac{99N}{99} = \frac{13}{99}
\]

\[
N = \frac{13}{99}
\]

22. $0.21$

**SOLUTION:**

**Step 1**
The hundredths place digit is repeated, so find $100N$.

\[
N = 0.2121...
\]

\[
100N = 100(0.2121...)\]

\[
100N = 21.2121...
\]

**Step 2**
Subtract $N$ from $100N$ to eliminate the part of the number that repeats.

\[
100N = 21.21212...
\]

\[
-N = -0.2121...
\]

\[
99N = 21
\]

\[
\frac{99N}{99} = \frac{21}{99}
\]

\[
N = \frac{21}{99} = \frac{7}{33}
\]

23. $-\sqrt{25}$

**SOLUTION:**

\[
-\sqrt{25} = -\sqrt{(5)^2} = -5
\]

24. $\sqrt{361}$

**SOLUTION:**

\[
\sqrt{361} = \sqrt{(19)^2} = 19
\]

25. $\pm \sqrt{36}$

**SOLUTION:**

\[
\pm \sqrt{36} = \pm \sqrt{(6)^2} = \pm 6
\]

26. $\sqrt{0.64}$

**SOLUTION:**

\[
\sqrt{0.64} = \sqrt{(0.8)^2} = 0.8
\]

27. $\pm \sqrt{1.44}$

**SOLUTION:**

\[
\pm \sqrt{1.44} = \pm \sqrt{(1.2)^2} = \pm 1.2
\]

28. $-\sqrt{6.25}$

**SOLUTION:**

\[
-\sqrt{6.25} = -\sqrt{(2.5)^2} = -2.5
\]

29. $\sqrt{\frac{16}{49}}$

**SOLUTION:**

\[
\sqrt{\frac{16}{49}} = \sqrt{\left(\frac{4}{7}\right)^2} = \frac{4}{7}
\]

30. $\sqrt{\frac{169}{196}}$

**SOLUTION:**

\[
\sqrt{\frac{169}{196}} = \sqrt{\left(\frac{13}{14}\right)^2} = \frac{13}{14}
\]
0-2 Real Numbers

31. $\sqrt{\frac{25}{324}}$

SOLUTION:

$$\sqrt{\frac{25}{324}} = \sqrt{(\frac{5}{18})^2} = \frac{5}{18}$$

Estimate each root to the nearest whole number.

32. $\sqrt{112}$

SOLUTION:

Find the two perfect squares closest to 112.

$$100 < \sqrt{112} < 121$$

Since 121 is closer to 121 than 100, the best whole number estimate for $\sqrt{112}$ is 11.

33. $\sqrt{252}$

SOLUTION:

Find the two perfect squares closest to 252.

$$225 < \sqrt{252} < 256$$

Since 252 is closer to 256 than 225, the best whole number estimate for $\sqrt{252}$ is 16.

34. $\sqrt{415}$

SOLUTION:

Find the two perfect squares closest to 415.

$$400 < \sqrt{415} < 441$$

Since 415 is closer to 400 than 441, the best whole number estimate for $\sqrt{415}$ is 20.

35. $\sqrt{670}$

SOLUTION:

Find the two perfect squares closest to 670.

$$625 < \sqrt{670} < 676$$

Since 670 is closer to 676 than 625, the best whole number estimate for $\sqrt{670}$ is 26.
Find each sum or difference.

1. \(-8 + 13\)
   \[
   -8 + 13 = (|13| - |8|) \\
   = 13 - 8 \\
   = 5
   \]

2. \(11 + (-19)\)
   \[
   11 + (-19) = -(|19| - |11|) \\
   = -(19 - 11) \\
   = -8
   \]

3. \(-19 - 8\)
   \[
   -19 - 8 = -19 + (-8) \\
   = -27
   \]

4. \(-77 + (-46)\)
   \[
   -77 + (-46) = -123
   \]

5. \(12 - 34\)
   \[
   12 - 34 = 12 + (-34) \\
   = -22
   \]

6. \(41 + (-56)\)
   \[
   41 + (-56) = -56 has greater absolute value, so the sum is negative.
   \]

7. \(50 - 82\)
   \[
   50 - 82 = 50 + (-82) \\
   = -32
   \]

8. \(-47 - 13\)
   \[
   -47 - 13 = -47 + (-13) \\
   = -60
   \]

9. \(-80 + 102\)
   \[
   -80 + 102 = 22
   \]

Find each product or quotient.

10. \(5(18)\)
    \[
    5(18) = 90
    \]

11. \(60 ÷ 12\)
    \[
    60 ÷ 12 = 5
    \]
0-3 Operations with Integers

12. \(-12(15)\)

**SOLUTION:**
The product of two integers with different signs is negative.

\[-12(15) = -180\]

13. \(-64 \div (-8)\)

**SOLUTION:**
The quotient of two integers with the same sign is positive.

\[-64 \div (-8) = 8\]

14. \(8(-22)\)

**SOLUTION:**
The product of two integers with different signs is negative.

\[8(22) = -176\]

15. \(54 \div (-6)\)

**SOLUTION:**
The quotient of two integers with different signs is negative.

\[54 \div (-6) = -9\]

16. \(30(14)\)

**SOLUTION:**
The product of two integers with the same sign is positive.

\[30(14) = 420\]

17. \(-23(5)\)

**SOLUTION:**
The product of two integers with different signs is negative.

\[-23(5) = -115\]

18. \(-200 \div 2\)

**SOLUTION:**
The quotient of two integers with different signs is negative.

\[-200 \div 2 = -100\]

19. **WEATHER** The outside temperature was \(-4°F\) in the morning and \(13°F\) in the afternoon. By how much did the temperature increase?

**SOLUTION:**
To find the change in temperature, subtract the first temperature from the second temperature.

\[13 - (-4) = 13 + (+4) = 17\]

So, the temperature increased by 17°.

20. **DOLPHINS** A dolphin swimming 24 feet below the ocean’s surface dives 18 feet straight down. How many feet below the ocean’s surface is the dolphin now?

**SOLUTION:**
The dolphin is 24 feet below the surface, or \(-24\) feet. The dolphin then dives down 18 more feet, or \(-18\) feet. Both numbers are negative, so the sum is negative.

\[-24 + (-18) = -42\]

The word “below” means negative. So, the dolphin is 42 feet below the ocean’s surface.

21. **MOVIES** A movie theater gave out 50 coupons for $3 off each movie. What is the total amount of discounts provided by the theater?

**SOLUTION:**
The movie theater gave out 50 coupons for $3 each. The product of two integers with the same sign is positive.

\[50(3) = 150\]

So, the movie theater gave out $150 worth of discounts.
22. **WAGES** Emilio earns $11 per hour. He works 14 hours a week. His employer withholds $32 from each paycheck for taxes. If he is paid weekly, what is the amount of his paycheck?

**SOLUTION:**
First, find the total amount Emilio earns before taxes are withheld. Multiply his wages by the hours worked. The product of two integers with the same sign is positive.

\[ 11 \times 14 = 154 \]

Emilio earns $154 a week. The employer withholds $32 dollars.

\[ 154 - 32 = 154 + (-32) \]
\[ = 122 \]

So, the amount of Emilio’s paycheck is $122.

23. **FINANCES** Talia is working on a monthly budget. Her monthly income is $500. She has allocated $200 for savings, $100 for vehicle expenses, and $75 for clothing. How much is available to spend on entertainment?

**SOLUTION:**
To find the amount available for entertainment, each amount for savings, vehicle expenses, and clothing must be subtracted from her income.

\[ 500 - 200 - 100 - 75 = 125 \]

So, Talia has $125 to spend on entertainment.
Section 1 Practice Problems

1. \(-\frac{5}{8} \leq \frac{3}{8}\)

\textit{SOLUTION:}
Because the fractions have a common denominator, compare the numerators.

\(-5 < 3\)

So, \(-\frac{5}{8} < \frac{3}{8}\)

2. \(\frac{4}{5} \geq 0.71\)

\textit{SOLUTION:}
To compare these numbers, write both fractions as a decimal. \(4 \div 5 = 0.8\)

0.8 is greater than 0.71, so \(\frac{4}{5}\) is greater than 0.71.

\(\frac{4}{5} > 0.71\)

3. \(\frac{5}{6} = 0.875\)

\textit{SOLUTION:}
To compare these numbers, write \(\frac{5}{6}\) as a decimal.

\(\frac{5}{6} = 0.83\)

So, \(\frac{5}{6} < 0.875\)

4. \(1.2 \leq 1\frac{2}{9}\)

\textit{SOLUTION:}
To compare these numbers, write \(1\frac{2}{9}\) as a decimal.

\(\frac{11}{9} = 1.222\overline{2}\)

1.20 < 1.22

So, \(1.2 < 1\frac{2}{9}\)

5. \(\frac{8}{15} > 0.53\)

\textit{SOLUTION:}
To compare these numbers, write \(\frac{8}{15}\) as a decimal.

\(\frac{8}{15} = 0.53\overline{3}\)

\(0.53 = 0.53\)

So, \(\frac{8}{15} = 0.53\overline{3}\)

6. \(-\frac{7}{11} \leq \frac{2}{3}\)

\textit{SOLUTION:}
To compare these numbers, write both fractions with a common denominator.

\(-\frac{7}{11} \cdot \frac{3}{3} = -\frac{21}{33}\)

\(-\frac{2}{11} \cdot \frac{11}{11} = -\frac{22}{33}\)

\(\frac{21}{33} > -\frac{22}{33}\)

So, \(-\frac{7}{11} < -\frac{2}{3}\)

Order each set of rational numbers from least to greatest.

7. 3.8, 3.06, \(3\frac{1}{6}\), \(3\frac{3}{4}\)

\textit{SOLUTION:}
To order these numbers from least to greatest, write the fractions as decimals.

\(3\frac{1}{6} = 3.\overline{1}\)

\(3\frac{3}{4} = 3.75\)

The decimals from least to greatest are 3.06, 3.1\overline{6}, 3.75, 3.8. So, the numbers in order from least to greatest are 3.06, 3\frac{1}{6}, 3\frac{3}{4}, 3.8.
8. \(2 \frac{1}{4}, 1 \frac{7}{8}, 1.75, 2.4\)

**SOLUTION:**
To order these numbers from least to greatest, write the fractions as decimals.

\[
\begin{align*}
1 \frac{7}{8} &= 1.875 \\
2 \frac{1}{4} &= 2.25
\end{align*}
\]

The decimals from least to greatest are 1.75, 1.875, 2.25, 2.4. So, the numbers in order from least to greatest are \(1.75, 1 \frac{7}{8}, 2 \frac{1}{4}, 2.4\).

9. \(0.11, -\frac{1}{9}, -0.5, \frac{1}{10}\)

**SOLUTION:**
To order these numbers from least to greatest, write the fractions as decimals.

\[
\begin{align*}
-\frac{1}{9} &= -0.1 \\
\frac{1}{10} &= 0.1
\end{align*}
\]

The decimals from least to greatest are \(-0.5, -0.1, 0.1, 0.11\). So, the numbers in order from least to greatest are \(-0.5, -\frac{1}{9}, \frac{1}{10}, 0.11\).

10. \(-4 \frac{3}{5}, -3 \frac{2}{5}, -4.65, -4.09\)

**SOLUTION:**
To order these numbers from least to greatest, write the fractions as decimals.

\[
\begin{align*}
-4 \frac{3}{5} &= -4.6 \\
-3 \frac{2}{5} &= -3.4
\end{align*}
\]

The decimals from least to greatest are \(-4.65, -4.6, -4.09, -3.4\). So, the numbers in order from least to greatest are \(-4.65, -4 \frac{3}{5}, -4.09, -3 \frac{2}{5}\).
0-4 Adding and Subtracting Rational Numbers

16. \( \frac{5}{8} + \frac{7}{8} \)

**SOLUTION:**
\[
\frac{5}{8} + \frac{7}{8} = \frac{5+7}{8} = \frac{12}{8} = \frac{1}{2}
\]

17. \( \frac{4}{3} + \frac{4}{3} \)

**SOLUTION:**
\[
\frac{4}{3} + \frac{4}{3} = \frac{4+4}{3} = \frac{8}{3} = 2\frac{2}{3}
\]

18. \( \frac{7}{15} - \frac{2}{15} \)

**SOLUTION:**
\[
\frac{7}{15} - \frac{2}{15} = \frac{7-2}{15} = \frac{5}{15} = \frac{1}{3}
\]

19. \( \frac{1}{3} - \frac{2}{9} \)

**SOLUTION:**
\[
\frac{1}{3} - \frac{2}{9} = \frac{3-2}{9} = \frac{1}{9}
\]

20. \( \frac{1}{2} + \frac{1}{4} \)

**SOLUTION:**
\[
\frac{1}{2} + \frac{1}{4} = \frac{2}{4} + \frac{1}{4} = \frac{3}{4}
\]

21. \( \frac{1}{3} - \frac{1}{3} \)

**SOLUTION:**
\[
\frac{1}{3} - \frac{1}{3} = \frac{3-2}{6} = \frac{1}{6}
\]

22. \( \frac{3}{7} + \frac{5}{14} \)

**SOLUTION:**
\[
\frac{3}{7} + \frac{5}{14} = \frac{6}{14} + \frac{5}{14} = \frac{11}{14}
\]

23. \( \frac{7}{10} - \frac{2}{15} \)

**SOLUTION:**
\[
\frac{7}{10} - \frac{2}{15} = \frac{21}{30} - \frac{4}{30} = \frac{17}{30}
\]

24. \( \frac{3}{8} + \frac{1}{6} \)

**SOLUTION:**
\[
\frac{3}{8} + \frac{1}{6} = \frac{9}{24} + \frac{4}{24} = \frac{13}{24}
\]
25. \( \frac{13}{20} - \frac{2}{5} \)

**SOLUTION:**

\[
\frac{13}{20} - \frac{2}{5} = \frac{13}{20} - \frac{8}{20} = \frac{5}{20} = \frac{1}{4}
\]

Find each sum or difference. Write in simplest form if necessary.

