Solve for volume in this problem about a storage container.

**Example:** Stow-It Storage offers new storage solutions for busy customers. Customers fill a cube-shaped storage unit measuring 6 feet per side. The company then picks up the unit and stores it in a warehouse. What is the volume of the storage unit?

Substitute the values into the formula and solve. 

\[ V = s^3 \]

\[ = 6 \times 6 \times 6 \]

\[ = 216 \text{ cubic feet} \]

**Answer:** The volume of the storage unit is **216 cubic feet**.

**Check:** You know \(6 \times 6\) is 36. Use front-end estimation for the final step: \(30 \times 6 = 180\). The answer 216 cubic feet makes sense.

**S K I L L  P R A C T I C E**

Solve each problem.

1. To reach an underground methane gas well, workers dig a rectangular hole 6 feet wide, 8 feet long, and 9 feet deep. How many cubic feet of dirt do they remove from the hole?

2. The height of a cube is 3.5 centimeters. Find the volume of the cube in cubic centimeters.

3. A storage unit has 243 cubic feet of space. What is the volume of the unit in cubic yards? (Hint: First figure out the number of cubic feet in a cubic yard.)

4. What is the volume of the cardboard box in cubic inches?

**P R O B L E M  S O L V E R**

**Connection**

Before solving a formula problem, ask yourself, “Which answers don’t make sense?”

You can often eliminate some answer choices using common sense.

**Example:** A train traveled 120 km per hour for \(2 \frac{1}{4}\) hours. How many miles did it travel?

<table>
<thead>
<tr>
<th></th>
<th>160</th>
<th>220</th>
<th>240</th>
<th>330</th>
<th>360</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(2)</td>
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</tr>
<tr>
<td>(3)</td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

**Think:** The train traveled between 2 and 3 hours. If it averaged 120 km per hour for 2 hours, it would have traveled 240 km. Using common sense, you know that choices (1), (2), and (3) are too low to be correct.

Suppose the train traveled for 3 hours. Multiply 120 by 3. **Which answer choice can you eliminate? Which answer choice must be correct?**

Answers and explanations start on page 320.
8. An art project calls for building a rectangular wood frame to pour plaster into, creating a 10-inch by 14-inch tile. Assuming no waste, how many feet of wood does it take to build the frame?
   (1) 2
   (2) 4
   (3) 4.8
   (4) 48
   (5) 140

9. An Air Tobego plane flew at an average speed of 418 mph. How many miles did it travel in 3.5 hours?
   (1) 1463
   (2) 1290
   (3) 836
   (4) 418
   (5) 119

10. Ariel is training for a community walk-a-thon. She walked 12.4 miles on Monday, 14 miles on Wednesday, 10 miles on Friday, and not as far on Saturday. What was her average, in miles, for the 4 days?
    (1) 9.1
    (2) 12.4
    (3) 36.4
    (4) 40
    (5) Not enough information is given.

11. A plastic cube is used to make snow bricks. It measures 10 cm wide, 10 cm long, and 10 cm deep. Which formula can be used to find how much snow the cube holds?
    (1) \( A = s^2 \)
    (2) \( A = lw \)
    (3) \( V = \pi r^2 h \)
    (4) \( P = 4s \)
    (5) \( V = s^3 \)

Questions 12 and 13 are based on the following information. Refer to the formulas page on page 340 if needed.

The Rosarian family has five children. The ages of the three youngest are 4, 7, and 11; the twins are 14 years old.

12. In years, what is the average age of the Rosarian children?
    (1) 8
    (2) 9
    (3) 10
    (4) 11
    (5) 14

13. In years, what is the median age of the Rosarian children?
    (1) 8
    (2) 9
    (3) 10
    (4) 11
    (5) 14

Question 14 is based on the following drawing.

14. The area of Pico Park’s rectangular sandbox is 10.35 square meters. One side measures 2.3 m. Which expression represents the length of the other side?
    (1) \( 10.35 \times 2.3 \)
    (2) \( \frac{10.35}{2.3} \)
    (3) \( \frac{10.35}{2(2.3)} \)
    (4) \( \frac{4 \times 2.3}{2} \)
    (5) \( \frac{2.3}{10.35} \)
Look how the formula is applied in solving for a leg measure in a right-triangle problem.

**Example:** One leg of a right triangle measures 5 centimeters. The hypotenuse measures 13 centimeters. Find the length of the remaining leg.

Use the Pythagorean relationship. 
\[ c^2 = a^2 + b^2 \]
\[ 13^2 = 5^2 + b^2 \]
\[ 169 = 25 + b^2 \]

Subtract 25 from both sides to isolate the variable.
\[ 169 - 25 = 25 - 25 + b^2 \]
Find the square root of 144.
\[ b = \sqrt{144} = 12 \text{ centimeters} \]

**Answer:** The missing measurement is 12 centimeters.

Most right triangles do not have three measurements that can be written in whole numbers. Thus, the GED Math Test makes frequent use of a few special ratios. Watch for problems written using a 3:4:5 ratio. Look at the triangle to the right. Do you recognize the ratio? Each of the numbers in the ratio has been doubled.

