LESSON 3 *Perimeter • Circumference*

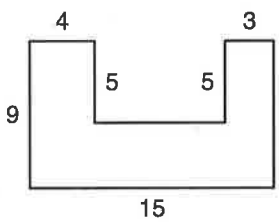
3.A

perimeter

The word **perimeter** comes from the Greek prefix *peri-*, which means "around," and the Greek word *metron*, which means "measure." Thus, perimeter means the measure around or the distance around.

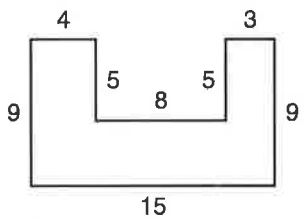
example 3.1

Find the perimeter of this figure. All angles are right angles. Dimensions are in inches.



solution

Several lengths are not given. Since all angles are right angles, we can determine the missing lengths. Since it is 15 inches across the bottom, it must be 15 inches across the top. The missing length on top is 8 inches because $4 + 3 + 8 = 15$. The height of the left-hand side is 9 inches, so the height of the right-hand side is 9 inches.



The perimeter is the distance around the figure, which equals the sum of the lengths of the straight sides of the figure.

$$\text{Perimeter} = (9 + 4 + 5 + 8 + 5 + 3 + 9 + 15) \text{ inches}$$

$$= \mathbf{58 \text{ inches}}$$

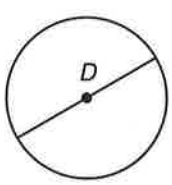
3.B

circumference

Every point on a circle is the same distance from the center of the circle. This distance is called the **radius** of the circle. The **diameter** of a circle is twice the length of the radius of the circle.



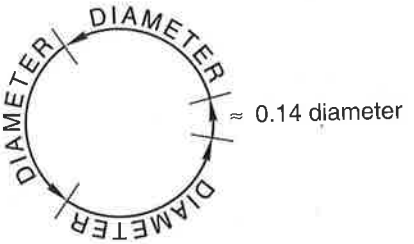
Radius



Diameter

We call the perimeter of a circle the **circumference** of the circle. Many ancients thought that the circle was the perfect geometric figure. They were especially interested in the relationship between the diameter of a circle and the circumference of the same circle. They

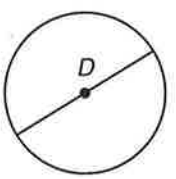
found that it takes approximately 3.14 diameters to go all the way around a circle no matter how small or how large the circle is. The symbol $\approx$ means "approximately equals."



Now we know the exact number of times the diameter will go around a circle. This exact number is a number we call *pi* (pronounced "pie"). We use the symbol π to represent this number. To write π as a decimal number would require an infinite number of digits because π is an **irrational number.** A calculator gives a decimal approximation of π as

3.141592654

In this book, we will use 3.14 as an approximation for π when doing calculations that involve the number π. It takes π diameters to equal the circumference of a circle, and it takes 2π radii to equal the circumference of a circle.



Circumference = πD



Circumference = $2\pi r$

Circumference of a circle = $\pi D = \pi(2r) = 2\pi r$

example 3.2 The radius of a circle is 3 centimeters. Find the circumference of the circle.

solution The formula for the circumference of a circle of radius r is given by

$$\text{Circumference} = 2\pi r$$

Substituting 3 cm for r, we get

$$\begin{aligned}\text{Circumference} &= 2\pi(3\text{ cm}) \\ &= 2(3.14)(3\text{ cm}) \\ &= \mathbf{18.84\text{ cm}}\end{aligned}$$

example 3.3 The circumference of a circle is 24 meters. Find the radius of the circle.