26. \(-1.6 + (-3.8)\)

**SOLUTION:**

Both numbers are negative, so the sum is negative. Add the absolute values.

\[
-1.6 + (-3.8) = -((-1.6) + (-3.8)) \\
= -(1.6 + 3.8) \\
= -5.4
\]

27. \(-32.4 + (-4.5)\)

**SOLUTION:**

Both numbers are negative, so the sum is negative. Add the absolute values.

\[
-32.4 + (-4.5) = -((32.4) + (4.5)) \\
= -(32.4 + 4.5) \\
= -36.9
\]

28. \(-38.9 + 24.2\)

**SOLUTION:**

Subtract the absolute values. Because \(-38.9\) > \(24.2\), the result is negative.

\[
-38.9 + 24.2 = -((38.9) - (24.2)) \\
= -(38.9 - 24.2) \\
= -14.7
\]

29. \(-9.16 - 10.17\)

**SOLUTION:**

To subtract, add the inverse. Both numbers in the sum are negative, so the result is negative.

\[
-9.16 - 10.17 = -9.16 + (-10.17) \\
= -((-9.16) + (-10.17)) \\
= -(9.16 + 10.17) \\
= -19.33
\]

30. \(26.37 + (-61.1)\)

**SOLUTION:**

If \(-61.1\) > \([26.37]\), so the result is negative.

\[
26.37 + (-61.1) = -((61.1) - (26.37)) \\
= -(61.1 - 26.37) \\
= -34.73
\]

31. \(72.5 - (-81.3)\)

**SOLUTION:**

To subtract \(-81.3\), add its inverse.

\[
72.5 - (-81.3) = 72.5 + 81.3 = 153.8
\]

32. \(43.2 + (-27.9)\)

**SOLUTION:**

If \([43.2]\) > \([-27.9]\), so the result is positive.

\[
43.2 + (-27.9) = ([43.2] - [27.9]) \\
= (43.2 - 27.9) \\
= 15.3
\]

33. \(79.3 - (-14)\)

**SOLUTION:**

To subtract \((-14)\), add its inverse.

\[
79.3 - (-14) = 79.3 + 14 = 93.3
\]
0-4 Adding and Subtracting Rational Numbers

34. \(1.34 - (-0.458)\)

**SOLUTION:**
To subtract \(-0.458\), add its inverse.

\[
1.34 - (-0.458) = 1.34 + 0.458 = 1.798
\]

35. \(\frac{1}{6} - \frac{2}{3}\)

**SOLUTION:**
The LCD is 6.

\[
\frac{1}{6} - \frac{2}{3} = \frac{-2}{6} + \frac{4}{6} = \frac{2}{6} = \frac{1}{3}
\]

36. \(\frac{1}{2} - \frac{4}{5}\)

**SOLUTION:**
\[
\frac{1}{2} - \frac{4}{5} = \frac{5}{10} - \frac{8}{10} = -\frac{3}{10}
\]

37. \(\frac{2}{5} + \frac{17}{20}\)

**SOLUTION:**
The LCD for 5 and 20 is 20.

\[
\frac{2}{5} + \frac{17}{20} = \frac{8}{20} + \frac{17}{20} = \frac{25}{20} = \frac{5}{4}
\]

38. \(-\frac{4}{5} + \left(-\frac{1}{3}\right)\)

**SOLUTION:**

\[
-\frac{4}{5} + \left(-\frac{1}{3}\right) = -\frac{12}{15} + \left(-\frac{5}{15}\right) = -\frac{17}{15}
\]

39. \(-\frac{1}{12} - \left(-\frac{3}{4}\right)\)

**SOLUTION:**

\[
-\frac{1}{12} - \left(-\frac{3}{4}\right) = -\frac{1}{12} + \frac{9}{12} = \frac{8}{12} = \frac{2}{3}
\]

40. \(-\frac{7}{8} + \left(-\frac{3}{16}\right)\)

**SOLUTION:**

\[
-\frac{7}{8} + \left(-\frac{3}{16}\right) = -\frac{14}{16} + \left(-\frac{3}{16}\right) = -\frac{17}{16}
\]

SOLUTION:

\[
\frac{5}{12} + \left(-\frac{2}{3}\right)
\]

**SOLUTION:**

\[
\frac{5}{12} + \left(-\frac{8}{12}\right) = -\frac{3}{12} = -\frac{1}{4}
\]
41. **GEOGRAPHY** About \( \frac{7}{10} \) of the surface of Earth is covered by water. The rest of the surface is covered by land. How much of Earth’s surface is covered by land?

**SOLUTION:**
To find how much of Earth’s surface is covered by land, subtract the amount covered by water from the total. The entire Earth’s surface can be represented by 1.

\[
1 - \frac{7}{10} = \frac{10}{10} - \frac{7}{10} = \frac{3}{10}
\]

So, \( \frac{3}{10} \) of the Earth’s surface is covered by land.
Find each product or quotient. Round to the nearest hundredth if necessary.

1. \(6.5(0.13)\)
   
   **SOLUTION:**
   The product of two numbers with the same sign is positive. So, \(6.5(0.13) = 0.85\).

2. \(-5.8(2.3)\)
   
   **SOLUTION:**
   The product of two numbers with different signs is negative. So, \(-5.8(2.3) = -13.34\).

3. \(42.3 \div (-6)\)
   
   **SOLUTION:**
   The quotient of two numbers with different signs is negative. So, \(42.3 \div (-6) = -7.05\).

4. \(-14.1(-2.9)\)
   
   **SOLUTION:**
   The product of two numbers with the same sign is positive. So, \(-14.1(-2.9) = 40.89\).

5. \(-78 \div (-1.3)\)
   
   **SOLUTION:**
   The quotient of two numbers with the same sign is positive. So, \(-78 \div (-1.3) = 60\).

6. \(108 \div (-0.9)\)
   
   **SOLUTION:**
   The quotient of two numbers with different signs is negative. So, \(108 \div (-0.9) = -120\).

7. \(0.75(-6.4)\)
   
   **SOLUTION:**
   The product of two numbers with different signs is negative. So, \(0.75(-6.4) = -4.8\).

8. \(-23.94 \div 10.5\)
   
   **SOLUTION:**
   The quotient of two numbers with different signs is negative. So, \(-23.94 \div 10.5 = -2.28\).

9. \(-32.4 \div 21.3\)
   
   **SOLUTION:**
   The quotient of two numbers with different signs is negative. So, \(-32.4 \div 21.3 \approx -1.52\).

Find each product. Simplify before multiplying if possible.

10. \(\frac{3}{4} \cdot \frac{1}{5}\)
    
    **SOLUTION:**
    Multiply.
    \[
    \frac{3}{4} \cdot \frac{1}{5} = \frac{3 \cdot 1}{4 \cdot 5} = \frac{3}{20}
    \]
    Simplify.

11. \(\frac{2}{5} \cdot \frac{3}{7}\)
    
    **SOLUTION:**
    Multiply.
    \[
    \frac{2}{5} \cdot \frac{3}{7} = \frac{2 \cdot 3}{5 \cdot 7} = \frac{6}{35}
    \]
    Simplify.

12. \(-\frac{1}{3} \cdot \frac{2}{5}\)
    
    **SOLUTION:**
    Multiply.
    \[
    -\frac{1}{3} \cdot \frac{2}{5} = \frac{-1 \cdot 2}{3 \cdot 5} = \frac{-2}{15}
    \]
    Simplify.

13. \(-\frac{2}{3} \cdot \left(-\frac{1}{11}\right)\)
    
    **SOLUTION:**
    Multiply.
    \[
    -\frac{2}{3} \cdot \left(-\frac{1}{11}\right) = \frac{-2 \cdot (-1)}{3 \cdot 11} = \frac{2}{33}
    \]

14. \(2\frac{1}{2} \cdot \left(-\frac{1}{4}\right)\)
    
    **SOLUTION:**
    Write \(2\frac{1}{2}\) as an improper fraction.
    \[
    2\frac{1}{2} \cdot \left(-\frac{1}{4}\right) = \frac{5}{2} \cdot \left(-\frac{1}{4}\right) = \frac{5 \cdot (-1)}{2 \cdot 4} = \frac{-5}{8}
    \]
    Simplify.
15. \(3\frac{1}{2} \cdot 1\frac{1}{2}\)

**SOLUTION:**

First write the fractions as improper fractions.

\[
3\frac{1}{2} \cdot 1\frac{1}{2} = \frac{7}{2} \cdot \frac{3}{2} \quad \frac{3}{2} \cdot \frac{7}{2} = \frac{21}{4} \text{ or } 5\frac{1}{4} \text{ Simplify.}
\]

16. \(\frac{2}{9} \cdot \frac{1}{2}\)

**SOLUTION:**

\[
\frac{2}{9} \cdot \frac{1}{2} = \frac{\frac{8}{9}}{1} \quad \text{Divide by the GCF, } 2
\]

\[= \frac{1}{9} \quad \text{Simplify.}
\]

17. \(\frac{3}{2} \cdot \left(-\frac{1}{3}\right)\)

**SOLUTION:**

\[
\frac{3}{2} \cdot \left(-\frac{1}{3}\right) = \frac{\frac{1}{2}}{1} \quad \text{Divide by the GCF, } 3
\]

\[= \frac{1 \cdot (-1)}{2 \cdot 1} \quad \text{Multiply.}
\]

\[= -\frac{1}{2} \quad \text{Simplify.}
\]

18. \(\frac{1}{3} \cdot \frac{6}{5}\)

**SOLUTION:**

\[
\frac{1}{3} \cdot \frac{6}{5} = \frac{1 \cdot 6}{3 \cdot 5} = \frac{\frac{2}{5}}{5} \quad \text{Divide by the GCF, } 3
\]

\[= \frac{1 \cdot 2}{1 \cdot 5} \quad \text{Multiply.}
\]

\[= \frac{\frac{2}{5}}{5} \quad \text{Simplify.}
\]

19. \(-\frac{9}{4} \cdot \frac{1}{18}\)

**SOLUTION:**

\[
-\frac{9}{4} \cdot \frac{1}{18} = -\frac{\frac{3}{2}}{\frac{1}{2}} \quad \text{Divide by the GCF, } 9
\]

\[= \frac{-3}{4} \cdot \frac{1}{2} \quad \text{Multiply.}
\]

\[= \frac{-1}{8} \quad \text{Simplify.}
\]

20. \(\frac{11}{3} \cdot \frac{9}{44}\)

**SOLUTION:**

\[
\frac{11}{3} \cdot \frac{9}{44} = \frac{11 \cdot 3}{3 \cdot 44} \quad \text{Divide by the GCF, } 11 \text{ and } 3
\]

\[= \frac{1 \cdot 3}{4 \cdot 4} \quad \text{Multiply.}
\]

\[= \frac{3}{16} \quad \text{Simplify.}
\]

21. \((-\frac{30}{11}) \cdot \left(-\frac{1}{3}\right)\)

**SOLUTION:**

\[
\left(-\frac{30}{11}\right) \cdot \left(-\frac{1}{3}\right) = \left(-\frac{10 \cdot (-1)}{11 \cdot (-1)}\right) \quad \text{Multiply}
\]

\[= \frac{10}{11} \quad \text{Simplify.}
\]
22. \(-\frac{3}{5} \cdot \frac{5}{6}
\]
\[
\text{SOLUTION:} \\
-\frac{3}{5} \cdot \frac{5}{6} = \frac{-3 \cdot 5}{5 \cdot 6} = \frac{-15}{30} = \frac{15}{30} \text{ Divide by GCF, 3 and 5} \\
= \frac{15}{30} \cdot \frac{1}{2} \text{ Multiply.} \\
= \frac{1}{2} \text{ Simplify.}
\]

23. \(-\frac{1}{3} \cdot -\frac{7}{2}
\]
\[
\text{SOLUTION:} \\
\left(-\frac{1}{3}\right) \cdot \left(-\frac{7}{2}\right) = \left(-\frac{1}{3}\right) \cdot \left(-\frac{7}{2}\right) \div \frac{5}{2} \text{ Divide by GCF, 3} \\
\frac{-5}{2} = -\frac{5}{12} \text{ Multiply.} \\
= \frac{5}{2} \text{ or } \frac{-1}{2} \text{ Simplify.}
\]

24. \(\frac{2}{7} \cdot \frac{4}{3}
\]
\[
\text{SOLUTION:} \\
\frac{2}{7} \cdot \frac{4}{3} = \frac{2}{7} \cdot \frac{4}{3} \div 3 \text{ Divide by GCF, 3} \\
\frac{2}{7} = \frac{2 \cdot 3}{7 \cdot 3} \text{ Multiply.} \\
\frac{2}{7} = \frac{4}{3} \text{ or } \frac{1}{3} \text{ Simplify.}
\]

Name the reciprocal of each number.

25. \(\frac{6}{7}
\]
\[
\text{SOLUTION:} \\
The product of a number and its reciprocal is 1. So, \\
\frac{7}{6} \text{ or } \frac{1}{6} \text{ is the reciprocal of } \frac{6}{7}.
\]

26. \(\frac{1}{22}
\]
\[
\text{SOLUTION:} \\
The product of a number and its reciprocal is 1. So, \\
\frac{1}{22} \text{ is the reciprocal of } \frac{1}{22}.
\]

27. \(-\frac{14}{23}
\]
\[
\text{SOLUTION:} \\
The product of a number and its reciprocal is 1. So, \\
-\frac{23}{14} \text{ or } -\frac{9}{14} \text{ is the reciprocal of } -\frac{14}{23}.
\]

28. \(\frac{3}{4}
\]
\[
\text{SOLUTION:} \\
The product of a number and its reciprocal is 1. \\
\frac{3}{4} = \frac{11}{4} \text{ So, } \frac{4}{11} \text{ is the reciprocal of } \frac{3}{4}.
\]

29. \(-\frac{1}{3}
\]
\[
\text{SOLUTION:} \\
The product of a number and its reciprocal is 1. \\
-\frac{3}{1} = -\frac{16}{3} \text{ So, } -\frac{3}{3} \text{ is the reciprocal of } -\frac{1}{3}.
\]

30. \(\frac{3}{4}
\]
\[
\text{SOLUTION:} \\
The product of a number and its reciprocal is 1. \\
\frac{3}{4} = \frac{15}{4} \text{ So, } \frac{4}{15} \text{ is the reciprocal of } \frac{3}{4}.
\]
Find each quotient.

31. \( \frac{2}{3} \div \frac{1}{3} \)

**SOLUTION:**

\[
\frac{2}{3} \div \frac{1}{3} = \frac{2}{3} \cdot \frac{3}{1} = \frac{2 \cdot 3}{3 \cdot 1} = \frac{2}{1} \cdot \frac{3}{1} = \frac{2}{1} \cdot 3 = 2
\]

32. \( \frac{16}{9} \div \frac{4}{9} \)

**SOLUTION:**

\[
\frac{16}{9} \div \frac{4}{9} = \frac{16}{9} \cdot \frac{9}{4} = \frac{16 \cdot 9}{9 \cdot 4} = \frac{16 \cdot (\frac{9}{9})}{4} = \frac{16 \cdot 1}{4} = \frac{16}{4} = 4
\]

33. \( \frac{3}{2} \div \frac{1}{2} \)

**SOLUTION:**

\[
\frac{3}{2} \div \frac{1}{2} = \frac{3}{2} \cdot \frac{2}{1} = \frac{3 \cdot 2}{2 \cdot 1} = \frac{3 \cdot 1}{1} = 3
\]

34. \( \frac{3}{7} \div \left( -\frac{1}{5} \right) \)

**SOLUTION:**

\[
\frac{3}{7} \div \left( -\frac{1}{5} \right) = \frac{3}{7} \cdot \left( -\frac{5}{1} \right) = \frac{3 \cdot (-5)}{7 \cdot 1} = \frac{-15}{7} = -2\frac{1}{7}
\]

35. \( -\frac{9}{10} \div 3 \)

**SOLUTION:**

\[
-\frac{9}{10} \div 3 = -\frac{9}{10} \cdot \frac{1}{3} = \frac{-9 \cdot 1}{10 \cdot 3} = \frac{-9}{30} = \frac{-3}{10}
\]
39. \( \frac{11}{12} \div \frac{1\frac{1}{3}}{3} \)

**SOLUTION:**

\[
\frac{11}{12} \div \frac{1\frac{1}{3}}{3} = \frac{11}{12} \div \frac{4}{12} \cdot \frac{1}{3} \quad \text{Divide by GCF, 12.}
\]

\[
= \frac{11}{4} \cdot \frac{1}{3} \quad \text{Simplify.}
\]

\[
= \frac{11}{12} \quad \text{Multiply.}
\]

40. \( 4 \div \left( -\frac{2}{7} \right) \)

**SOLUTION:**

\[
4 \div \left( -\frac{2}{7} \right) = 4 \div \left( -\frac{7}{2} \right) \quad \text{Multiply by the reciprocal}
\]

\[
= \frac{4}{1} \cdot \left( -\frac{7}{2} \right) \quad \text{Divide by GCF, 1.}
\]

\[
= -\frac{14}{1} \quad \text{Multiply.}
\]

\[
= -\frac{14}{1} \quad \text{Simplify.}
\]

41. \( -\frac{1}{3} \div \left( -\frac{1}{5} \right) \)

**SOLUTION:**

\[
-\frac{1}{3} \div \left( -\frac{1}{5} \right) = -\frac{1}{3} \div \left( -\frac{5}{1} \right) \quad \text{Multiply by the reciprocal}
\]

\[
= -\frac{1}{3} \div \left( -\frac{5}{1} \right) \quad \text{Same sign \Rightarrow positive quotient; multiply}
\]

\[
= \frac{5}{18} \quad \text{Simplify.}
\]

42. \( \frac{3}{25} \div \frac{2}{15} \)

**SOLUTION:**

\[
\frac{3}{25} \div \frac{2}{15} = \frac{3}{25} \div \frac{2}{15} \quad \text{Multiply by the reciprocal}
\]

\[
= \frac{3}{25} \cdot \frac{5}{2} \quad \text{Divide by GCF, 5.}
\]

\[
= \frac{3}{10} \quad \text{Multiply.}
\]

43. **PIZZA** A large pizza at Pizza Shack has 12 slices. If Bobby ate \( \frac{1}{4} \) of the pizza, how many slices of pizza did he eat?