**SKILL PRACTICE**

Solve each problem.

1. Find the missing side of these right triangles.

<table>
<thead>
<tr>
<th>leg (a)</th>
<th>leg (b)</th>
<th>hypotenuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 9</td>
<td>12</td>
<td>(c)</td>
</tr>
<tr>
<td>b. 10</td>
<td>(c)</td>
<td>26</td>
</tr>
<tr>
<td>c. (c)</td>
<td>24</td>
<td>25</td>
</tr>
</tbody>
</table>

2. The legs of a right triangle each measure 8 inches. Choose the best estimate for the length of the hypotenuse.

   (1) Between 9 and 10 inches
   (2) Between 10 and 11 inches
   (3) Between 11 and 12 inches
   (4) Between 12 and 13 inches
   (5) Between 13 and 14 inches

**Calculator Connection**

Use your calculator to find the square roots that you have not memorized.

**Example:** While remodeling his kitchen, Ted needs to cut a piece of dry wall in the shape of a right triangle, to fit into a corner. The shorter sides of this piece measure 8 in and 11 in. What will the longest side measure to the nearest tenth of an inch?

**Step 1.** Use the Pythagorean relationship, \(8^2 + 11^2 = c^2\).

**Calculator:** \[ 8 \times 8 + 11 \times 11 = 185 \]

**Step 2.** Press the square root key (\( \sqrt{} \)). The display reads \( 13.60147 \).

**Answer:** Round the nearest tenth. The longest side will measure about 13.6 inches.

**Try this one:** The legs of a right triangle measure 5 cm and 9 cm. Find the length of the hypotenuse to the nearest tenth of a centimeter.
**Answer:** The circumference of the rug is approximately **25.12 feet**. **Check:** You can quickly estimate using 3 for pi. Multiply: $3 \times 8 = 24$. The answer 25.12 makes sense.

**Finding Area**

When we find the area of a circle, we are attempting to find the number of square units we will need to cover the surface of the circle exactly. Although we cannot fit square units neatly within a circular area, we can use a formula to approximate the area.

| area of a circle $(A)$ | $A = \pi r^2$; where $\pi = 3.14$ and $r = \text{radius}$ |

Use the formula to find the area of Nita’s rug.

We know the diameter is 8 feet. Divide by 2 to find the radius. $8 \div 2 = 4$ feet

Use the formula. First, square the radius. $A = \pi r^2$
Then multiply by 3.14.

**Answer:** The area of the rug is about **50.24 square feet**. **Check:** Multiply using 3 for pi: $3 \times 16 = 48$. The answer 50.24 is reasonable.

When you take the GED Math Test, the formulas for the circumference and the area of a circle will be listed on the formulas page. Make sure you use the correct formula for any given situation.

**Skill Practice**

Solve each problem. Use 3.14 for pi.

1. A circular patio has a radius of 5 ft. If it will cost $6 per square foot to pave the patio with brick, how much will the paving cost? *(Hint: Find the area of the patio, then multiply by the cost per square foot.)*

2. LeRoy is building a circular oak table that is 5 feet 6 inches in diameter. He plans to add a metal band on the outside edge of the table. How many feet of banding does he need? *(Hint: 6 inches = $\frac{1}{2}$ foot)*

3. Panteha is making an anniversary cake for her parents. Which would have the greater surface area to write on, a 9-by-13-inch rectangular cake or a 12-inch circular cake?

4. At an aquarium, a circular tide pool is surrounded by a walkway for visitors. The diameter of the pool is 6 meters, and the width of the walkway is 1.5 meters.

   a. What is the circumference of the tide pool?  
   b. What is the outer circumference of the walkway?  
   c. What is the area of the walkway to the nearest tenth square meter? *(Hint: Find the area of the outer circle and subtract the area of the tide pool.)*

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Answers and explanations start on page 321.
Use a calculator to solve problems with difficult numbers.

**Example:** A concrete post is 6 feet long with a 1-foot 3-inch radius. What is the volume of concrete in the post to the nearest cubic foot?

Start by expressing 1 foot 3 inches as a decimal. Three inches is \( \frac{3}{12} \), or \( \frac{1}{4} \), of a foot. Therefore, 1 foot 3 inches is equal to 1.25 feet.

Substitute the values into the formula.

\[
V = \pi r^2 h
\]

Use a calculator to do the multiplication.

**Calculator:**

\[
3 \times 1.25 \times 6 = 29.4375
\]

Round to the nearest whole number: 29.

**Answer:** The post contains about **29 cubic feet** of concrete. **Check:** Use front-end estimation: \( 3 \times 1 \times 1 \times 6 = 18 \). The answer makes sense.

**Skill Practice**

Solve each problem.

1. An oil barrel in the shape of a cylinder has a radius of 24 inches and a height of 4 feet. What is the container's volume in cubic feet?

2. A pipe has an inside diameter of 1 meter and a length of 8 meters. What is its volume in cubic meters?

3. Find the volume in cubic inches of a cylinder with a length of 3 feet and a diameter of 10 inches. (Hint: Since the answer must be in cubic inches, change feet to inches.)