solution The formula for the circumference of a circle of radius r is given by

$$\text{Circumference} = 2\pi r$$

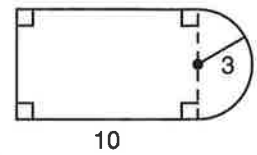
Substituting 24 m for circumference, we get

$$\begin{aligned}24\text{ m} &= 2\pi r \\ 24\text{ m} &= 2(3.14)r \\ 24\text{ m} &= 6.28r\end{aligned}$$

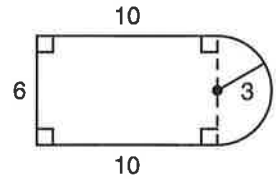
Solving for r, we get

$$r = \mathbf{3.82\text{ m}}$$

example 3.4 Find the perimeter of this figure. Dimensions are in inches.



solution We begin by finding the missing lengths of the straight sides.



The perimeter is the distance around the figure, which equals the sum of the lengths of the straight sides and the length of the semicircle (half of a circle).

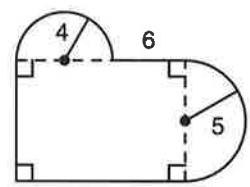
$$\text{Perimeter} = 10\text{ in.} + 6\text{ in.} + 10\text{ in.} + \frac{2\pi(3\text{ in.})}{2}$$

$$= 26\text{ in.} + \frac{2(3.14)(3\text{ in.})}{2}$$

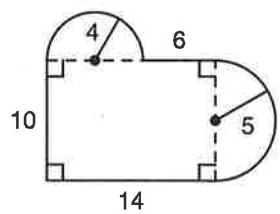
$$= 26\text{ in.} + 9.42\text{ in.}$$

$$= \mathbf{35.42\text{ in.}}$$

example 3.5 Find the perimeter of this figure. Dimensions are in feet.



solution We begin by finding the missing lengths of the straight sides.



The perimeter is the distance around the figure, which equals the sum of the lengths of the straight sides and the lengths of the two semicircles.

$$\text{Perimeter} = 14\text{ ft} + 10\text{ ft} + 6\text{ ft} + \frac{2\pi(4\text{ ft})}{2} + \frac{2\pi(5\text{ ft})}{2}$$

$$= 30\text{ ft} + \frac{2(3.14)(4\text{ ft})}{2} + \frac{2(3.14)(5\text{ ft})}{2}$$

$$= 30\text{ ft} + 12.56\text{ ft} + 15.7\text{ ft}$$

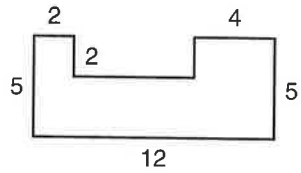
$$= \mathbf{58.26\text{ ft}}$$

practice

a. The length of a rectangle is 10 centimeters. The width of the rectangle is 5 centimeters. Find the perimeter of the rectangle.

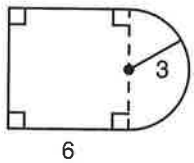
b. The perimeter of a square is 12 meters. What is the length of one side of the square?

c. Find the perimeter of this figure. All angles are right angles. Dimensions are in kilometers.



d. The radius of a circle is 5 inches. Find the circumference of the circle.

e. Find the perimeter of this figure. Dimensions are in feet.



problem set 3

1. (2) What is the sum of the measures of the three angles of any triangle?

2. (2) (a) What are the measures of the angles of an equiangular triangle?

(b) What are the measures of the angles of an equilateral triangle?

3. (2) If two sides of a triangle have equal lengths, then what is true about the angles opposite those sides?

4. (2) If two angles of a triangle have equal measures, then what is true about the sides opposite those angles?

5. (2) What is the name of the quadrilateral that has two pairs of parallel sides?

6. (2) What is the name of the quadrilateral that has exactly two parallel sides?

7. (3) The length of a rectangle is 12 inches. The width of the rectangle is 8 inches. Find the perimeter of the rectangle.

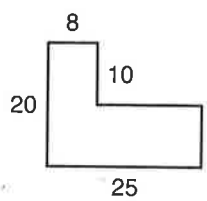
8. (3) The perimeter of a square is 16 feet. What is the length of one side of the square?