**SOLUTION:**

To find how many slices of pizza Bobby ate, multiply 12 by \( \frac{1}{4} \).

\[
12 \cdot \frac{1}{4} = \frac{12}{1} \cdot \frac{1}{4} = \frac{3}{1} = 3
\]

So, Bobby ate 3 slices.

44. **MUSIC** Samantha practices the flute for \( 4\frac{1}{2} \) hours each week. How many hours does she practice in a month?

**SOLUTION:**

To find how many hours Samantha practices the flute in a month, multiply \( 4\frac{1}{2} \) by 4, because there are typically 4 weeks in a month.

\[
4\frac{1}{2} \cdot 4 = \frac{9}{2} \cdot \frac{2}{1} = \frac{18}{1} = 18
\]

So, Samantha practices 18 hours in a month.
45. **BAND** How many band uniforms can be made with \(131\frac{3}{4}\) yards of fabric if each uniform requires \(3\frac{7}{8}\) yards?

**SOLUTION:**
To find the number of band uniforms that can be made with \(131\frac{3}{4}\) yards of fabric, divide \(131\frac{3}{4}\) by \(3\frac{7}{8}\).

\[
131\frac{3}{4} \div 3\frac{7}{8} = \frac{527}{4} \div \frac{31}{8} = \frac{527}{4} \cdot \frac{8}{31} = \frac{17}{1} \cdot \frac{8}{1} = 527 \div 4 \cdot 2 = 8
\]

Therefore, 34 uniforms can be made with \(131\frac{3}{4}\) yards of fabric.

46. **CARPENTRY** How many boards, each 2 feet 8 inches long, can be cut from a board 16 feet long if there is no waste?

**SOLUTION:**
There are 12 inches in a foot. So, a board that is 2 feet 8 inches long is \(2\frac{8}{12}\) or \(2\frac{2}{3}\) feet long. To find how many \(2\frac{2}{3}\)-foot boards can be cut from a board that is 16 feet long, divide 16 by \(2\frac{2}{3}\).

\[
16 \div 2\frac{2}{3} = 16 \div \frac{8}{3} = \frac{16}{1} \cdot \frac{3}{8} = \frac{2}{1} \cdot \frac{3}{8} = \frac{6}{1} = 6
\]

So, 6 boards can be cut from a board that is 16 feet long.
0-5 Multiplying and Dividing Rational Numbers

47. SEWING How many 9-inch ribbons can be cut from \(1\frac{1}{2}\) yards of ribbon?

**SOLUTION:**
There are 36 inches in a yard. To find how many 9-inch ribbons can be cut from \(1\frac{1}{2}\) yards of ribbon,

first find how many inches are in \(1\frac{1}{2}\) yards. Multiply \(1\frac{1}{2}\) by 36.

\[
1\frac{1}{2} \times 36 = \frac{3}{2} \times \frac{36}{1} = \frac{54}{1} = 54
\]

There are 54 inches in \(1\frac{1}{2}\) yards. Now, divide 54 by 9.

\[
54 \div 9 = 6
\]

So, six 9-inch ribbons can be cut from \(1\frac{1}{2}\) yards of ribbon.
Express each percent as a fraction or mixed number in simplest form.

1. 5%
   SOLUTION:
   \[ 5\% = \frac{5}{100} = \frac{1}{20} \]

2. 60%
   SOLUTION:
   \[ 60\% = \frac{60}{100} = \frac{3}{5} \]

3. 11%
   SOLUTION:
   \[ 11\% = \frac{11}{100} \]

4. 120%
   SOLUTION:
   \[ 120\% = \frac{120}{100} = \frac{6}{5} = 1 \frac{1}{5} \]

5. 78%
   SOLUTION:
   \[ 78\% = \frac{78}{100} = \frac{39}{50} \]

6. 2.5%
   SOLUTION:
   \[ 2.5\% = \frac{2.5}{100} = \frac{25}{1000} = \frac{1}{40} \]

7. 0.6%
   SOLUTION:
   \[ 0.6\% = \frac{0.6}{100} = \frac{60}{1000} = \frac{3}{500} \]

8. 0.4%
   SOLUTION:
   \[ 0.4\% = \frac{0.4}{100} = \frac{40}{1000} = \frac{1}{250} \]

9. 1400%
   SOLUTION:
   \[ 1400\% = \frac{1400}{100} = \frac{14}{1} = 14 \]

Use the percent proportion to find each number.

10. 25 is what percent of 125?
    SOLUTION:
    The part is 25 and the base is 125. Let \( p \) represent the percent.
    \[
    \frac{a}{b} = \frac{p}{100} \\
    \frac{25}{125} = \frac{p}{100} \quad a = 25, \quad b = 125 \\
    2500 = 125p \quad \text{Find the cross products.} \\
    \frac{2500}{125} = \frac{125p}{125} \\
    20 = p \quad \text{Simplify.}
    
    Therefore, 25 is 20% of 125.
11. 16 is what percent of 40?

**SOLUTION:**
The part is 16 and the base is 40. Let \( p \) represent the percent.

\[
\frac{16}{40} = \frac{p}{100} \quad \text{Replace } a \text{ with } 16 \text{ and } b \text{ with } 40
\]

\[
1600 = 40p \quad \text{Find the cross products}
\]

\[
\frac{1600}{40} = \frac{40p}{40} \quad \text{Divide each side by } 40.
\]

\[
40 = p \quad \text{Simplify}
\]

So, 16 is 40\% of 40.

12. 14 is 20\% of what number?

**SOLUTION:**
The percent is 20 and the part is 14. Let \( b \) represent the base.

\[
\frac{14}{b} = \frac{20}{100} \quad \text{Percent Proportion}
\]

\[
1400 = 20b \quad \text{Find the cross products}
\]

\[
\frac{1400}{20} = \frac{20b}{20} \quad \text{Divide each side by } 20.
\]

\[
70 = b \quad \text{Simplify.}
\]

So, 14 is 20\% of 70.

13. 50\% of what number is 80?

**SOLUTION:**
The percent is 50 and the part is 80. Let \( b \) represent the base.

\[
\frac{a}{b} = \frac{50}{100} \quad \text{Percent Proportion}
\]

\[
80 = 50b \quad \text{Find the cross products}
\]

\[
\frac{8000}{50} = \frac{50b}{50} \quad \text{Divide each side by } 50.
\]

\[
160 = b \quad \text{Simplify.}
\]

So, 80 is 50\% of 160.

14. What number is 25\% of 18?

**SOLUTION:**
The percent is 25 and the base is 18. Let \( a \) represent the part.

\[
\frac{a}{18} = \frac{25}{100} \quad \text{Percent Proportion}
\]

\[
100a = 450 \quad \text{Find the cross products}
\]

\[
\frac{100a}{100} = \frac{450}{100} \quad \text{Divide each side by } 100.
\]

\[
a = 4.5 \quad \text{Simplify.}
\]

So, 4.5 is 25\% of 18.

15. Find 10\% of 95.

**SOLUTION:**
The percent is 10 and the base is 95. Let \( a \) represent the part.

\[
\frac{a}{95} = \frac{10}{100} \quad \text{Percent Proportion}
\]

\[
100a = 950 \quad \text{Find the cross products}
\]

\[
\frac{100a}{100} = \frac{950}{100} \quad \text{Divide each side by } 100.
\]

\[
a = 9.5 \quad \text{Simplify.}
\]

So, 9.5 is 10\% of 95.
Use the percent proportion to find each number.

16. What percent of 48 is 30?

**SOLUTION:**
The part is 30 and the base is 48. Let \( p \) represent the percent.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]

\[
\frac{30}{48} = \frac{p}{100}
\]

Find the cross products

\[
3000 = 48p
\]

Divide each side by 48.

\[
\frac{3000}{48} = \frac{48p}{48}
\]

\[
62.5 = p
\]

So, 30 is 62.5% of 48.

17. What number is 150% of 32?

**SOLUTION:**
The percent is 150 and the base is 32. Let \( a \) represent the part.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]

\[
\frac{a}{32} = \frac{150}{100}
\]

Find the cross products

\[
100a = 4800
\]

Divide each side by 100.

\[
\frac{100a}{100} = \frac{4800}{100}
\]

\[
a = 48
\]

So, 48 is 150% of 32.

18. 5% of what number is 3.5?

**SOLUTION:**
The percent is 5 and the part is 3.5. Let \( b \) represent the base.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]

\[
\frac{3.5}{b} = \frac{5}{100}
\]

Find the cross products

\[
350 = 5b
\]

Divide each side by 5.

\[
\frac{350}{5} = \frac{5b}{5}
\]

\[
70 = b
\]

Simplify.

So, 3.5 is 5% of 70.

19. 1 is what percent of 400?

**SOLUTION:**
The part is 1 and the base is 400. Let \( p \) represent the percent.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]

\[
\frac{1}{400} = \frac{p}{100}
\]

Find the cross products.

\[
100 = 400p
\]

Divide each side by 400.

\[
\frac{100}{400} = \frac{400p}{400}
\]

\[
0.25 = p
\]

Simplify.

So, 1 is 0.25% of 400.

20. Find 0.5% of 250.

**SOLUTION:**
The percent is 0.5 and the base is 250. Let \( a \) represent the part.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]

\[
\frac{a}{250} = \frac{0.5}{100}
\]

Find the cross products

\[
100a = 125
\]

Divide each side by 100.

\[
\frac{100a}{100} = \frac{125}{100}
\]

\[
a = 1.25
\]

Simplify.

So, 1.25 is 0.5% of 250.
21. 49 is 200% of what number?

**SOLUTION:**
The percent is 200 and the part is 49. Let \( b \) represent the base.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]

\[
\frac{49}{b} = \frac{200}{100} \quad a = 49 \text{ and } p = 200.
\]

\[
4900 = 200b \quad \text{Find the cross products}
\]

\[
\frac{4900}{200} = \frac{200b}{200} \quad \text{Divide each side by 200}
\]

\[
24.5 = b \quad \text{Simplify.}
\]

So, 49 is 200% of 24.5.

22. 15 is what percent of 12?

**SOLUTION:**
The part is 15 and the base is 12. Let \( p \) represent the percent.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]

\[
\frac{15}{12} = \frac{p}{100} \quad a = 15 \text{ and } b = 12.
\]

\[
1500 = 12p \quad \text{Find the cross products}
\]

\[
\frac{1500}{12} = \frac{12p}{12} \quad \text{Divide each side by 12.}
\]

\[
125 = p \quad \text{Simplify.}
\]

So, 15 is 125% of 12.

23. 36 is what percent of 24?

**SOLUTION:**
The part is 36 and the base is 24. Let \( p \) represent the percent.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]

\[
\frac{36}{24} = \frac{p}{100} \quad a = 36 \text{ and } b = 24.
\]

\[
3600 = 24p \quad \text{Find the cross products}
\]

\[
\frac{3600}{24} = \frac{24p}{24} \quad \text{Divide each side by 24.}
\]

\[
150 = p \quad \text{Simplify.}
\]

So, 36 is 150% of 24.

24. **BASKETBALL** Madeline usually makes 85% of her shots in basketball. If she attempts 20, how many will she likely make?

**SOLUTION:**
To find how many shots Madeline will likely make, find 85% of 20. The percent is 25 and the base is 18. Let \( a \) represent the part.

\[
\frac{a}{20} = \frac{85}{100} \quad \text{Percent Proportion}
\]

\[
100a = 1700 \quad \text{Find the cross products}
\]

\[
\frac{100a}{100} = \frac{1700}{100} \quad \text{Divide each side by 100.}
\]

\[
a = 17 \quad \text{Simplify.}
\]

So, Madeline will likely make 17 shots.

25. **TEST SCORES** Brian answered 36 items correctly on a 40-item test. What percent did he answer correctly?

**SOLUTION:**
To find what percent Brian answered correctly, find what percent 36 is of 40. The part is 16 and the base is 40. Let \( p \) represent the percent.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]

\[
\frac{36}{40} = \frac{p}{100} \quad a = 36 \text{ and } b = 40.
\]

\[
3600 = 40p \quad \text{Find the cross products}
\]

\[
\frac{3600}{40} = \frac{40p}{40} \quad \text{Divide each side by 40.}
\]

\[
90 = p \quad \text{Simplify.}
\]

So, Brian answered 90% of the items correctly.
26. **CARD GAMES** Juanita told her dad that she won 80% of the card games she played yesterday. If she won 4 games, how many games did she play?

**SOLUTION:**
To find how many games Juanita played, find the number of which 4 is 80%. The percent is 80 and the part is 4. Let \( b \) represent the base.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]

\[
\frac{4}{b} = \frac{80}{100} \quad a = 4 \text{ and } p = 80.
\]

1. Find the cross products.
2. Divide each side by 80.
3. 5 = \( b \) Simplify.

So, Juanita won 5 games.

27. **SOLUTIONS** A glucose solution is prepared by dissolving 6 milliliters of glucose in 120 milliliters of pure solution. What is the percent of glucose in the resulting solution?

**SOLUTION:**
To find the percent of glucose in the pure solution, find what percent 6 is of 120. The part is 6 and the base is 120. Let \( p \) represent the percent.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]

\[
\frac{6}{120} = \frac{p}{100} \quad a = 6 \text{ and } b = 120.
\]

1. Find the cross products.
2. Divide each side by 120.
3. 5 = \( p \) Simplify.

So, there is 5% of glucose in the pure solution.

28. **DRIVER’S ED** Kara needs to get a 75% on her driving education test in order to get her license. If there are 35 questions on the test, how many does she need to answer correctly?

**SOLUTION:**
To find how many questions Kara needs to answer correctly, find 75% of 35. The percent is 75 and the base is 35. Let \( a \) represent the part.

\[
\frac{a}{35} = \frac{75}{100} \quad \text{Percent Proportion}
\]

1. Find the cross products.
2. Divide each side by 100.
3. \( a = 26.25 \) Simplify.

So, Kara needs to answer 27 questions correctly.

29. **HEALTH** The U.S. Food and Drug Administration requires food manufacturers to label their products with a nutritional label. The label below shows the information from a package of macaroni and cheese.