4. Yung Mae has built a raised circular flower bed with a diameter of 10 feet and a height of 2 feet. How many whole cubic yards of soil will she need to fill the space? (Hint: 1 cubic yard = 27 cubic feet.)

**History Connection**

**A piece of the pi story...**

**Pi** is a very old number; ancient Egyptian, Hebrew, and Babylonian mathematicians searched for its value. The Greek mathematician Archimedes proved that \( \pi \) is between \( 3 \frac{10}{71} \) and \( 3 \frac{1}{7} \). In 1706 William Jones first used the symbol \( \pi \) to represent the number 3.141592, because the Greek letter \( \pi \) stands for “perimeter” or “periphery.”

**Example:** Measure and record the circumference of several round objects (jars or lids) using a string and ruler. Measure and record each object’s diameter; then divide its circumference by its diameter. Find the average quotient. **What have you discovered?**
G E D  P R A C T I C E

PART ONE DIRECTIONS: Choose the one best answer to each of the following problems. Use a calculator wherever necessary. Use 3.14 for π.

1. How many inches is the circumference of a pizza with a diameter of 14 inches?
   (1) 14.0
   (2) 21.98
   (3) 43.96
   (4) 153.86
   (5) 439.6

Questions 2 and 3 are based on the following drawing.

2. Triangles A and B are
   (1) similar
   (2) congruent
   (3) right
   (4) equilateral
   (5) scalene

3. What is the measure of ∠d?
   (1) 20°
   (2) 25°
   (3) 40°
   (4) 50°
   (5) 70°

4. A circular patio has a diameter of 12 feet. Which of the following expressions could be used to find the area of the patio in square feet?
   (1) 12 × 6²
   (2) 3.14 × 12²
   (3) 3.14 × 12
   (4) 3.14 × 12² × 6
   (5) 3.14 × 6²

5. Terry has finished planting a circular rose garden for his neighbor. The circumference of the garden is 50.24 feet. What is the garden’s diameter in feet?
   (1) 3.14
   (2) 8
   (3) 16
   (4) 24
   (5) 25.12

6. What is the volume in cubic centimeters of a cylinder with a diameter of 10 centimeters?
   (1) 314
   (2) 78.5
   (3) 31.4
   (4) 15.7
   (5) Not enough information is given.

Questions 7 and 8 refer to the following figure.

7. Points A and B lie on a straight line. If ∠5 measures 58°, what is the measure of ∠4?
   (1) 32°
   (2) 35°
   (3) 122°
   (4) 148°
   (5) 302°

8. Angles 2 and 3 are complementary angles. If ∠3 measures 23°, what is the measure of ∠2?
   (1) 180°
   (2) 157°
   (3) 100°
   (4) 67°
   (5) 23°
9. Jeanine is sewing ribbon around equilateral triangles within the pattern of a baby quilt. One side of each triangle measures 8 inches. Find the perimeter of each triangle in inches.
   (1) 8
   (2) 16
   (3) 24
   (4) 48
   (5) 64

10. Which of these expressions would be used to find the radius of a circle whose area is 50.24?
   (1) \( r^2 = \frac{50.24}{3.14} \)
   (2) \( r = 2 \times \frac{50.24}{3.14} \)
   (3) \( r^2 = 50.24(3.14) \)
   (4) \( r = \frac{50.24}{3.14} \)
   (5) \( r = (50.24)(3.14)(2) \)

**Question 11** is based on the following map.

11. Starting at the corner of Park Road and Main Street, Ana’s soccer team jogs 9 blocks due north on Park Road and then 12 blocks due west on Key Street. At the corner of Key and Green Streets, they cut straight across the park to where they began. How many blocks is the last leg of their run?
   (1) 6
   (2) 10
   (3) 12
   (4) 15
   (5) 20

12. At 3 P.M. a building casts a shadow 120 meters long. At the same time, a pole, which measures 4 meters in height, casts a shadow of 1.6 meters. If the building and pole are both perpendicular to the ground, what is the height of the building in meters?
   (1) 48
   (2) 140
   (3) 300
   (4) 480
   (5) Not enough information is given.

**Question 13** refers to the following figure.

13. Points P, Q, and R lie on a straight line. Which of the following angles is supplementary to \( \angle TQR \)?
   (1) \( \angle SQR \)
   (2) \( \angle SQT \)
   (3) \( \angle PQS \)
   (4) \( \angle PQT \)
   (5) \( \angle PQR \)

14. One leg of a right triangle measures 3 inches. The hypotenuse measures 17 inches. Which equation could be used to find the length of the remaining leg?
   (1) \( 3^2 + 17^2 = b^2 \)
   (2) \( 17^2 = b^2 - 3^2 \)
   (3) \( 17^2 - 3^2 = b^2 \)
   (4) \( 17^2 = \frac{3^2}{b} \)
   (5) \( b^2 - 17^2 = 3^2 \)

15. The circumference of a circular granite block in Zuma Beach Plaza is 6.28 meters. What is the area of the surface of granite block in square meters?
   (1) 2.00
   (2) 3.14
   (3) 6.28
   (4) 18.84
   (5) 26.26
PART TWO DIRECTIONS: Choose the one best answer to each of the following problems. You may not use a calculator on these problems.