9. (3) The radius of a circle is 6 centimeters. Find the circumference of the circle.

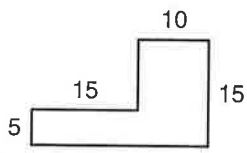
10. (3) The diameter of a circle is 8 meters. Find the circumference of the circle.

Find the perimeter of each figure. Corners that look square are square. Dimensions are in inches.

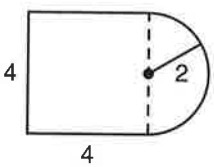
11. (3)



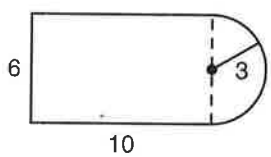
12. (3)



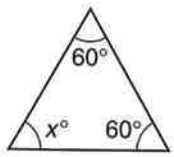
13. (3)



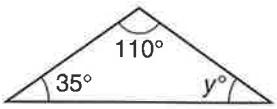
14. (3)



15. (2) Find x.



16. (2) Find y.



Add or subtract as indicated. Write answers as proper fractions reduced to lowest terms or as mixed numbers.

17. (1) $\frac{1}{2} + \frac{5}{18}$

18. (1) $\frac{11}{12} - \frac{3}{4}$

19. (1) $\frac{8}{15} + \frac{2}{3} - \frac{1}{5}$

20. (1) $5\frac{2}{3} + 1\frac{7}{12}$

21. (1) $7\frac{5}{6} + 4\frac{1}{18}$

22. (1) $6\frac{3}{5} + 14\frac{9}{10}$

23. (1) $4\frac{7}{8} + 3\frac{3}{16}$

24. (1) $5\frac{1}{8} + 8\frac{3}{7}$

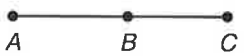
25. (1) $4\frac{3}{5} - 3\frac{4}{15}$

26. (1) $15\frac{2}{3} - 4\frac{5}{11}$

27. (1) $7\frac{5}{6} - 6\frac{11}{12}$

28. (1) $33\frac{5}{8} - 7\frac{11}{16}$

29. (1) The length of $\overline{AB}$ is $14\frac{1}{3}$ feet. The length of $\overline{BC}$ is $12\frac{2}{5}$ feet. Find AC.



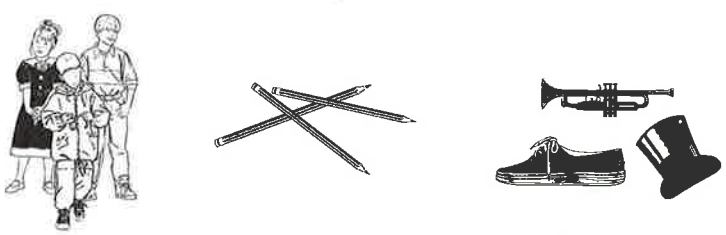
30. (1) DF is $7\frac{2}{3}$ yards. EF is $4\frac{1}{2}$ yards. Find DE.



LESSON 4 *Review of Arithmetic*

4.A numerals and numbers

A *number* is an idea. A *numeral* is a single symbol or a collection of symbols that we use to express the idea of a particular number.



The three drawings above all have the quality of *threeness*. The three children and the three pencils both bring to mind the idea of *three*. The drawing at the right also brings to mind the idea of *three*, although all the things in the drawing are not of the same kind.

If we wish to use a symbol to designate the idea of three, we could write any of the following:

$$\text{III}, \quad 3, \quad \frac{30}{10}, \quad \frac{27}{9}, \quad \frac{33}{11}, \quad 2 + 1, \quad 6 \div 2, \quad 11 - 8$$

Each of these is a symbolic representation of the idea of three. Throughout the book, when we use the word *number*, we are describing the idea. We will use numerals to designate the