<table>
<thead>
<tr>
<th>Nutrition Facts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Serving Size</strong></td>
</tr>
<tr>
<td><strong>Servings per container</strong></td>
</tr>
<tr>
<td><strong>Amount per serving</strong></td>
</tr>
<tr>
<td><strong>%Daily value</strong></td>
</tr>
<tr>
<td><strong>Total Fat</strong></td>
</tr>
<tr>
<td><strong>Saturated Fat</strong></td>
</tr>
<tr>
<td><strong>Cholesterol</strong></td>
</tr>
<tr>
<td><strong>Sodium</strong></td>
</tr>
<tr>
<td><strong>Total Carbohydrate</strong></td>
</tr>
<tr>
<td><strong>Dietary Fiber</strong></td>
</tr>
<tr>
<td><strong>Sugars</strong></td>
</tr>
<tr>
<td><strong>Protein</strong></td>
</tr>
</tbody>
</table>

**a.** The label states that a serving contains 3 grams of saturated fat, which is 15% of the daily value recommended for a 2000-Calorie diet. How many grams of saturated fat are recommended for a 2000-Calorie diet?

**b.** The 470 milligrams of sodium (salt) in the macaroni and cheese is 20% of the recommended...
daily value. What is the recommended daily value of sodium?
c. For a healthy diet, the National Research Council recommends that no more than 30 percent of the total Calories come from fat. What percent of the Calories in a serving of this macaroni and cheese come from fat?

**SOLUTION:**

a. To find how many grams of saturated fat are recommended for a 2000-Calorie diet, find the number of which 3 is 15%. The percent is 15 and the part is 3. Let \( b \) represent the base.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]

\[
\frac{3}{b} = \frac{15}{100} \quad \alpha = 3 \text{ and } p = 15.
\]

\[
300 = 15b \quad \text{Find the cross products}
\]

\[
\frac{300}{15} = \frac{15b}{15} \quad \text{Divide each side by 15}.
\]

\[
20 = b \quad \text{Simplify}.
\]

So, 20 grams of saturated fat are recommended for a 2000-Calorie diet.

b. To find the recommended daily value of sodium, find the number of which 470 is 20%. The percent is 20 and the part is 470. Let \( b \) represent the base.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]

\[
\frac{470}{b} = \frac{20}{100} \quad \alpha = 470 \text{ and } p = 20.
\]

\[
47,000 = 20b \quad \text{Find the cross products}
\]

\[
\frac{47,000}{20} = \frac{20b}{20} \quad \text{Divide each side by 20}.
\]

\[
2350 = b \quad \text{Simplify}.
\]

So, 2350 milligrams is the recommended daily value of sodium.

c. There are 250 calories in a serving of this macaroni and cheese, and 110 of those calories come from fat. To find what percent of the calories come from fat, find what percent 110 is of 250. The part is 110 and the base is 250. Let \( p \) represent the percent.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]

\[
\frac{110}{250} = \frac{p}{100} \quad \alpha = 110 \text{ and } b = 250;
\]

\[
11,000 = 250p \quad \text{Find the cross products}
\]

\[
\frac{11,000}{250} = \frac{250p}{250} \quad \text{Divide each side by 250}.
\]

\[
44 = p \quad \text{Simplify}.
\]

So, 44% of the Calories in a serving of this macaroni and cheese come from fat.

30. **TEST SCORES** The table shows the number of points each student in Will’s study group earned on a recent math test. There were 88 points possible on the test. Express all answers to the nearest tenth of a percent.

<table>
<thead>
<tr>
<th>Name</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Will</td>
<td>72</td>
</tr>
<tr>
<td>Penny</td>
<td>68</td>
</tr>
<tr>
<td>Cheng</td>
<td>88</td>
</tr>
<tr>
<td>Mirora</td>
<td>87</td>
</tr>
<tr>
<td>Rob</td>
<td>75</td>
</tr>
</tbody>
</table>

**SOLUTION:**

a. Find Will’s percent correct on the test.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]

\[
\frac{72}{88} = \frac{p}{100} \quad \alpha = 72 \text{ and } b = 88.
\]

\[
7200 = 88p \quad \text{Find the cross products}
\]

\[
\frac{7200}{88} = \frac{88p}{88} \quad \text{Divide each side by 88}.
\]

\[
81.8\% = p \quad \text{Simplify}.
\]

So, Will got 81.8% correct.

b. To find Cheng’s percent correct on the test, find what percent 81 is of 88. The part is 81 and the base is 88. Let \( p \) represent the percent.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]

\[
\frac{81}{88} = \frac{p}{100} \quad \alpha = 81 \text{ and } b = 88.
\]

\[
81 = \frac{88p}{88} \quad \text{Find the cross products}
\]

\[
81 = p \quad \text{Simplify}.
\]

So, Cheng got 92.1% correct.
So, Cheng got 92.0% correct.

d. Since Minowa had the highest score and Penny had the lowest score, find their percent correct.

To find Minowa’s percent correct on the test, find what percent 87 is of 88. The part is 87 and the base is 88. Let \( p \) represent the percent.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]
\[
\frac{87}{88} = \frac{p}{100}
\]
\[
8700 = 88p \quad \text{Find the cross products}
\]
\[
\frac{8700}{88} = \frac{88p}{88} \quad \text{Divide each side by 88.}
\]
\[
98.88 \approx p \quad \text{Simplify.}
\]

So, Minowa got the highest percentage with 98.9% correct.

To find Penny’s percent correct on the test, find what percent 68 is of 88. The part is 68 and the base is 88. Let \( p \) represent the percent.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]
\[
\frac{68}{88} = \frac{p}{100}
\]
\[
6800 = 88p \quad \text{Find the cross products}
\]
\[
\frac{6800}{88} = \frac{88p}{88} \quad \text{Divide each side by 88.}
\]
\[
77.27 \approx p \quad \text{Simplify.}
\]

So, Penny got the lowest percentage with 77.3% correct.

31. **PET STORE** In a pet store, 15% of the animals are hamsters. If the store has 40 animals, how many of them are hamsters?

**SOLUTION:**
To find how many of the animals are hamsters, find 15% of 40. The percent is 15 and the base is 40. Let \( a \) represent the part.

\[
\frac{a}{b} = \frac{p}{100} \quad \text{Percent Proportion}
\]
\[
\frac{a}{40} = \frac{15}{100}
\]
\[
\frac{100a}{40} = \frac{100 \times 15}{100}
\]
\[
\frac{100a}{40} = 600 \quad \text{Divide each side by 100.}
\]
\[
a = 6 \quad \text{Simplify.}
\]

So, 6 of the animals are hamsters.
Find the perimeter of each figure.

1. SOLUTION:
   \[ P = 4s \]
   \[ = 4(5) \]
   \[ = 20 \]
   The perimeter is 20 meters.

2. SOLUTION:
   \[ P = 2(\ell + w) \]
   \[ = 2(11 + 8) \]
   \[ = 2(19) \]
   \[ = 38 \]
   The perimeter is 38 kilometers.

3. SOLUTION:
   \[ P = 2(a + b) \]
   \[ = 2(27 + 18) \]
   \[ = 2(45) \]
   \[ = 90 \]
   The perimeter is 90 inches.

4. SOLUTION:
   \[ P = a + b + c \]
   \[ = 9 + 15 + 12 \]
   \[ = 36 \]
   The perimeter is 36 millimeters.

5. a square with side length 8 inches
   SOLUTION:
   \[ P = 4s \]
   \[ = 4(8) \]
   \[ = 32 \]
   The perimeter is 32 inches.

6. a rectangle with length 9 centimeters and width 3 centimeters
   SOLUTION:
   \[ P = 2(\ell + w) \]
   \[ = 2(9 + 3) \]
   \[ = 2(12) \]
   \[ = 24 \]
   The perimeter is 24 centimeters.

7. a triangle with sides 4 feet, 13 feet, and 12 feet
   SOLUTION:
   \[ P = a + b + c \]
   \[ = 4 + 13 + 12 \]
   \[ = 29 \]
   The perimeter is 29 feet.
8. a parallelogram with side lengths $6 \frac{1}{4}$ inches and 5 inches

**SOLUTION:**

\[
P = 2(a + b) = 2 \left(6 \frac{1}{4} + 5\right) = 2 \left(11 \frac{1}{4}\right) = 22 \frac{1}{2}
\]

The perimeter is $22 \frac{1}{2}$ inches.

9. a quarter-circle with a radius of 7 inches

**SOLUTION:**

\[
C = 2\pi r = 2\pi(7) = 14\pi 
\]

Approximately $43.96$ inches.

To find the perimeter of a quarter-circle, divide the perimeter by four.

43.96 ÷ 4 = 10.99 ÷ 11.0. Add two radii of 7. Then the perimeter is 25.0 inches.

---

**Find the circumference of each circle. Round to the nearest tenth.**

10.

\[
C = 2\pi r = 2\pi(3) = 6\pi 
\]

Approximately 18.8 meters.

11.

**SOLUTION:**

\[
C = \pi d = 10\pi 
\]

Approximately 31.4 inches.
0-7 Perimeter

12. SOLUTION:
\[
C = 2\pi r \\
= 2\pi(12) \\
= 24\pi \\
\approx 75.398
\]
The exact circumference is \(24\pi\) centimeters. Rounded to the nearest tenth, the circumference is about 75.4 centimeters.

13. GARDENS A square garden has a side length of 5.8 meters. What is the perimeter of the garden?

**SOLUTION:**
\[
P = 4s \\
= 4(5.8) \\
= 23.2
\]
The perimeter of the garden is 23.2 meters.

14. ROOMS A rectangular room is \(12\frac{1}{2}\) feet wide and 14 feet long. What is the perimeter of the room?

**SOLUTION:**
\[
P = 2(l + w) \\
= 2\left(14 + 12\frac{1}{2}\right) \\
= 2\left(26\frac{1}{2}\right) \\
= 53
\]
The perimeter of the room is 53 feet.

15. CYCLING The tire for a 10-speed bicycle has a diameter of 27 inches. Find the distance traveled in 10 rotations of the tire. Round to the nearest tenth.

**SOLUTION:**

One rotation is equivalent to the circumference of the tire. In other words, if the tire makes one complete rotation, the bicycle has traveled a distance equal to the circumference of the tire.

\[
C' = \pi d \\
= \pi(27) \\
= 27\pi \\
\approx 84.82
\]
The circumference is about 84.82 inches. To find the distance the bicycle will travel in 10 rotations, multiply the circumference by 10.

\[
84.8(10) = 848.2
\]
So, the bicycle will travel about 848.2 inches in 10 rotations.

16. GEOGRAPHY The circumference of the Earth’s equator is approximately 25,000 miles. If you could dig a tunnel to the center of the Earth, how long would the tunnel be? Round to the nearest tenth mile.

**SOLUTION:**

A tunnel from the surface to the center of Earth represents a radius of the equator. Solve the formula for the circumference of a circle for \(r\).

\[
C = 2\pi r \\
25,000 = 2\pi r \\
3978.9 \approx r
\]
The radius of Earth’s equator, and the length of the tunnel, is about 3978.9 miles.
Find the perimeter of each figure. Round to the nearest tenth.

17.  
\[ P = 2.4 + 3.5 + 2.0 + 2.0 + 3.5 \]
\[ = 13.4 \]
The perimeter of the figure is 13.4 centimeters.

18.  
\[ C = \pi d \]
\[ = \pi (3) \]
\[ \approx 9.4 \]
Then add the two side lengths of the square.
\[ 9.4 + 3 + 3 = 15.4 \]
The perimeter is about 15.4 inches.

19.  
\[ C = \pi d \]
\[ = \pi (4) \]
\[ \approx 12.6 \]
Then add the diameter.
\[ 6.3 + 4 = 10.3 \]
So, the perimeter of the figure is about 10.3 feet.

20.  
\[ C = \pi d \]
\[ = \pi (4) \]
\[ \approx 12.56 \]
Next, add the sides of the triangle.
\[ 6.28 + 5 + 3 = 14.28 \]
So, the perimeter of the figure is about 14.3 meters.
Find the area of each figure.

1. 

\[ A = \ell w \]
\[ = (3)2 \]
\[ = 6 \]

The area of the rectangle is 6 square centimeters.

2. 

\[ A = s^2 \]
\[ = 6^2 \]
\[ = 36 \]

The area of the square is 36 square inches.

3. 

\[ A = bh \]
\[ = 8(15) \]
\[ = 120 \]

The area of the parallelogram is 120 square meters.

Find the area of each figure. Round to the nearest tenth if necessary,

4. a triangle with a base 12 millimeters and height 11 millimeters

\[ A = \frac{1}{2}bh \]
\[ = \frac{1}{2}(12)(11) \]
\[ = 66 \]

The area of the triangle is 66 square millimeters.

5. a square with side length 9 feet

\[ A = s^2 \]
\[ = 9^2 \]
\[ = 81 \]

The area of the square is 81 square feet.

6. a rectangle with length 8 centimeters and width 2 centimeters

\[ A = \ell w \]
\[ = 8(2) \]
\[ = 16 \]

The area of the rectangle is 16 square centimeters.

7. a triangle with a base 6 feet and height 3 feet

\[ A = \frac{1}{2}bh \]
\[ = \frac{1}{2}(6)(3) \]
\[ = 9 \]

The area of the triangle is 9 square feet.
8. a quarter-circle with a diameter of 4 meters

**SOLUTION:**
The radius is half the diameter, or 2 meters.

\[
A = \pi r^2 \\
= \pi (2)^2 \\
= 4\pi \\
\approx 12.57
\]

The area of the circle is about 12.57 square meters.
To find the area of a quarter-circle, divide the area of the circle by 4.
\[
12.57 \div 4 = 3.1425
\]
So, the area of the quarter-circle is about 3.1 square meters.

9. a semi-circle with a radius of 3 inches

**SOLUTION:**
To find the area of a semi-circle, first find the area of a circle with a radius of 3 inches.

\[
A = \pi r^2 \\
= \pi (3)^2 \\
= 9\pi \\
\approx 28.27
\]

The area of the circle is 28.27 square inches. To find the area of a semi-circle, divide the area of the circle by 2.
\[
28.27 \div 2 = 14.135
\]
So, the area of the semi-circle is about 14.1 square inches.

---

Find the area of each circle. Round to the nearest tenth.

10. **SOLUTION:**

\[
A = \pi r^2 \\
= \pi (5)^2 \\
= 25\pi \\
\approx 78.5
\]

The area of the circle is about 78.5 square inches.

11. **SOLUTION:**

\[
A = \pi r^2 \\
= \pi (2)^2 \\
= 4\pi \\
\approx 12.6
\]

The area of the circle is about 12.6 square feet.

12. **SOLUTION:**
The radius is half the diameter, or 1 kilometer.

\[
A = \pi r^2 \\
= \pi (1)^2 \\
= \pi \\
\approx 3.1
\]

The area of the circle is about 3.1 square kilometers.
13. The radius is 4 centimeters.

\[ A = \pi r^2 \]
\[ = \pi (4)^2 \]
\[ = 16\pi \]
\[ \approx 50.3 \]

The area of the circle is about 50.3 square centimeters.

14. The radius is 7.2 millimeters.

\[ A = \pi r^2 \]
\[ = \pi (7.2)^2 \]
\[ = 51.84\pi \]
\[ \approx 162.9 \]

The area of the circle is about 162.9 square millimeters.

15. The diameter is 16 inches.

\[ A = \pi r^2 \]
\[ = \pi (8)^2 \]
\[ = 64\pi \]
\[ \approx 201.1 \]

The area of the circle is about 201.1 square inches.

16. The diameter is 25 feet.

\[ A = \pi r^2 \]
\[ = \pi (12.5)^2 \]
\[ = 156.25\pi \]
\[ \approx 490.9 \]

The area of the circle is about 490.9 square feet.

17. CAMPING The square floor of a tent has an area of 49 square feet. What is the side length of the tent?

\[ A = s^2 \]
\[ 49 = s^2 \]
\[ \sqrt{49} = s \]
\[ 7 = s \]

The side length of the tent is 7 feet.

Estimate the area of each polygon in square units.