16. What is the approximate circumference of a circle with a radius of 3 inches?
   (1) between 0 and 5 inches
   (2) between 5 and 10 inches
   (3) between 10 and 15 inches
   (4) between 15 and 20 inches
   (5) between 20 and 30 inches

Questions 17 and 18 are based on the following figure.

17. Lines X and Y are parallel lines. If the measure of \( \angle 1 \) is 102°, what is the measure of \( \angle 6 \)?
   (1) 12°
   (2) 51°
   (3) 78°
   (4) 88°
   (5) 102°

18. Which of the following angles has a measure equal to the measure of \( \angle 5 \)?
   (1) \( \angle 2 \)
   (2) \( \angle 3 \)
   (3) \( \angle 4 \)
   (4) \( \angle 6 \)
   (5) \( \angle 8 \)

19. About how many square inches is the area of a circle with a radius of 5 inches?
   (1) 3
   (2) 15
   (3) 25
   (4) 60
   (5) 75

Question 20 refers to the following figure.

20. What kind of triangle is \( \triangle ABC \)?
   (1) equilateral
   (2) isosceles
   (3) right
   (4) scalene
   (5) Not enough information is given.

21. Lines G and H are parallel. Line A is perpendicular to Line G. How many 90° angles are formed by this arrangement?
   (1) 8
   (2) 6
   (3) 4
   (4) 2
   (5) 1

22. \( \triangle XYZ \) is a scalene triangle. \( \angle X \) measures 36°. Which of the following must be a true statement?
   (1) \( \angle Y \) must be a right angle.
   (2) The sum of \( \angle Y \) and \( \angle Z \) equals 180°.
   (3) \( \angle X \) and \( \angle Y \) must be complementary angles.
   (4) Angle Z must measure 36°.
   (5) Neither \( \angle Y \) nor \( \angle Z \) measures 36°.

23. A cylindrical container has an inside radius of 4 inches and a height of 10 inches. Approximately how many cubic inches of juice can it hold?
   (1) 200
   (2) 300
   (3) 400
   (4) 500
   (5) 600
Alternate Math Formats

The questions below are based on the math skills in Programs 33–35. For more information on answering alternate format items, review pages 20–22.

Grid in the answers to questions 24 through 35.

24. A hiking trail is 2600 meters in length. What is the length of the trail in kilometers?

25. Taraneh needs to cut six 18-inch lengths of wood from a piece of lumber that is 16 feet long. How many feet of lumber will she have left after she makes the cuts? (Disregard any waste.)

26. Noah is painting and carpeting the rooms shown in the diagram. After painting, he plans to put a wallpaper border along the top of all walls. What is the measure in feet of the perimeter of the rooms?

27. To carpet the rooms, Noah needs to know the area of the rooms. Find the area of the rooms in square feet.

28. Adrianne bought a new sofa for $650. She financed the purchase over 3 years at 8% simple interest. How much will she pay in interest over the length of the loan?

29. To the nearest tenth, what is the area in square centimeters of a circle with a diameter of 8 cm?
Questions 30 and 31 refer to the following diagram.

30. A metal pole used to hang banners and advertisements is attached to a brick building to form a right angle. A diagonal brace is placed 5 feet below the pole to give support. What is the length in feet of the pole?

31. The pole, wall, and brace form a triangle. What is the measure of \( x \) in degrees?

32. A square tile measures 6 1/2 inches per side. To the nearest tenth, what is the area in square inches of the tile?

Question 33 refers to the following diagram.

33. The storage compartment is in the shape of a rectangular container. In cubic feet, what is the volume of the storage compartment?

34. Angles 1 and 2 are supplementary angles. If \( \angle 1 \) measures 85°, what is the measure in degrees of \( \angle 2 \)?

35. A container holds 3.42 liters of cleaning fluid. If the fluid is divided evenly into 3 smaller containers, how many milliliters will each hold?

Answers and explanations start on page 323.
1. Add the three bills, then divide by the number of bills.

2. Use the total cost formula: \( c = nr \). Solve for the rate: \( r = \frac{c}{n} \).

3. Use the distance formula: \( d = rt \). Solve for time: \( t = \frac{d}{r} \).

4. Use the formula \( A = lw \).

Social Studies Connection, page 161
In January, the average temperature is about 25° in Grand Junction and about 42° in Atlanta.

The average temperature is higher in Atlanta.

Skill Practice, page 163
1. \( 80 \) square feet \( A = bh = 8(10) = 80 \)
2. \( 60 \) square feet \( A = \frac{1}{2}bh = \frac{1}{2}(12)(10) = 6(10) = 60 \) sq ft
3. \( 37.6 \) feet \( P = a + b + c = 10 + 15.6 + 12 = 37.6 \) feet
4. \( 180 \) square feet Find the area of the larger path: \( A = 12(10) = 120 \). Add the area of the path to the area of the flower garden (from item 2): \( A = 120 + 60 = 180 \) sq ft.