18. 

\[ A \approx \text{squares} + \text{partial squares} \]
\[ \approx 26 + 10(0.5) \]
\[ 26 \text{ whole squares and 10 partial squares} \]
\[ \approx 26 + 5 \]

The area is about 31 units\(^2\).
Find the area of each figure. Round to the nearest tenth.

21.

SOLUTION:
The figure consists of a square and a triangle. Find the area of the square.

\[ A = s^2 \]
\[ = (4.1)^2 \]
\[ = 16.81 \]

Find the area of the triangle.

\[ A = \frac{1}{2}bh \]
\[ = \frac{1}{2}(4.1)(2.6) \]
\[ = 5.33 \]

To find the total area, add the two areas.
16.81 + 5.33 = 22.14
So, the area of the figure is about 22.1 square centimeters.
22. **SOLUTION:**
This figure consists of a rectangle and a triangle.
Find the area of the rectangle.

\[ A = \ell w \]
\[ = 5.2(3.5) \]
\[ = 18.2 \]

Find the area of the triangle. To find the base of the triangle, subtract 5.2 from 8.0.
\[ b = 8.0 - 5.2 = 2.8 \]

\[ A = \frac{1}{2}bh \]
\[ = \frac{1}{2}(2.8)(3.5) \]
\[ = 4.9 \]

To find the total area, add the two areas.
\[ 18.2 + 4.9 = 23.1 \]
So, the area of the figure is 23.1 square centimeters.

---

23. **SOLUTION:**
This figure consists of a rectangle and a semi-circle. Find the area of the rectangle.

\[ A = \ell w \]
\[ = 2.9(1.2) \]
\[ = 3.48 \]

Find the area of a circle with a diameter of 1.2 centimeters. The radius is half the diameter.
\[ r = 1.2 \div 2 = 0.6 \]

\[ A = \pi r^2 \]
\[ = \pi (0.6)^2 \]
\[ = 0.36\pi \]
\[ \approx 1.1 \]

To find the area of the semi-circle, divide the area of the circle by 2.
\[ 1.1 \div 2 = 0.55 \]
To find the total area, add the two areas.
\[ 3.48 + 0.55 = 4.03 \]
So, the area of the figure is about 4.0 square centimeters.
Find the volume of each rectangular prism given the length, width, and height.

1. \( l = 5 \text{ cm}, \quad w = 3 \text{ cm}, \quad h = 2 \text{ cm} \)

   \[
   V = l \cdot w \cdot h \\
   = 5 \cdot 3 \cdot 2 \\
   = 30
   \]

   So, the volume is 30 cubic centimeters.

2. \( l = 10 \text{ m}, \quad w = 10 \text{ m}, \quad h = 1 \text{ m} \)

   \[
   V = l \cdot w \cdot h \\
   = 10 \cdot 10 \cdot 1 \\
   = 100
   \]

   So, the volume is 100 cubic meters.

3. \( l = 6 \text{ yd}, \quad w = 2 \text{ yd}, \quad h = 4 \text{ yd} \)

   \[
   V = l \cdot w \cdot h \\
   = 6 \cdot 2 \cdot 4 \\
   = 48
   \]

   So, the volume is 48 cubic yards.

4. \( l = 2 \text{ in.}, \quad w = 5 \text{ in.}, \quad h = 12 \text{ in.} \)

   \[
   V = l \cdot w \cdot h \\
   = 2 \cdot 5 \cdot 12 \\
   = 120
   \]

   So, the volume is 120 cubic inches.

5. \( l = 13 \text{ ft}, \quad w = 9 \text{ ft}, \quad h = 12 \text{ ft} \)

   \[
   V = l \cdot w \cdot h \\
   = 13 \cdot 9 \cdot 12 \\
   = 1404
   \]

   So, the volume is 1404 cubic feet.

6. \( l = 7.8 \text{ mm}, \quad w = 0.6 \text{ mm}, \quad h = 8\text{ mm} \)

   \[
   V = l \cdot w \cdot h \\
   = 7.8 \cdot 0.6 \cdot 8 \\
   = 37.44
   \]

   So, the volume is 37.44 cubic millimeters.

Find the volume of each rectangular prism.

7. \( \text{ } \)

   \[
   V = l \cdot w \cdot h \\
   = 2 \cdot 2 \cdot 5 \\
   = 20
   \]

   So, the volume is 20 cubic meters.

8. \( \text{ } \)

   \[
   V = l \cdot w \cdot h \\
   = 6 \cdot 12 \cdot 2 \\
   = 144
   \]

   So, the volume is 144 cubic inches.
9. **GEOMETRY** A cube measures 3 meters on a side. What is its volume?

**SOLUTION:**
A cube is a rectangular prism with equal side lengths.

\[ V = l \cdot w \cdot h \]
\[ = 3 \cdot 3 \cdot 3 \]
\[ = 27 \]

So, the volume of the cube is 27 cubic meters.

10. **AQUARIUMS** An aquarium is 8 feet long, 5 feet wide and 5.5 feet deep. What is the volume of the aquarium?

**SOLUTION:**
The aquarium is a rectangular prism.

\[ V = l \cdot w \cdot h \]
\[ = 8 \cdot 5 \cdot 5.5 \]
\[ = 220 \]

So, the volume of the aquarium is 220 cubic feet.

11. **COOKING** What is the volume of a microwave oven that is 18 inches wide by 10 inches long with a depth of \(1 \frac{1}{2}\) inches?

**SOLUTION:**
The microwave is a rectangular prism.

\[ V = l \cdot w \cdot h \]
\[ = 18 \cdot 10 \cdot 1 \frac{1}{2} \]
\[ = 2070 \]

So, the volume of the microwave is 2070 cubic inches.

12. **BOXES** A cardboard box is 32 inches long, 22 inches wide, and 16 inches tall. What is the volume of the box?

**SOLUTION:**
The box is a rectangular prism

\[ V = l \cdot w \cdot h \]
\[ = 32 \cdot 22 \cdot 16 \]
\[ = 11,264 \]

So, the volume of the cardboard box is 11,264 cubic inches.

13. **SWIMMING POOLS** A children’s rectangular pool holds 480 cubic feet of water. What is the depth of the pool if its length is 30 feet and its width is 16 feet?

**SOLUTION:**
The amount of water held by the pool is the volume of a rectangular prism. To find the depth of the pool, solve the formula for the volume of a rectangular prism for \(h\).

\[ V = l \cdot w \cdot h \]
\[ 480 = 30 \cdot 16 \cdot h \]
\[ 480 = 480h \]
\[ h = \frac{480}{480} \]
\[ h = 1 \]

So, the depth of the pool is 1 foot.
14. **BAKING** A rectangular cake pan has a volume of 234 cubic inches. If the length of the pan is 9 inches and the width is 13 inches, what is the height of the pan?

**SOLUTION:**
The cake pan is a rectangular prism. To find the height of the pan, solve the formula for the volume of a rectangular prism for \( h \).

\[
V = l \cdot w \cdot h
\]
\[
234 = 9 \cdot 13 \cdot h
\]
\[
234 = 117h
\]
\[
\frac{234}{117} = \frac{117h}{117}
\]
\[
2 = h
\]

So, the height of the pan is 2 inches.

15. **GEOMETRY** The volume of the rectangular prism at the right is 440 cubic centimeters. What is the width?

**SOLUTION:**
To find the width, solve the formula for the volume of a rectangular prism for \( w \).

\[
V = l \cdot w \cdot h
\]
\[
440 = 10 \cdot w \cdot 11
\]
\[
440 = 110w
\]
\[
\frac{440}{110} = \frac{110w}{110}
\]
\[
4 = w
\]

So, the width of the rectangular prism is 4 centimeters.

---

16. **Find the volume of each cylinder. Round to the nearest tenth.**

**SOLUTION:**

\[
V = \pi r^2h
\]
\[
= \pi (12.2)^2 (12.2)
\]
\[
\approx 5704.7
\]

So, the volume of the cylinder is 5704.7 cubic centimeters.

17. **SOLUTION:**
The radius of the cylinder is half the diameter, or 7 inches.

\[
V = \pi r^2h
\]
\[
= \pi (7)^2 (18)
\]
\[
\approx 2770.9
\]

So, the volume of the cylinder is 2770.0 cubic inches.

18. **SOLUTION:**

\[
V = \pi r^2h
\]
\[
= \pi (4.9)^2 (6.2)
\]
\[
\approx 467.7
\]

So, the volume of the cylinder is 467.7 cubic meters.
19. **FIREWOOD** Firewood is usually sold by a measure known as a *cord*. A full cord may be a stack $8 \times 4 \times 4$ feet or a stack of $8 \times 8 \times 2$ feet.

   a. What is the volume of a full cord of firewood?
   b. A "short cord" of wood is $8 \times 4 \times$ the length of the logs. What is the volume of a short cord of $2 \frac{1}{2}$ foot logs?
   c. If you have an area that is 12 feet long and 2 feet wide in which to store your firewood, how high will the stack be if it is a full cord of wood?

**SOLUTION:**

a. A full cord is a rectangular prism.

   \[ V = \ell \cdot w \cdot h \]
   \[ = 8 \cdot 4 \cdot 4 \quad \text{or} \quad = 8 \cdot 8 \cdot 2 \]
   \[ = 128 \quad = 128 \]

   The volume of a full cord of firewood is 128 cubic feet.

b. The short cord is a rectangular prism.

   \[ V = \ell \cdot w \cdot h \]
   \[ = 8 \cdot 4 \cdot 2 \frac{1}{2} \]
   \[ = 80 \]

   So, the volume of a short cord of $2 \frac{1}{2}$ foot logs is 80 cubic feet.

c. The volume of a full cord is 128 cubic feet. To find the height of the stack, solve the formula for the volume of a rectangular prism for the height, \( h \).

   \[ V = \ell \cdot w \cdot h \]
   \[ 128 = 12 \cdot 2 \cdot h \]
   \[ 128 = 24h \]
   \[ \frac{128}{24} = \frac{24h}{24} \]
   \[ 5 \frac{1}{3} = h \]

   So, the height of the stack of wood is $5 \frac{1}{3}$ feet, or 5 feet 4 inches.
0-10 Surface Area

Find the surface area of each rectangular prism given the measurements below.

1. \(l = 6\) in., \(w = 1\) in., \(h = 4\) in.

**SOLUTION:**
\[S = 2lw + 2lh + 2wh\]
\[= 2(6)(1) + 2(6)(4) + 2(1)(4)\]
\[= 12 + 48 + 8\]
\[= 68\]

So, the surface area is 68 square inches.

2. \(l = 8\) m, \(w = 2\) m, \(h = 2\) m

**SOLUTION:**
\[S = 2lw + 2lh + 2wh\]
\[= 2(8)(2) + 2(8)(2) + 2(2)(2)\]
\[= 32 + 32 + 8\]
\[= 72\]

So, the surface area is 72 square meters.

3. \(l = 10\) mm, \(w = 4\) mm, \(h = 5\) mm

**SOLUTION:**
\[S = 2lw + 2lh + 2wh\]
\[= 2(10)(4) + 2(10)(5) + 2(4)(5)\]
\[= 80 + 100 + 40\]
\[= 220\]

So, the surface area is 220 square millimeters.

4. \(l = 6.2\) cm, \(w = 1\) cm, \(h = 3\) cm

**SOLUTION:**
\[S = 2lw + 2lh + 2wh\]
\[= 2(6.2)(1) + 2(6.2)(3) + 2(1)(3)\]
\[= 12.4 + 37.2 + 6\]
\[= 55.6\]

So, the surface area is 55.6 square centimeters.

5. \(l = 7\) ft, \(w = 2\) ft, \(h = \frac{1}{2}\) ft

**SOLUTION:**
\[S = 2lw + 2lh + 2wh\]
\[= 2(7)(2) + 2(7)(\frac{1}{2}) + 2(2)(\frac{1}{2})\]
\[= 28 + 7 + 2\]
\[= 37\]

So, the surface area is 37 square feet.

6. \(l = 7.8\) m, \(w = 3.4\) m, \(h = 9\) m

**SOLUTION:**
\[S = 2lw + 2lh + 2wh\]
\[= 2(7.8)(3.4) + 2(7.8)(9) + 2(3.4)(9)\]
\[= 53.04 + 140.4 + 61.2\]
\[= 254.64\]

So, the surface area is 254.64 square meters.

Find the surface area of each solid.

7. 

**SOLUTION:**
\[S = 2lw + 2lh + 2wh\]
\[= 2(2)(2) + 2(2)(5) + 2(2)(5)\]
\[= 8 + 20 + 20\]
\[= 48\]

So, the surface area is 48 square meters.
0-10 Surface Area

SOLUTION:
\[ S = 2lw + 2lh + 2hw \]
\[ = 2(4)(2) + 2(4)(3) + 2(2)(3) \]
\[ = 16 + 24 + 12 \]
\[ = 52 \]

So, the surface area is 52 square feet.

SOLUTION:
\[ S = 2lw + 2lh + 2hw \]
\[ = 2(12)(6) + 2(12)(2) + 2(6)(2) \]
\[ = 144 + 48 + 24 \]
\[ = 216 \]

So, the surface area is 216 square inches.

SOLUTION:
\[ S = 2lw + 2lh + 2hw \]
\[ = 2(5)(1.2) + 2(5)(8) + 2(1.2)(3) \]
\[ = 12 + 80 + 19.2 \]
\[ = 111.2 \]

So, the surface area is 111.2 square millimeters.

SOLUTION:
\[ S = 2\pi rh + 2\pi r^2 \]
\[ = 2\pi (4.5)(12.5) + 2\pi (4.5^2) \]
\[ = 112.5\pi + 40.5\pi \]
\[ = 153\pi \]
\[ \approx 480.7 \]

So, the surface area is about 480.7 square inches.

SOLUTION:
\[ S = 2\pi rh + 2\pi r^2 \]
\[ = 2\pi (5.1)(6.2) + 2\pi (5.1^2) \]
\[ = 63.24\pi + 52.02\pi \]
\[ = 115.26\pi \]
\[ \approx 362.1 \]

So, the surface area is about 362.1 square centimeters.

13. GEOMETRY What is the surface area of a cube with a side length of 2 meters?

SOLUTION:
A cube is a rectangular prism with equal side lengths.
\[ S = 2lw + 2lh + 2hw \]
\[ = 2(2)(2) + 2(2)(2) + 2(2)(2) \]
\[ = 8 + 8 + 8 \]
\[ = 24 \]

So, the surface area of the cube is 24 square meters.
14. **GIFTS** A gift box is a rectangular prism 14 inches long, 5 inches wide, and 4 inches high. If the box is to be covered in fabric, how much fabric is needed if there is no overlap?

**SOLUTION:**
The gift box is a rectangular prism.

\[ S = 2lw + 2lh + 2wh \]
\[ = 2(14)(5) + 2(14)(4) + 2(5)(4) \]
\[ = 140 + 112 + 40 \]
\[ = 292 \]

So, the surface area of the gift box is 292 square inches and we need 292 square inches of fabric.

15. **BOXES** A new refrigerator is shipped in a box 34 inches deep, 66 inches high, and 33\(\frac{1}{4}\) inches wide. What is the surface area of the box in square feet? Round to the nearest square foot. (*Hint: 1 \text{ ft}^2 = 144 \text{ in}^2*)

**SOLUTION:**
The refrigerator box is a rectangular prism.

\[ S = 2lw + 2lh + 2wh \]
\[ = 2(34)(66) + 2(34)(3\frac{1}{4}) + 2(66)(3\frac{1}{4}) \]
\[ = 2261 + 4488 + 4389 \]
\[ = 11,138 \]

The surface area of the box is 11,138 square inches. To find the answer in feet squared, use the hint 1 \text{ ft}^2 = 144 \text{ in}^2.

\[ 11,138 \div 144 \approx 77 \]

The surface area of the refrigerator box is about 77 square feet.

16. **PAINTING** A cabinet is 6 feet high, 3 feet wide, and 2 feet long. The entire outside surface of the cabinet is being painted except for the bottom. What is the surface area of the cabinet that is being painted?

**SOLUTION:**
The cabinet is a rectangular prism. Only one \(hw\) is needed since the bottom is not being painted.

\[ S = lw + 2lh + 2wh \]
\[ = (2)(3) + 2(2)(6) + 2(3)(6) \]
\[ = 6 + 24 + 36 \]
\[ = 66 \]

So, the surface area of the cabinet that is being painted is 66 square feet.

17. **SOUP** A soup can is 4 inches tall and has a diameter of 3\(\frac{1}{4}\) inches. How much paper is needed for the label on the can? Round your answer to the nearest tenth.

**SOLUTION:**
The soup can is a cylinder. The label will not cover the top and bottom of the can. Therefore, we need to subtract the area of the top and bottom of the can from the surface area in order to find how much paper is needed.

The area of the top and bottom of the can is represented by \(\pi r^2 + \pi r^2\) or \(2\pi r^2\). Subtract this from the formula for surface area of a cylinder.

\[ 2\pi rh + 2\pi r^2 - 2\pi r^2 = 2\pi rh \]

The radius is half the diameter, or \(\frac{5}{8}\) inches.

\[
\text{Area} = 2\pi rh \\
= 2\pi \left(\frac{5}{8}\right)(4) \\
= 13\pi \\
\approx 40.8
\]

So, about 40.8 square inches of paper is needed for the label on the can.
18. **CRAFTS** For a craft project, Sarah is covering all the sides of a box with stickers. The length of the box is 8 inches, the width is 6 inches, and the height is 4 inches. If each sticker has a length of 2 inches and a width of 4 inches, how many stickers does she need to cover the box?

**SOLUTION:**
To find the total number of stickers needed to cover the box, the total surface area of the box must be divided by the area of one sticker. The box is a rectangular prism

\[
S = 2lw + 2lh + 2wh
\]

\[
= 2(8)(6) + 2(8)(4) + 2(6)(4)
\]

\[
= 96 + 64 + 48
\]

\[
= 208
\]

The surface area of the box is 208 square inches. One sticker has an area of 2 \cdot 4, or 8, square inches. Divide the box’s surface area by the sticker’s area. 208 \div 8 = 26

So, Sarah needs 26 stickers to cover the box.
One coin is randomly selected from a jar containing 70 nickels, 100 dimes, 80 quarters, and 50 one-dollar coins. Find each probability.

1. $P(\text{quarter})$

**SOLUTION:**
The number of possible outcomes is $70 + 100 + 80 + 50$, or 300.
\[
\text{probability} = \frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}
\]
\[
P(\text{quarter}) = \frac{80}{300} = \frac{4}{15}
\]

2. $P(\text{dime})$

**SOLUTION:**
The number of possible outcomes is $70 + 100 + 80 + 50$, or 300.
\[
\text{probability} = \frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}
\]
\[
P(\text{dime}) = \frac{100}{300} = \frac{1}{3}
\]

3. $P(\text{quarter or nickel})$

**SOLUTION:**
The number of possible outcomes is $70 + 100 + 80 + 50$, or 300.
\[
\text{probability} = \frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}
\]
\[
P(\text{quarter or nickel}) = \frac{150}{300} = \frac{1}{2}
\]

4. $P(\text{value greater than$0.10$})$

**SOLUTION:**
The number of possible outcomes is $70 + 100 + 80 + 50$, or 300. The coins with a value greater than$0.10 are the quarter and the one-dollar coins. So, the number of favorable outcomes is $80 + 50$, or 130.
\[
\text{probability} = \frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}
\]
\[
P(\text{quarter or one-dollar coin}) = \frac{130}{300} = \frac{13}{30}
\]

5. $P(\text{value less than$1$})$

**SOLUTION:**
The number of possible outcomes is $70 + 100 + 80 + 50$, or 300. The coins with a value less than$1 are the nickels, dimes, and quarters. So, the number of favorable outcomes is $70 + 100 + 80$, or 250.
\[
\text{probability} = \frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}
\]
\[
P(\text{nickel, dime, or quarter}) = \frac{250}{300} = \frac{5}{6}
\]

6. $P(\text{value at most$1$})$

**SOLUTION:**
The number of possible outcomes is $70 + 100 + 80 + 50$, or 300. All of the coins have a value of at most$1. So, the number of favorable outcomes is 300.
\[
\text{probability} = \frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}
\]
\[
P(\text{value at most$1$}) = \frac{300}{300} = 1
\]

One of the polygons below is chosen at random. Find each probability.

7. $P(\text{triangle})$

**SOLUTION:**
There are 6 shapes, so there are 6 possible outcomes.
\[
\text{probability} = \frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}
\]
\[
P(\text{triangle}) = \frac{3}{6} = \frac{1}{2}
\]
8. \( P(\text{pentagon}) \)

**SOLUTION:**
There are 6 shapes, so there are 6 possible outcomes.

\[
\text{probability} = \frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}
\]

\[
P(\text{pentagon}) = \frac{1}{6}
\]

9. \( P(\text{not a quadrilateral}) \)

**SOLUTION:**
There are 6 shapes, so there are 6 possible outcomes.

\[
\text{probability} = \frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}
\]

\[
P(\text{not a quadrilateral}) = \frac{4}{6} = \frac{2}{3}
\]

10. \( P(\text{more than 2 right angles}) \)

**SOLUTION:**
There are 6 shapes, so there are 6 possible outcomes.

\[
\text{probability} = \frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}
\]

\[
P(\text{more than 2 right angles}) = \frac{2}{6} = \frac{1}{3}
\]

---

Use a tree diagram to find the sample space for each event. State the number of possible outcomes.

11. The spinner is spun and two coins are tossed.

![Tree diagram]

**SOLUTION:**

20 Outcomes

12. At a restaurant, you choose two sides to have with breakfast. You can choose white or whole wheat toast. You can choose sausage links, sausage patties, or bacon.

**SOLUTION:**

- **White bread**
  - Sausage links
  - Sausage patties
  - Bacon

- **Wheat bread**
  - Sausage links
  - Sausage patties
  - Bacon

There are a total of 6 choices.
13. How many different 3-character codes are there using A, B, or C for the first character, 8 or 9 for the second character, and 0 or 1 for the third character?

**SOLUTION:**

A tree diagram is shown with the branches representing the possible outcomes.

The tree diagram shows that there are 12 outcomes.

14. \( P(\text{not red}) \)

**SOLUTION:**

Picking a red marble and not picking a red marble are complementary events. The sum of the probabilities of two complementary events is 1.

\[
P(\text{not red}) = 1 - P(\text{red})
\]

\[
= 1 - \frac{1}{8}
\]

\[
= \frac{7}{8}
\]

15. \( P(\text{not blue}) \)

**SOLUTION:**

Picking a blue marble and not picking a blue marble are complementary events. The sum of the probabilities of two complementary events is 1.

\[
P(\text{blue}) + P(\text{not blue}) = 1
\]

\[
P(\text{not blue}) = 1 - P(\text{blue})
\]

\[
= 1 - \frac{13}{24}
\]

\[
= \frac{11}{24}
\]

Find the odds of each outcome if a computer randomly picks a letter in the name THE UNITED STATES OF AMERICA.

16. the letter \( A \)

**SOLUTION:**

There are 24 possible outcomes; 3 are successes and 21 are failures.

So, the odds of picking an \( A \) are 3:21 or 1:7.

17. the letter \( T \)

**SOLUTION:**

There are 24 possible outcomes; 4 are successes and 20 are failures.

So, the odds of picking the letter \( T \) are 4:20 or 1:5.

18. a vowel

**SOLUTION:**

There are 24 possible outcomes; 11 are successes and 13 are failures.

So, the odds of picking a vowel are 11:13.

19. a consonant

**SOLUTION:**

There are 24 possible outcomes; 11 are successes and 13 are failures.

So, the odds of picking a consonant are 13:11.
20. Find the number of possible orders of a sub with one topping and one dressing option.

**SOLUTION:**
Use the Fundamental Counting Principle. There are 6 different subs, 4 different dressings and 4 different toppings.

\[ 6 \cdot 4 \cdot 4 = 96 \]

So, there are 96 possible orders of a sub with one topping and one dressing option.

21. Find the number of possible ham subs with mayonnaise, any combination of toppings or no toppings at all.

**SOLUTION:**
There are 4 different ham sandwiches with mayonnaise and 1 topping. There are 6 different ham sandwiches with mayonnaise and 2 toppings, and 4 different sandwiches with mayonnaise and 3 toppings. There is 1 ham sandwich with mayonnaise and all 4 toppings. There is also 1 ham sandwich with mayonnaise and no toppings. So, there are 16 options.

22. Find the number of possible orders of a sub with any combination of dressing and/or toppings.

**SOLUTION:**
There are 6 different subs. There are 4 different types of dressing and 4 different types of toppings.

We can use the Fundamental Counting Principle to find the number of possible choices.

There are 4 types of dressing, so an order could have no dressing, 1 type of dressing, 2 types, 3 types, or all 4. Address these one at a time.

No dressing: There is only 1 way to have “no dressing”.

1 Type: There are 4 different ways to have one type of dressing: mayo, mustard, vinegar, or oil.

2 Types: There are 6 different ways to have two types of dressing: mayo/mustard, mayo/vinegar, mayo/oil, mustard/vinegar, mustard/oil, and vinegar/oil.

3 Types: There are 4 different ways to have three types of dressing: mayo/mustard/vinegar, mayo/mustard/oil, mayo/oil/vinegar, and mustard/oil/vinegar.

4 Types: There is only 1 way to have “all of the dressing”.

Therefore, there are \[ 1 + 4 + 6 + 4 + 1 = 16 \]
different combinations of dressing.

The same procedure can be done for toppings. Like the dressing, there are 4 different types of toppings, so there will also be 16 different combinations of toppings.

Now we can apply the Fundamental Counting Principle.

\[ \text{type of sub} \cdot \text{type of dressing} \cdot \text{type of topping} = \text{number of choices} \]

\[ 6 \cdot 16 \cdot 16 = 1536 \]

Therefore, there are 1536 possible orders of a sub.
Find the mean, median, mode, and range for each data set.

1. number of students helping at the cookie booth each hour: 3, 5, 8, 1, 4, 11, 3

**SOLUTION:**

\[
\text{mean} = \frac{3+5+8+1+4+11+3}{7} = \frac{35}{7} = 5
\]

Order the data from least to greatest.

\{1, 3, 3, 4, 5, 8, 11\}

The median, or middle number, is 4.

The number 3 appears most often, so the mode is 3.

The greatest value is 11 and the least value is 1. The range is 11 – 1 or 10.

2. weight in pounds of boxes loaded onto a semi truck: 201, 201, 200, 199, 199

**SOLUTION:**

\[
\text{mean} = \frac{(201+201+200+199+199)}{5} = \frac{1000}{5} = 200
\]

Order the data from least to greatest.

\{199, 199, 200, 201, 201\}

The median, or middle number, is 200.

The numbers 199 and 201 both occur most often, so the modes are 199 and 201.

The greatest value is 201 and the least value is 199. The range is 201 – 199 or 2.

3. car speeds in miles per hour observed by a highway patrol officer:

\{60, 53, 53, 52, 53, 55, 55, 57\}

**SOLUTION:**

\[
\text{mean} = \frac{60 + 53 + 53 + 52 + 53 + 55 + 55 + 57}{8} = \frac{438}{8} = 54.75
\]

Order the data from least to greatest.

\{52, 53, 53, 53, 55, 55, 57, 60\}

There is an even number of data, so the median is the mean of the two middle numbers.

\[
\frac{53 + 55}{2} = 54
\]

The number 53 appears most often, so the mode is 53.

The greatest value is 60 and the least value is 52. The range is 60 – 52 or 8.

4. number of songs downloaded by students last week in Ms. Turner’s class:

\{3, 7, 21, 23, 63, 27, 29, 95, 23\}

**SOLUTION:**

\[
\text{mean} = \frac{(3 + 7 + 21 + 23 + 63 + 27 + 29 + 95 + 23)}{9}
\]

\[
= \frac{291}{9} = 32\frac{1}{3}
\]

Order the data from least to greatest.

\{3, 7, 21, 23, 23, 27, 29, 63, 95\}

The number 23 appears most often, so the mode is 23.

The greatest value is 95 and the least value is 3. The range is 95 – 3 or 92.
5. ratings of an online video: 2, 5, 3.5, 4, 4.5, 1, 1, 4, 2,
1.5, 2.5, 2, 3, 3.5

**SOLUTION:**
Find the sum of the data values.
2 + 5 + 3.5 + 4 + 4.5 + 1 + 1 + 4 + 2 + 1.5 + 2.5 + 2 + 3 + 3.5 = 39.5

\[
\text{mean} = \frac{\text{sum of data values}}{\text{number of data values}}
\]
\[
= \frac{39.5}{14}
\]
\[
\approx 2.8
\]

Order the data from least to greatest.
{1, 1, 1.5, 2, 2, 2, 2.5, 3, 3.5, 3.5, 4, 4, 4.5, 5}

There is an even number of data, so the median is the mean of the two middle numbers.
\[
\frac{2.5 + 3}{2} \approx 2.75
\]

The number 2 appears most often, so the mode is 2.

The greatest value is 5 and the least value is 1. The range is 5 – 1 or 4.

6. **SCHOOL SUPPLIES** The table shows the cost of some school supplies. Find the mean, median, mode, and range of the costs.

<table>
<thead>
<tr>
<th>Supply</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>pencils</td>
<td>$0.50</td>
</tr>
<tr>
<td>pens</td>
<td>$2.00</td>
</tr>
<tr>
<td>paper</td>
<td>$2.00</td>
</tr>
<tr>
<td>pocket Folder</td>
<td>$1.25</td>
</tr>
<tr>
<td>calculator</td>
<td>$5.25</td>
</tr>
<tr>
<td>notebook</td>
<td>$3.00</td>
</tr>
<tr>
<td>eraser</td>
<td>$2.50</td>
</tr>
<tr>
<td>markers</td>
<td>$3.50</td>
</tr>
</tbody>
</table>

**SOLUTION:**
Find the sum of the data values.

\[
\text{mean} = \frac{\text{sum of data values}}{\text{number of data values}}
\]
\[
= \frac{20}{8}
\]
\[
\approx 2.50
\]

So, the mean is $2.50.

Order the data from least to greatest.
{0.50, $1.25, $2.00, $2.00, $2.50, $3.00, $3.50, $5.25}

There is an even number of data, so the median is the mean of the two middle numbers.
\[
\frac{2.00 + 2.50}{2} = \frac{4.50}{2} = 2.25
\]

So, the median is $2.25.

The cost $2.00 appears most often, so the mode is $2.00.

The difference between the greatest and least value is the range.
\[
5.25 - 0.50 = 4.75
\]

The range is $4.75.
7. **BOWLING** Sue’s average for 9 games of bowling is 108. What is the lowest score she can receive for the tenth game to have an mean of 110?

*SOLUTION:*
Let \( x \) be the score of Sue’s tenth game. If she has an average of 108 for the first 9 games, she has a total score of \( 108 \times 9 \), or 972.

\[
110 = \frac{972 + x}{10}
\]

\[
10 \cdot 110 = 10 \left( \frac{972 + x}{10} \right)
\]

\[
1100 = 972 + x
\]

\[
128 = x
\]

So, the lowest score Sue can receive for her tenth game is 128.