Skill Practice, page 165
1. \( 432 \) cubic feet \( V = lwh = 6(8)(9) = 432 \) cu ft
2. \( 42.875 \) cubic centimeters \( V = s^3 = (3.5)^3 = 42.875 \) cu cm
3. \( 9 \) cubic yards First find the number of cubic feet in one cubic yard. Since 1 yd = 3 ft, 1 cu yd = \( 3^3 = 27 \) cu ft in one cubic yard. Next, convert the volume of the storage unit to cubic yards: 243 cubic feet ÷ 27 = 9 cubic yards.
4. \( 9072 \) cubic inches Remember to change 1.5 feet to 18 inches before multiplying: \( V = lwh = 36(18)(14) = 9072 \) cu in.

Problem Solver Connection, page 165
After 3 hours of travel, the train would have traveled 360 km. Since the train actually traveled less than 3 hours, choice (5) can be eliminated.

Choice (4) **330 must be correct.**

GED Practice, pages 166–168
1. Since the figure is a triangle, the appropriate formula to solve the problem is \( A = \frac{1}{2}bh \), where \( b = \text{base} \) and \( h = \text{height} \).
2. Isolate the unknown variable, number of units (rolls of masking tape), in the total cost formula, \( c = nr \). To do this, divide both sides of the equation by \( r \), giving you \( \frac{c}{r} = n \). Substitute the known numbers.
3. Remember to compute the mean, or average, by adding all the units and dividing by the number of units: \( \frac{12.75 + 16 + 3.5}{3} = \frac{32.25}{3} = 10.75 \).
4. Using the formula \( c = nr \), solve for \( r \): \( \frac{c}{n} = r \). Substitute the known values and divide: \( \frac{9.36}{23} = 0.39 \).
5. The correct choice is the simple-interest formula, \( i = prt \), with its variables replaced by the known numbers from Plan B.
6. Remember that the simple interest formula is \( i = prt \). Substitute the Plan A values you know: \( i = 725(0.06)(2.5) \). Multiply: \( i = \$108.75 \). The question asks how much Nuyen will pay “in all,” so add the principal to the simple interest: \( \$725 + \$108.75 = \$833.75 \).
7. Add to find the number of miles from Lakewood to Marion: 103 + 42 = 145 miles. The time is \( \frac{21}{2} = 2.5 \) hr. Using the formula \( d = rt \), solve for rate (\( r \)): \( r = \frac{d}{t} \), so \( r = \frac{145}{2.5} = 58 \) miles per hour.
8. Using the formula for perimeter, \( P = 2l + 2w \), substitute your known terms: \( P = 2(14) + 2(10) \). Multiply and then add: 28 + 20 = 48. Remember to convert inches to the measurement unit asked for in the problem, feet: \( \frac{48}{12} = 4 \) feet.
9. Use the distance formula, \( d = rt \), and substitute the known terms: \( d = 418(3.5) = 1463 \).
10. Not enough information is given. The problem does not state how many miles Ariel walked on the fourth day, Saturday.
11. Because all the dimensions in a cube are the same (10 cm, in this case), cube the length of one side, \( s \), to find the volume.
12. Add all five ages (4 + 7 + 11 + 14 + 14 = 50), and divide by the number of children: \( \frac{50}{5} = 10 \).
13. The median is the middle number in the list of children’s ages: 4, 7, 11, 14, 14.
14. Isolate the length in the area formula of a rectangle: \( A = lw \), so \( l = \frac{A}{w} \). Divide the total area by the one known side.
15. Substitute the known terms into the perimeter formula for a rectangle.
16. You know the time (5 hours) and the rate (60 miles per hour). Substitute the values in the distance formula to find distance driven round-trip: \( d = rt \). Luisa drove 300 miles round-trip. That means the distance one way from Sierra to Clayton is half that amount, or 150 miles. The information that Luisa drove on both Tuesday and Thursday is unnecessary, or extra information.
17. Multiply the length by the width to find the area of a rectangle: \( 20 \times 16 = 320 \) square feet.
18. The volume of a rectangular container is found by multiplying the length by the width by the height.
19. (4) Elm Place  Use number sense to solve this problem. In each column, Elm Place has the most expensive homes sold compared to the other three streets, so it will also have the highest mean, or average, price.

20. (3) $67,350 Put all 12 selling prices in order from greatest to least or least to greatest. The two middle prices in the list are $68,200 and $66,500. To find the median, find the mean of these two prices: $68,200 + $66,500 = $134,700, and $134,700 = $67,350.

21. (4) 12 You would divide by the number of homes sold, which is 4 streets × 3 homes each = 12.

PROGRAM 35: GEOMETRY

Skill Practice, page 175
1. 120° 180° - 60° = 120°
2. 45° $\frac{1}{2}$ × 90° = 45°
3. 68° 180° - 112° = 68°
4. 40° 90° - 50° = 40°
5. 60° 180° - 90° - 30° = 60°
6. 130° 180° - 50° = 130°
7. 90° 180° - 90° = 90°
8. True Angle ABF measures 180°, which is the sum of three angles: ∠ABC, ∠CBE, and ∠EBF. The sum of the known angles is 80°, so the remaining angle, ∠CBE, must measure 100°.