---

8. **LAUNDRY** Two brands of laundry detergents were tested to determine how many times a shirt could be washed before it faded. The results for 6 shirts in number of washes follow.

Brand A: 16, 15, 13, 14, 16, 16
Brand B: 11, 16, 18, 12, 15, 18

a. Find the mean and range for each brand.
b. Which brand performed more consistently? Explain.

*SOLUTION:*

**a. Brand A:**

\[
\text{mean} = \frac{16 + 15 + 13 + 14 + 16 + 16}{6}
\]

\[
= \frac{92}{6}
\]

\[
= 15.3
\]

The greatest value is 16 and the least value is 13. The range is \( 16 - 13 \) or 3.

**Brand B:**

\[
\text{mean} = \frac{11 + 16 + 18 + 12 + 15 + 18}{6}
\]

\[
= \frac{90}{6}
\]

\[
= 15
\]

The greatest value is 18 and the least value is 11. The range is \( 18 - 11 \) or 7.

**b. Brand A; sample answer: Brand A has a smaller measure of spread, so all the results are closer to the mean.**
Find the minimum, lower quartile, median, upper quartile, and maximum values for each data set.

9. prices in dollars of smartphones: 311, 309, 312, 314, 399, 312

**SOLUTION:**
Order the data from least to greatest,
\{309, 311, 312, 312, 314, 399\}

**minimum:** 309

**lower quartile:** The lower quartile is the middle value for the lower half of the data, \{309, 311, 312\}. So, the lower quartile is 311.

**median:** There is an even number of data, so the median is the mean of the two middle numbers. \[
\frac{312 + 312}{2} = 312
\]

**upper quartile:** The upper quartile is the middle value for the upper half of the data, \{312, 314, 399\}. So, the upper quartile is 314.

**maximum:** 399

10. attendance at an event for the last nine years: 68, 99, 73, 65, 67, 62, 80, 81, 83

**SOLUTION:**
Order the data from least to greatest,
\{62, 65, 67, 68, 73, 80, 81, 83, 99\}

**minimum:** 62

**lower quartile:** The lower quartile is the middle value for the lower half of the data, \{62, 65, 67, 68\}. So, the lower quartile is \[
\frac{65 + 67}{2} = 66.
\]

**median:** The median, or middle value, is 73.

**upper quartile:** The upper quartile is the middle value for the upper half of the data, \{80, 81, 83, 99\}. So, the upper quartile is \[
\frac{81 + 83}{2} = 82.
\]

**maximum:** 99

11. books a student checks out of the library: 17, 9, 10, 17, 18, 5, 2

**SOLUTION:**
Order the data from least to greatest,
\{2, 5, 9, 10, 17, 17, 18\}

**minimum:** 2

**lower quartile:** The lower quartile is the middle value for the lower half of the data, \{2, 5, 9\}. So, the lower quartile is 5.

**median:** The median, or middle value, is 10.

**upper quartile:** The upper quartile is the middle value for the upper half of the data, \{17, 17, 18\}. So, the upper quartile is 17.

**maximum:** 18

12. ounces of soda dispensed into 36-ounce cups:
36.1, 35.8, 35.2, 36.5, 36.0, 36.2, 35.7, 35.8, 35.9, 36.4, 35.6

**SOLUTION:**
Order the data from least to greatest,
\{35.2, 35.6, 35.7, 35.8, 35.9, 36.0, 36.1, 36.2, 36.4, 36.5\}

**minimum:** 35.2

**lower quartile:** The lower quartile is the middle value for the lower half of the data, \{35.2, 35.6, 35.7, 35.8\}. So, the lower quartile is 35.7.

**median:** The median, or middle value, is 35.9.

**upper quartile:** The upper quartile is the middle value for the upper half of the data, \{36.0, 36.1, 36.2, 36.4, 36.5\}. So, the upper quartile is 36.2.

**maximum:** 36.5
13. ages of riders on a roller coaster:
   45, 17, 16, 22, 25, 19, 20, 21, 32, 37, 19, 21, 24, 20, 18,
   22, 23, 19

   **SOLUTION:**
   Order the data from least to greatest,
   \{16, 17, 18, 19, 19, 19, 20, 20, 21, 21, 22, 22, 23, 24,
   25, 32, 37, 45\}

   **minimum:** 16

   **lower quartile:** The lower quartile is the middle
   value for the lower half of the data, \{16, 17, 18, 19,
   19, 19, 20, 20, 21\}. So, the lower quartile is 19.

   **median:** There is an even number of data, so the
   median is the mean of the two middle numbers.
   \(\frac{21+21}{2}\) or 21

   **upper quartile:** The upper quartile is the middle
   value for the upper half of the data, \{21, 22, 22, 23,
   24, 25, 32, 37, 45\}. So, the upper quartile is 24.

   **maximum:** 45

---

14. **NUTRITION** The table shows the number of
   servings of fruits and vegetables that Cole eats one
   week. Find the minimum, median, lower quartile,
   upper quartile, and maximum number of savings.
   Then interpret this five-number summary.

   ![Fruit and Vegetable Servings Table]

   **SOLUTION:**
   Order the data from least to greatest.
   \{3, 3, 4, 5, 5, 7, 8\}
   The median, or middle number, is 5.

   The lower quartile is the median of the lower half of
   the data set. The lower half is \{3, 3, 4, \}. The median
   of this half is 3. So, the lower quartile is 3.

   The upper quartile is the median of the upper half of
   the data set. The upper half is \{5, 7, 8\}. The median
   of this half is 7. So, the upper quartile is 7.

   The minimum is 3 and the maximum is 8.

   Cole had a minimum of 3 servings and a maximum of
   8 servings of fruits and vegetables, ate 7 or more
   servings at least 25% of the time, ate 5 or more
   servings at least 50% of the time, and ate 3 or more
   servings at least 75% of the time.

   **Find the mean and median of the data set, and
   then identify any outliers. If the set has an
   outlier, find the mean and median without the
   outlier, and state which measure is affected
   more by the removal of this value.**
15. distance traveled in miles to visit relatives during winter break:
210, 45, 10, 108, 452, 225, 35, 95, 140, 25, 65, 250

**SOLUTION:**
Find the sum of the data values.

\[ 210 + 45 + 10 + 108 + 452 + 225 + 35 + 95 + 140 + 25 + 65 + 250 = 1660 \]

\[ \text{mean} = \frac{\text{sum of data values}}{\text{number of data values}} = \frac{1660}{12} \approx 138.3 \]

Order the data from least to greatest.
{10, 25, 35, 45, 65, 95, 108, 140, 210, 225, 250, 452}

There is an even number of data, so the median is the mean of the two middle numbers.

\[ \frac{95+108}{2} = 101.5 \]

To identify any outliers, first find the interquartile range, which is the difference between the upper quartile and lower quartile.

Upper quartile: \[ \frac{210+225}{2} = 217.5 \]

Lower quartile: \[ \frac{35+45}{2} = 40 \]

Interquartile range: \( 217.5 - 40 = 177.5 \)

To identify any outliers, look for values that are beyond the upper and lower quartiles by more than 1.5 times the interquartile range.

lower quartile – 1.5(interquartile range): \[ 40 - 1.5(177.5) = 40 - 266.25 = -226.25 \]

upper quartile + 1.5(interquartile range): \[ 217.5 + 1.5(177.5) = 217.5 + 266.25 = 483.75 \]

There are no values below -226.25 or above 483.75. So, there are no outliers.

16. time spent on social networking Web sites in minutes per day:
25, 35, 45, 30, 65, 50, 25, 100, 45, 35, 5, 105, 110, 190, 40, 30, 80

**SOLUTION:**
Find the sum of the values.

\[ 25 + 35 + 45 + 30 + 65 + 50 + 25 + 100 + 45 + 35 + 5 + 105 + 110 + 190 + 40 + 30 + 80 = 1015 \]

\[ \text{mean} = \frac{\text{sum of data values}}{\text{number of data values}} = \frac{1015}{17} \approx 59.7 \]

Order the data from least to greatest.
{5, 25, 25, 30, 30, 35, 35, 40, 45, 45, 50, 65, 80, 100, 105, 110, 190}

The median is the middle numbers, 45.

To identify any outliers, first find the interquartile range, which is the difference between the upper quartile and lower quartile.

Upper quartile: \[ \frac{80+100}{2} = 90 \]

Lower quartile: \[ \frac{30+30}{2} = 30 \]

Interquartile range: \( 90 - 30 = 60 \)

To identify any outliers, look for values that are beyond the upper and lower quartiles by more than 1.5 times the interquartile range.

lower quartile – 1.5(interquartile range): \[ 60 - 1.5(60) = 60 - 90 = -30 \]

upper quartile + 1.5(interquartile range): \[ 90 + 1.5(60) = 90 + 90 = 180 \]

There are no values below -226.25. There is one value, 190, above 180. So 190 is an outlier.

Remove 190 from the data set and recalculate the mean and median.

The new sum is 1015 – 190 = 825
0-12 Measures of Center, Variation, and Position

\[
\text{mean} = \frac{\text{sum of data values}}{\text{number of data values}}
\]

\[
= \frac{825}{16}
\]

\[
\approx 51.6
\]

There is now an even number of data, so the median is the mean of the two middle numbers.

\[
\frac{40 + 45}{2} = 42.5
\]

The mean has been affected more by the removal of the outlier.

17. batting averages for the last 10 seasons: 0.267, 0.305, 0.304, 0.201, 0.284, 0.302, 0.311, 0.289, 0.300, 0.292

**SOLUTION:**
Find the sum of the data values.

\[
0.267 + 0.305 + 0.304 + 0.201 + 0.284 + 0.302 + 0.311 + 0.289 + 0.300 + 0.292 = 2.855
\]

**mean** = \[
\frac{\text{sum of data values}}{\text{number of data values}}
\]

\[
= \frac{2855}{10}
\]

\[
\approx 0.286
\]

Order the data from least to greatest.

\{0.201, 0.267, 0.284, 0.289, 0.292, 0.300, 0.302, 0.304, 0.305, 0.311\}

The median is the average of the 2 middle numbers.

\[
\text{median} = \frac{0.292 + 0.300}{2} = 0.296
\]

To identify any outliers, first find the interquartile range, which is the difference between the upper quartile and lower quartile.

Upper quartile: 0.304
Lower quartile: 0.284
Interquartile range: 0.304 – 0.284 = 0.02

To identify any outliers, look for values that are beyond the upper and lower quartiles by more than 1.5 times the interquartile range.

lower quartile – 1.5(interquartile range): 0.284 – 1.5(0.02) = 0.284 – 0.03 or 0.254

upper quartile + 1.5(interquartile range): 0.304 + 1.5(0.02) = 0.304 + 0.03 or 0.334

There are no values above 0.334. There is one value, 0.201, below 0.254. So 0.201 is an outlier.

Remove 0.201 from the data set and recalculate the mean and median.

\[
2.855 – 0.201 = 2.654
\]

\[
\text{mean} = \frac{\text{sum of data values}}{\text{number of data values}}
\]

\[
= \frac{2654}{9}
\]

\[
\approx 0.295
\]

The mean has been affected more by the removal of the outlier.


a. Find the mean, median, mode, and range of the pants prices.

b. Suppose each pair of pants needs to be hemmed at an additional cost of $8 per pair. Including these alteration costs, what are the mean, median, mode, and range of the pants prices?

c. Suppose the original price of each pair of pants is discounted by 25%. Find the mean, median, mode, and range of the discounted pant prices.

d. Make a conjecture as to the effect on the mean, median, mode, and range of a data set if the same value \( n \) is added to each value in the data set. What is the effect on these same measures if each item in a data set is multiplied by the same value \( n \)?

**SOLUTION:**

Find the sum of the values.

\[
\]
Find the mean, median, mode, and range for each data set.

1. number of students helping at the cookie booth each day:

   - mean
   - median
   - mode
   - range

   - order the data from least to greatest.
   - the mean of the two middle numbers.
   - the median, or middle number.
   - the mode.
   - the range.

   The greatest value is 39.99 and the least value is 14.99. The range is 39.99 – 14.99 or 25.

b. 

   8 × 8 = 64, so the new total is 214.92 + 64 = 278.92.

   mean
   = \frac{\text{sum of data values}}{\text{number of data values}}
   = \frac{278.92}{8}
   \approx 34.87

   Order the data from least to greatest.

   There is an even number of data, so the median is the mean of the two middle numbers.
   \frac{31.99 + 34.99}{2} \text{ or } 33.49

   The number 27.99 appears most often, so the mode is 27.99.

   The greatest value is 47.99 and the least value is 22.99. The range is 39.99 – 14.99 or 25.

c. 

   Multiply the sum by 0.25.

   \[0.25 \times 214.92 = 53.73\]

   Now, subtract the 25% discount from the original price.
   \[214.92 - 53.73 = 161.19\]

   mean
   = \frac{\text{sum of data values}}{\text{number of data values}}
   = \frac{161.19}{8}
   \approx 20.15

   Order the data from least to greatest.

   There is an even number of data, so the median is the mean of the two middle numbers.
   \[\frac{17.99 + 20.24}{2} \text{ or about } 19.12\]

   The number 14.99 appears most often, so the mode is 14.99.

   The greatest value is 29.99 and the least value is 11.24. The range is 29.99 – 11.24 or 18.75.

d. If \(n\) is added to each value in the data set, then \(n\) is added to the mean, median, and mode. The range will remain the same. If each value in the data set is multiplied by \(n\), the mean, median, mode, and range will be multiplied by \(n\).
0-13 Representing Data

1. **SURVEYS** Alana surveyed several students to find the number of hours of sleep they typically get each night. The results are shown in the table. Make a bar graph of the data.

<table>
<thead>
<tr>
<th>Hours of Sleep</th>
<th>Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Alana</td>
</tr>
<tr>
<td>7.25</td>
<td>Nick</td>
</tr>
<tr>
<td>7.75</td>
<td>Tomas</td>
</tr>
<tr>
<td>8.5</td>
<td>Sharla</td>
</tr>
</tbody>
</table>

**SOLUTION:**
Draw a histogram to represent the number of hours of sleep by student. The vertical scale is the number of hours of sleep play. The horizontal scale is the student. There is should be space between the bars.

2. **PLAYS** The frequency table shows the ages of people attending a high school play.

- **a.** Make a histogram to display the data.
- **b.** Make a cumulative frequency histogram showing the number of people attending who were less than 20, 40, 60, or 80 years old.

<table>
<thead>
<tr>
<th>Age</th>
<th>Tally</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–19</td>
<td>38</td>
</tr>
<tr>
<td>20–39</td>
<td>43</td>
</tr>
<tr>
<td>40–59</td>
<td>31</td>
</tr>
<tr>
<td>60–79</td>
<td>8</td>
</tr>
</tbody>
</table>

**SOLUTION:**
- **a.** Draw a histogram to represent the ages attending the play. The vertical scale is the number of people attending the play. The horizontal scale is the age range. There is no space between the bars.
- **b.** Draw a cumulative frequency histogram with the vertical axis representing the number of people and the horizontal axis representing the number of people below the age groupings given.
3. **LAWN CARE** Marcus started a lawn care service. The chart shows how much money he made over the first 8 weeks of summer break. Make a line graph of the data.

![Lawn Care Profits Graph](image)

**SOLUTION:**
Draw a line graph to represent the profit made each week. The vertical scale is the profit in dollars. The horizontal scale is weeks. Plot the points to represent the data. Draw a line connecting each pair of consecutive points.

4. **Use each set of data to make a stem-and-leaf plot and a box-and-whisker plot. Describe how the outliers affect the quartile points.**

   **SOLUTION:**
   The greatest place value is tens. So, the stems should be 5, 6, and 7. The leaves should be the values in the ones place.

   ![Stem-and-Leaf Plot](image)

   The data in order from least to greatest are 58, 59, 60, 63, 65, 66, 69, 70, 71, 71, 72, 73.

   Find $Q_2$ or the median first. Since there is an even number of values, find the mean of the middle two.

   \[ Q_2 = \frac{66 + 69}{2} = 67.5 \]

   The $Q_1$ is the median of the lower half of the data set. The lower half is \{58, 59, 60, 63, 65, 66, 69\}. Since there is an even number of values, find the mean of the middle two.

   \[ Q_1 = \frac{60 + 63}{2} = 61.5 \]

   There are no outliers.
5. \{31, 30, 28, 26, 22, 34, 26, 31, 47, 32, 18, 33, 26, 23, 18\}

**SOLUTION:**
The greatest place value is tens. So, the stems should be 1, 2, 3, and 4. The leaves should be the values in the ones place.

<table>
<thead>
<tr>
<th>Stem</th>
<th>Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>1 3 6 6 6 8</td>
</tr>
<tr>
<td>3</td>
<td>0 1 1 2 3 4</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
</tr>
</tbody>
</table>

Key: $18 = 18$

The data from least to greatest are 18, 18, 21, 23, 26, 26, 26, 28, 30, 31, 31, 32, 33, 34, 47. The median \(Q_2\), or the middle number, is 28.

The \(Q_1\) is the median of the lower half of the data set. The lower half is \{18, 18, 21, 23, 26, 26, 26\}. The median of this half is 23. So, \(Q_1 = 23\).

The \(Q_3\) is the median of the upper half of the data set. The upper half is \{30, 31, 31, 32, 33, 34, 47\}. The median of this half is 32. So, \(Q_3 = 32\).

The only outlier is 47.

6. **FINANCIAL LITERACY** The table shows how Ping spent his allowance of $40. Make a circle graph of the data.

<table>
<thead>
<tr>
<th>How Spent</th>
<th>Ratio</th>
<th>Degrees for Section of Graph</th>
</tr>
</thead>
<tbody>
<tr>
<td>savings</td>
<td>(\frac{15}{40} = \frac{3}{8})</td>
<td>(\frac{3}{8} \cdot 360^\circ = 135^\circ)</td>
</tr>
<tr>
<td>downloaded music</td>
<td>(\frac{8}{40} = \frac{1}{5})</td>
<td>(\frac{1}{5} \cdot 360^\circ = 72^\circ)</td>
</tr>
<tr>
<td>snacks</td>
<td>(\frac{5}{40} = \frac{1}{8})</td>
<td>(\frac{1}{8} \cdot 360^\circ = 45^\circ)</td>
</tr>
<tr>
<td>T-shirts</td>
<td>(\frac{12}{40} = \frac{3}{10})</td>
<td>(\frac{3}{10} \cdot 360^\circ = 108^\circ)</td>
</tr>
</tbody>
</table>
7. **JOGGING** The table shows the number of miles Hannah jogged each day for 10 days. Make a line graph of the data.

<table>
<thead>
<tr>
<th>Day</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miles Jogged</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3.5</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Day</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miles Jogged</td>
<td>4.5</td>
<td>2.5</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**SOLUTION:**
Draw a line graph to represent the number of miles jogged each day. The vertical scale is the number of miles. The horizontal scale is days. Plot the points to represent the data. Draw a line connecting each pair of consecutive points.

![Miles Jogged Graph](image)

8. **BASKETBALL** Two basketball teams are analyzing the number of points they scored in each game this season.

- Lions: 48, 52, 55, 49, 53, 55, 51, 50, 46, 53, 47, 55, 50, 51, 60, 52, 57, 56, 58, 55
- Eagles: 35, 39, 37, 40, 44, 42, 53, 42, 40, 44, 48, 46, 43, 47, 45, 41, 45, 47, 48

- **a.** Make a double box-and-whisker plot to display the data.
- **b.** How does the number of points scored by the Lions compare to the number of points scored by the Eagles?
- **c.** In the first game of the post season, a sports announcer reported the Lions scored a whopping 60 points. Is it appropriate for the announcer to use the word whopping in the statement? Is 60 an unusually high number of points for the Lions to score? Explain your answer.

**SOLUTION:**

a. Enter the Lions’ values into **L1** on a graphing calculator. Enter the Eagles’ values into **L2**. Turn the **Stat Plot 1** on and specify box-and-whiskers plot with **L1**. Turn the **Stat Plot 2** on and specify box-and-whiskers plot with **L2**. To graph, **ZoomStat** first.

![Box-and-Whisker Plot](image)

b. Calculate the quartiles.

**Lions**

- \(\text{Min} = 46\)
- \(Q_1 = 50\)
- \(\text{Median} = 52.5\)
- \(Q_3 = 55\)
- \(\text{Max} = 60\)

**Eagles**

- \(\text{Min} = 35\)
- \(Q_1 = 39\)
- \(\text{Median} = 43.45\)
- \(Q_3 = 47\)
- \(\text{Max} = 58\)
For Lions Q₁ = 55 and Q₃ = 46.5. For the Eagles, Q₁ = 50 and Q₃ = 46.5. Thus, the interquartile range for both teams is about the same.

If you compare the medians Lions is 52.5 compared to 43.5 for the Eagles. If you compare the means, Lions is 52.7 compared to 73.5 for the Eagles.

Therefore, all quartiles of the Lions scores are shifted to the right of those of the Eagles, meaning the Lions have a higher average score.

c. No, 60 is not an unusually high score for the Lions. It is higher than the average, but not by much.

9. TESTS Mr. O’Neil teaches two algebra classes. The test scores for the two classes are shown.

<table>
<thead>
<tr>
<th>Third Period</th>
<th>77</th>
<th>93</th>
<th>85</th>
<th>79</th>
<th>76</th>
<th>86</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>99</td>
<td>78</td>
<td>81</td>
<td>80</td>
<td>82</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>84</td>
<td>91</td>
<td>67</td>
<td>88</td>
<td>93</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td>83</td>
<td>85</td>
<td>84</td>
<td>95</td>
<td>90</td>
<td>88</td>
</tr>
<tr>
<td>Sixth Period</td>
<td>91</td>
<td>93</td>
<td>88</td>
<td>75</td>
<td>60</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>89</td>
<td>79</td>
<td>93</td>
<td>88</td>
<td>85</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>81</td>
<td>90</td>
<td>82</td>
<td>95</td>
<td>76</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>83</td>
<td>88</td>
<td>91</td>
<td>72</td>
<td>88</td>
<td>70</td>
</tr>
</tbody>
</table>

a. Make a double box-and-whisker plot to display the data.
b. Write a brief description of each data distribution.
c. How do the scores from the third period class compare to the scores from the sixth period class?

SOLUTION:
a. Enter the 3rd periods’ values into L₁ on a graphing calculator. Enter the Sixth periods’ values into L₂. Turn the Stat Plot 1 on and specify box-and-whiskers plot with L1. Turn the Stat Plot 2 on and specify box-and-whiskers plot with L2. To graph, ZoomStat first.

[63.8, 102.2] scl:1

b. Calculate the quartiles using a graphing calculator. From the CALC option on the STAT menu, select 1-Var Stats. Use 2nd L1 or 2nd L2 to specify the class period.

3rd period

<table>
<thead>
<tr>
<th>1-Var Stats</th>
</tr>
</thead>
<tbody>
<tr>
<td>x=85</td>
</tr>
<tr>
<td>f=2040</td>
</tr>
<tr>
<td>x²=174624</td>
</tr>
<tr>
<td>SX²=7.295825106</td>
</tr>
<tr>
<td>SX=7.141428429</td>
</tr>
<tr>
<td>n=24</td>
</tr>
</tbody>
</table>

6th period

<table>
<thead>
<tr>
<th>1-Var Stats</th>
</tr>
</thead>
<tbody>
<tr>
<td>x=84.875</td>
</tr>
<tr>
<td>f=2037</td>
</tr>
<tr>
<td>x²=174071</td>
</tr>
<tr>
<td>SX²=7.164601994</td>
</tr>
<tr>
<td>SX=7.013751374</td>
</tr>
<tr>
<td>n=24</td>
</tr>
</tbody>
</table>
0-13 Representing Data

For 3rd period Q₃ – Q₁ is 89 – 80.5 or 8.5. For the 6th period, Q₃ – Q₁ is 90.5 – 79.5 or 11. Thus, the interquartile range for 6th period is larger than 3rd period.

For 3rd period, the minimum score is 67 and highest score is 99. For 6th period, the minimum score is 70 and maximum is 95. The median for 3rd period is 84.5 compared to 88 for 6th period.

Most of the data for third period are spread fairly evenly from about 80 to 89, with the lowest score being 67 and the highest score being 99. Most of the data for sixth period are between 79 and 91, with the lowest score for the class being 70 and the highest score being 94.

c. The sixth period class has a smaller range, a higher median, and a larger interquartile range than the third period class.

Which type of graph is the best way to display each set of data? Explain.

10. an organization’s dollar contributions to 4 different charities

SOLUTION:
Since four charities represent category data and contribution amounts are numeric, a bar graph is the best way to display the data.

11. the prices of a college football ticket from 1990 to the present

SOLUTION:
Since, the data would show change over time, a line graph would give a clear picture of the change in the cost of a seat changes over time.

12. the percent of glass, plastic, paper, steel, and aluminum in a recycling center

SOLUTION:
Since, the data will show how parts are related to a whole, a circle graph would provide a clear distribution of the different products recycled at the recycling center.

13. DISCUS The winning distances for the girls’ discus throw at an annual track meet are shown below.

<table>
<thead>
<tr>
<th>Year</th>
<th>Distance (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>119</td>
</tr>
<tr>
<td>2006</td>
<td>124</td>
</tr>
<tr>
<td>2007</td>
<td>126</td>
</tr>
<tr>
<td>2008</td>
<td>129</td>
</tr>
<tr>
<td>2009</td>
<td>130</td>
</tr>
<tr>
<td>2010</td>
<td>136</td>
</tr>
</tbody>
</table>

a. Make a stem-and-leaf plot to display the winning distances.
b. Make a histogram to display the winning distances.
c. What does the stem-and-leaf plot show you that the histogram does not?
d. If this trend continues, what would you expect the winning distance to be in 2030? Is your answer reasonable? Explain.

SOLUTION:
a. Look at the data to find the least place value. The least place value is the ones. Let the leaves in the stem-and-leaf plot be the digits in the ones place. So, 119 m would have a stem of 11 and a leaf of 9.

<table>
<thead>
<tr>
<th>Stem</th>
<th>Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>12</td>
<td>4    6  9</td>
</tr>
<tr>
<td>13</td>
<td>0    0  3  5  6  7  8</td>
</tr>
<tr>
<td>14</td>
<td>0</td>
</tr>
</tbody>
</table>

Key: 11|9 = 119

b. The distances in the table range from 119 to 140. Use 10-unit intervals on the frequency table.

<table>
<thead>
<tr>
<th>Distance</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>110-119</td>
<td>1</td>
</tr>
<tr>
<td>120-129</td>
<td>3</td>
</tr>
<tr>
<td>130-139</td>
<td>7</td>
</tr>
<tr>
<td>140-149</td>
<td>1</td>
</tr>
</tbody>
</table>
1. **SURVEYS** Alana surveyed several students to find the number of hours of sleep they typically get each night. The vertical scale is the number of hours of sleep by student. The horizontal scale is the number of students. The table shows the data obtained in part a.

<table>
<thead>
<tr>
<th>Hours of Sleep</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>

b. The histogram shows the frequencies of groups of data while the stem-and-leaf plot shows every data value. Notice in this case that the stems are equivalent to the size of the intervals and the number of leaves for each stem is equal to the corresponding frequency.

d. From looking at the table, the winning distance increased by 16 meters from 2000 to 2010. This could be seen easier with a line graph.

If the distance increases by 16 meters every 10 years, in 2030 the winning distance will be 32 meters more than in 2010, or 172 meters. It is unreasonable to expect that every year girls will be able to throw farther and farther, at some time the distance will level off.

14. **DRINKS** Tate is buying drinks for a party. He is comparing 2-liter bottles to 12-packs of 12-ounce cans. The prices of 2-liter bottles are $0.99, $1.99, $1.87, $1.79, $1.29, $1.43, and $1.15. The prices of 12-packs are $2.50, $4.25, $3.34, $2.65, $3.19, $3.89, and 2.99.

a. Make a double box-and-whisker plot to display the data.

b. Notice that instead of comparing price per item it would be more beneficial to compare price per ounce. What is the price per ounce of each item if a 2-liter is approximately 67 ounces and a 12-pack is 144 ounces? Round to the nearest cent.

c. Make a new double box-and-whisker plot from the data obtained in part b.

d. Which is the better deal, the 12-packs of cans or the 2-liter bottles? Explain.

**SOLUTION:**

a. To create a box-and-whisker with out technology, determine the quartiles, interquartile range and identify any outliers.

2-liter bottles:
Order the data from least to greatest and determine the quartiles.
0.99, 1.15, 1.29, 1.43, 1.79, 1.87, 1.99

\[ Q_1 = 1.15, Q_2 = 1.43, \text{ and } Q_3 = 1.87 \]

Determine the interquartile range.

\[ \text{IQR} = Q_3 - Q_1 = 1.87 - 1.15 = 0.72 \]

Check to see if there are any outliers.

\[ 1.15 - 1.5(0.72) = 0.07 \]
\[ 1.87 + 1.5(0.72) = 2.93 \]

Prices less than 0.07 or greater than 2.93 are outliers. Therefore, there are no outliers.

b. Make a new double box-and-whisker plot from the data obtained in part b.

d. Which is the better deal, the 12-packs of cans or the 2-liter bottles? Explain.
Q₁ = 2.65, Q₂ = 3.19, and Q₃ = 3.89

Determine the interquartile range.
IQR = Q₃ – Q₁ = 3.89 - 2.65 = 1.24

Check to see if there are any outliers.

2.65 – 1.5(1.24) = 0.79
3.89 + 1.5(1.24) = 5.75

Prices less than 0.79 or greater than 5.75 are outliers. Therefore, there are no outliers.

Draw the plots using the same number line.
Draw a number line that includes the least and greatest numbers in the data. Place dots above the number line to represent the quartiles and the ends of the whiskers. Draw the boxes and whiskers. The vertical lines go through the quartiles.

To use graphing technology for the box-and-whiskers plots, enter the 2-liter values into L₁ on a graphing calculator and the 12-pack values into L₂. Turn the Stat Plot 1 on and specify box-and-whiskers plot with L₁. Turn the Stat Plot 2 on and specify box-and-whiskers plot with L₂. To graph, ZoomStat first.

b. Divide the 2-liters values by 67 and the 12-pack values by 144. If the data is already entered into a graphing calculator as L1 and L2, then set L3 to equal L1 ÷ 67 and L4 equal to L2 ÷ 144.
2-liters: $0.01, $0.03, $0.03, $0.03, $0.02, $0.02, $0.02
12-packs: $0.02, $0.03, $0.02, $0.02, $0.02, $0.03, $0.02

b. c. For the 2-liter data – Q₁ = 0.02, Q₂ = 0.02, and Q₃ = 0.03. For the 12-pack data – Q₁ = 0.02, Q₂ = 0.02, and Q₃ = 0.03.
d. There is not a significant difference in price per ounce. The 2-liters are between $0.01 and $0.03 per ounce and the 12-packs are between $0.02 and $0.03 per ounce.