Skill Practice, page 177
1. a, d, e, h, i, k, and l
2. 140°
3. g, j, and n
4. (4) Angle f measures 50°. Angle f corresponds to ∠m, which is the vertical angle to a 50° angle. Therefore, ∠f also measures 50°.

Science Connection, page 177
The star is 25° above the horizon. It is midway between the mark for 20° and the mark for 30°.

Skill Practice, page 179
1. 1$\frac{1}{4}$ inch or 1.25 inch Set up a proportion: $\frac{5}{3} = \frac{1}{x}$. Solve: $5 \times 1 ÷ 4 = 1 \frac{1}{4}$ or 1.25.
2. 9.6 The base of the larger triangle is 16. The leg of the larger triangle is 8 + 12, or 20. Set up a proportion comparing the larger triangle to the smaller similar triangle: $\frac{16}{20} = \frac{x}{12}$. Solve: $16 \times 12 \div 20 = 9.6$.
3. No Remember that the sum of the interior angles of a triangle is 180° and that a right angle measures 90°. Thus, the missing angle in triangle A must measure 40°, and the missing angle in triangle B must measure 60°. Because they have different angles, the triangles cannot be similar.

4. (4) ΔDEF is an isosceles triangle. The triangles are similar, which means they both are the same shape with equal corresponding angles, but they are different in size. Since ΔABC has two equal sides, ΔDEF also has two equal sides, making it an isosceles triangle.

Skill Practice, page 181
1. To solve each problem, use the Pythagorean relationship and insert the values you are given.
   a. 15 $c^2 = 9^2 + 12^2$, so $c^2 = 81 + 144 = 225$, and $c = \sqrt{225} = 15$.
   b. 24 $10^2 + b^2 = 26^2$, so $b^2 = 676 - 100 = 576$, and $b = \sqrt{576} = 24$.
   c. 7 $a^2 + 24^2 = 25^2$, so $a^2 = 625 - 576 = 49$, and $a = \sqrt{49} = 7$.

   (3) Between 11 and 12 inches Use the Pythagorean relationship: $8^2 + 8^2 = c^2$
   $64 + 64 = c^2$
   $128 = c^2$
   You know the square of 11 is 121 and the square of 12 is 144. Therefore, the square root of 128 must be between 11 and 12.

Calculator Power, page 181
10.3 cm Use the Pythagorean relationship: $5^2 + 9^2 = c^2$.

   Calculator: $\text{[5]} \times \text{[9]} \div \text{[9]} \times \text{[9]} = \boxed{106}$
   Press the square root key to get 10.29563. Round to the nearest tenth, or 10.3.

Skill Practice, page 183
1. $\$471.00 First find the area of the patio:
   $A = \pi r^2 = 3.14 \times 5^2 = 78.5$ square feet. Then find the total cost: $c = nr = 78.5 \times 6 = \$471.00$.
2. 17.27 feet Use the circumference formula: $C = \pi d = 3.14 \times 5.5 = 17.27$ feet.
3. The rectangular cake has the greater area. The rectangular cake has an area of 117 square inches (9 × 13). The circular cake has an area of about 113.04 square inches (3.14 × 6²). (The radius of a 12-inch pan is 6 inches.)
4. a. about 18.84 meters Use the circumference formula: $C = \pi d = 3.14 \times 6 = 18.84$.
   b. about 28.26 meters The diameter of the outer circle is 9 meters (6 + 1.5 + 1.5). Use the circumference formula:
   $C = \pi d = 3.14 \times 9 = 28.26$.
   c. about 35.3 square meters To find the area of the walkway, find the area of the pool and walkway combined, then subtract the area of the pool. Use these facts: The diameter of the pool is 6 meters, so the radius is $\frac{6}{2}$, or 3 meters. The width of the walkway is 1.5 meters. Combine to find the radius of the entire figure: $3 + 1.5 = 4.5$ meters. Use the formula $A = \pi r^2$ to find the area of the pool and walkways combined:
A = 3.14 \times 4.5^2.
= 3.14 \times 20.25
= 63.585 \text{ square meters}

Now find the area of the pool using the same formula and 3 meters for the radius:
A = 3.14 \times 3^2
= 3.14 \times 9
= 28.26 \text{ square meters}

Subtract to find the difference: 63.585 - 28.26 = 35.325. Rounded to the nearest tenth, the area of the walkway is 35.3 square meters. Note: If you rounded as you worked, your answer might be slightly different. Each time you round, your answer becomes less accurate.

Skill Practice, page 185
1. about 50.24 cubic feet Use 2 feet for 24 inches; \(V = \pi r^2 h = 3.14 \times 2^2 \times 4 = 50.24\).
2. about 6.28 cubic meters Use a radius of 0.5 meter: \(V = \pi r^2 h = 3.14 \times 0.5^2 \times 8 = 6.28\).
3. about 2826 cubic inches Use 36 inches for 3 feet: \(V = \pi r^2 h = 3.14 \times 3^2 \times 36 = 2826\).
4. 6 cubic yards Find the volume in feet: \(V = \pi r^2 h = 3.14 \times 5^2 \times 2 = 157\). Then divide by 27 to convert to cubic yards: 6 cubic yards.

History Connection, page 185
A circle’s circumference is slightly more than three times the size of its diameter.

GED Practice, pages 186–188
1. (3) 43.96 On your calculator, use the circumference formula, \(C = \pi d\), where \(\pi = 3.14\): \(C = 3.14(14) = 43.96\).
2. (1) similar The two triangles have the same shape and the same corresponding angles; their corresponding sides are in proportion to each other.
3. (3) 40° In an isosceles triangle, the two angles opposite the two equal sides are equal. Thus, \(\angle b = 70°\). To find \(\angle a\), subtract the sum of 70° + 70° from 180° (the total of the three angles in a triangle) for a remaining 40° angle. Since \(\angle d\) and \(\angle a\) are equal angles, \(\angle d = 40°\).
4. (5) 3.14 \times 6^2 Use the formula for finding the area of a circle: \(A = \pi r^2\). Find the radius of the circle by dividing the diameter by 2: \(\frac{12}{2} = 6\) feet. Substitute the values from the problem into the formula using 3.14 for pi: \(A = 3.14 \times 6^2\).
5. (3) 16 Using the formula for circumference of a circle, substitute the known terms: \(C = \pi d\), so \(d = \frac{C}{\pi} = \frac{50.24}{3.14}\). On your calculator, divide 50.24 by pi, 3.14. The result is 16 feet.
6. (5) Not enough information is given. Look at the formula for volume of a cylinder. You need the height of the cylinder to compute its volume.
7. (3) 122° Since angles 4 and 5 combine to form a line, their sum is 180°. Subtract to find the missing angle: 180° - 58° = 122°.
8. (4) 67° Remembering that complementary angles total 90°, subtract: 90° - 23° = 67°.
9. (3) 24 An equilateral triangle has sides of equal length, so 3 sides \(\times 8\) inches = 24 inches.
10. (1) \(r^2 = \frac{50.24}{3.14}\). If \(A = \pi r^2\), then \(r^2 = \frac{50.24}{3.14}\).
11. (4) 15 The path Ana’s team jogs is a right triangle. Because you are looking for the hypotenuse of this triangle, you can use the Pythagorean relationship: \(c^2 = a^2 + b^2\). Substitute and solve:
\(c^2 = 9^2 + 12^2 = 81 + 144 = 225\). To solve for \(c\), find the square root of 225: \(\sqrt{225} = 15\). However, notice that the measurements of this triangle can reduce to the common 3:4:5 ratio. Both legs have been multiplied by 3, so the missing hypotenuse must be 5 \times 3, or 15.
12. (3) 300 Set up a proportion and solve:
\[\frac{\text{post height}}{\text{building height}} = \frac{\text{building shadow}}{\text{shadow}}\]
\[\frac{4}{4m} = \frac{h}{60m}\]. Cross multiply: \(4(120) = 1.6h\). Divide: \(\frac{480}{1.6} = 300\).
13. (4) \(\angle PQT\) The sum of two supplementary angles is equal to 180°, or the measure of the degrees in a straight line. You know that points P, Q, and R lie on a straight line. \(\angle TQR\) forms one portion of the line. The angle that completes the line when combined with \(\angle TQR\) is \(\angle PQT\).
14. (3) 17² - 3² = 2² Use the Pythagorean relationship: \(c^2 = a^2 + b^2\). Substitute the known amounts, and isolate the unknown variable.
15. (2) 3.14 First use the formula for the circumference for a circle: \(C = \pi d\). Substitute and solve for the diameter: \(d = \frac{6.28}{3.14} = 2\). The radius of a circle is half its diameter: \(\frac{2}{2} = 1\). Now that you know the radius, you can solve for the area: \(A = \pi r^2 = 3.14(1)^2 = 3.14\) square meters.
16. (4) between 15 and 20 inches Estimate the circumference of the circle as 3 (pi rounded) times its diameter (twice the radius, or 3 inches \(\times 2 = 6\): 3 \times 6 = 18). This approximation falls between 15 and 20 inches.
17. (3) 78° Angles 1 and 5 have the same measure, given as 102°. Since angles 5 and 6 are supplementary angles, you can find the measure of \(\angle 6\) by subtracting from 180°: 180° - 102° = 78°.
18. (2) \(\angle Z\) Line Z is a transversal to the parallel lines X and Y. When a transversal crosses parallel lines, groups of corresponding and vertical angles are formed. Angles 1 and 5 are corresponding angles. Angle 7 is a vertical angle to \(\angle 5\), and \(\angle 7\) corresponds to \(\angle Z\). Thus, angles 1, 3, 5, and 7 all have equal measures, but only one of these appears among the answer choices: \(\angle Z\).
19. (5) 75 The question asks for an approximation, so round pi to 3 and use the area formula: \(A = \pi r^2 = 3(5)^2 = 3(25) = 75\).
20. **right** The sum of the interior angles of a triangle is 180°. You can find the missing angle by adding the known angles and subtracting from 180°: 33° + 57° = 90°, and 180° – 90° = 90°. The missing angle is a right angle; therefore, the triangle must be a right triangle.

21. **8** Sketch a picture of lines G and H and the perpendicular intersecting line A. Remember that line A will cross both lines G and H, by definition of a line. Eight angles are formed, all of which will be right angles, or 90-degree angles.

22. **Neither ∠Y nor ∠Z equals 36°.** In a scalene triangle, there are no equal angles (or equal sides). Since ∠X equals 36°, the other angles must have different measures.

23. **500** Use the formula for volume of a cylinder: \( V = \pi r^2 h \). Since you need an approximate answer, round \( \pi \) to 3. Substitute and solve: \( V = 3 \times 4^2 \times 10 = 3 \times 16 \times 10 = 480 \). You know the answer will be a bit more than 480, so your best choice is (4).

Alternate Math Formats, pages 189–190

24. **26** Divide 2600 by 1000, since 1000 m = 1 km.

25. **7** 18 in \( \times \) 6 = 108 in, but you need the amount in feet. Since 12 in = 1 ft, 108 in = 9 ft. Subtract to find the remaining amount: 16 ft – 9 ft = 7 ft.

26. **144** Find the missing distances. The total length of the diagram is \( 44 \) ft \((28 + 16)\), so the missing length at the bottom of the diagram must be \( 44 - 24 = 20 \) ft. The total width is \( 28 \) ft \((20 + 8)\), so the missing width at the top of the diagram must be \( 28 - 20 = 8 \) ft. Add all measurements:

\[
20 + 28 + 8 + 16 + 20 + 24 + 8 + 20 = 144 \text{ ft}
\]

27. **816** Break the space into three rectangles. The measurements are 20 by 16 ft, 20 by 20 ft, and 12 by 8 ft. You will need to use the other measurements on the diagram to calculate the length and width of the smallest rectangle. Find the area of each rectangle using the formula \( A = lw \):

\[
20 \times 16 = 320
\]

\[
20 \times 20 = 400
\]

\[
12 \times 8 = 96
\]

Then add the areas: 320 + 400 + 96 = 816 sq ft.

28. **156** Use the formula for finding simple interest: \( i = prt \). \( i = 650 \times 0.08 \times 3 = 156 \)

29. **50.2** Use the formula for finding the area of a circle: \( A = \pi r^2 \). The radius is 4 cm, which is half the diameter. \( A = 3.14 \times 4^2 = 3.14 \times 16 = 50.24 \). Round to the nearest tenth.

30. **12** Use the Pythagorean relationship: \( c^2 = a^2 + b^2 \).

\[
13^2 = 5^2 + b^2
\]

\[
169 = 25 + b^2
\]

\[
144 = b^2
\]

\[
12 = b
\]

31. **3.3** The sum of the interior angles of a triangle is always 180°. You know that one angle is a right angle measuring 90°. The measure of another angle is given as 67°. Solve for the missing angle:

\[
180 = 90 + 67 + x
\]

\[
180 = 157 + x
\]

\[
x = 23
\]

32. **42.3** Use the formula for finding the area of a square: \( A = s^2 \). \( s = 6\frac{1}{2} \times 6\frac{1}{2} = 42.25 \). Round to the nearest tenth.

33. **1296** Use the formula for finding the volume of a rectangular container: \( V = lwh \). \( V = 18 \times 6 \times 12 = 1296 \) cubic feet.

34. **95** The sum of supplementary angles is 180°. Subtract to find the unknown angle measurement: 180° – 85° = 95°.

35. **1140** Divide 3.42 by 3, then multiply by 1000 to convert your answer to milliliters.

**PROGRAM 36: DATA ANALYSIS, PART ONE**

**Skill Practice, page 197**

1. **a. True**
   - **b. False**
   - **c. True**
   - **d. False**

2. **New York** You can quickly see that only New York and Los Angeles increased by more than 3,000,000 from 1900 to 1990. Subtract to find the exact difference for each city.

3. **4.5** Use a calculator to divide New York’s population by Houston’s. You can also round to the hundred thousands place and estimate an answer. Houston’s population rounds to 2,600,000, and New York’s rounds to 7,300,000. Compare the numbers 16 and 73. The number 73 is about 4 1/2 times greater than 16.

4. **Memphis** This city’s population dropped by 6%. The next smallest change was Nashville’s, with an increase of 7%.

5. No The chart does not give you any information about the actual size of the population of the cities.

**Skill Practice, page 199**

1. **$1,125,000** Multiply 4 1/2 by $250,000.

2. **$1,875,000** The row for basketball players contains 7 1/2 symbols more than the row for football players. Multiply 7 1/2 by $250,000.

3. **a. False**
   - **b. False**
   - **c. True**
   - **d. True** Each symbol represents $250,000, so compare the number of symbols and see if the difference is less than 1:

\[
5\frac{1}{4} - 4\frac{1}{4} = 5\frac{1}{4} - 4\frac{2}{4} = \frac{3}{4} = 0.75
\]