Section 2.2: Perimeter and Area

**Perimeter** is the length of the boundary of a two dimensional figure.

The perimeter of a [circle](#) is called the **circumference**.

The perimeter of any two dimensional figure whose sides are straight lines can be found by adding up the length of each side.

**Example:** the perimeter of this rectangle is \(7 + 3 + 7 + 3 = 20\)

![Rectangle Perimeter Example](image)

**Example:** the perimeter of this regular [pentagon](#) is \(3 + 3 + 3 + 3 + 3 = 5 \times 3 = 15\)

![Regular Pentagon Perimeter Example](image)
There are formulas that can help us find the perimeter of a few standard shapes. However, if a two dimensional shape has a border that consists of only straight lines simply adding up the lengths of each side will be sufficient to find the perimeter. I will need to use a formula to find the perimeter (circumference) of a circle as its border is not made of straight lines.

**Perimeter Formulas**

**Triangle**
Perimeter = $a + b + c$

**Square**
Perimeter = $4 \times a$

$a$ = length of side

**Rectangle**
Perimeter = $2 \times (w + h)$
Or $2(\text{length} + \text{width})$

$w$ = width
$h$ = height

**Quadrilateral**
Perimeter = $a + b + c + d$

**Circle**
Circumference = $2\pi r$

$r$ = radius
**Example:** Use the appropriate formula to find the perimeter of the rectangle below.

I will use the formula: \( \text{Perimeter} = 2(\text{length} + \text{width}) \)

It is customary to call the longer side of a rectangle the length.

I will replace the length in the formula with 7 yards, and the width with 4 yards.

\[
\text{Perimeter} = 2(7 \text{ yards} + 4 \text{ yards}) \\
= 2(11 \text{ yards})
\]

Answer: Perimeter = 22 yards (The units in a perimeter problem are linear and do not have squares.)

**Example:** Find the circumference of the following circle.

I will use the formula: \( \text{Circumference} = 2\pi r \) (where \( r \) is the radius which is the distance from the center of the circle to the side)

The “” is short hand for inches. The unit of this problem are inches.

\[
\text{Circumference} = 2\pi(5”)
\]

Answer: Circumference = \( 10\pi” \) or \( 10\pi \) in
Homework #1-4: Find the circumference of each circle. Make sure to include the proper units in your answer. Leave your answer in terms of $\pi$.

1) $r = 14$ m

2) $r = 6$ cm

3) 16 cm

4) 3 yd
Homework #5-12: Find the perimeter.

5) Find the perimeter of the rectangle with sides 8 cm and 4 cm.

6) Find the perimeter of the rectangle with sides 10 cm and 4 cm.

7) Assume opposite sides have equal lengths.

8) Assume opposite sides have equal lengths.

9) Find the perimeter of the triangle with sides 156 feet, 156 feet, and 124 feet.

10) Find the perimeter of the triangle with sides 9 cm, 7 cm, and 12 cm.

11) Find the perimeter of the shape with sides 4 inches, 5 inches, 3 inches, and 8 inches.

12) Find the perimeter of the shape with sides 16 cm, 10 cm, 12 cm, and 20 cm.
**Area** is the amount of space a 2 dimensional object covers. Area is measured in square units.

**Example:** Find the area of a 4 by 9 rectangle.

One way to do this is to draw a diagram of a rectangle that is 4 by 9, and then divide the rectangle up into 1 by 1 squares as shown below.

The area of this 4 by 9 rectangle is simply the number of 1 by 1 squares that it takes to fill it up.

Answer: Area = 36 square units.
It is often impractical to find the area of a 2 dimensional shape by creating a drawing and then dividing the drawing into 1 by 1 squares. We often use formulas to find the area of 2 dimensional shapes. Here are some common area formulas.

<table>
<thead>
<tr>
<th>NAME</th>
<th>FIGURE</th>
<th>AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRAPEZOID</td>
<td><img src="image" alt="Trapezoid" /></td>
<td>$A = \frac{(B+b) \times h}{2}$</td>
</tr>
<tr>
<td>CIRCLE</td>
<td><img src="image" alt="Circle" /></td>
<td>$A = \pi r^2$</td>
</tr>
<tr>
<td>SQUARE</td>
<td><img src="image" alt="Square" /></td>
<td>$A = l^2$</td>
</tr>
<tr>
<td>RECTANGLE</td>
<td><img src="image" alt="Rectangle" /></td>
<td>$A = L \times w$</td>
</tr>
<tr>
<td>RHOMBUS</td>
<td><img src="image" alt="Rhombus" /></td>
<td>$A = b \times h$</td>
</tr>
<tr>
<td>PARALLELOGRAM</td>
<td><img src="image" alt="Parallelogram" /></td>
<td>$A = b \times h$</td>
</tr>
<tr>
<td>TRAINGLE</td>
<td><img src="image" alt="Triangle" /></td>
<td>$A = \frac{b \times h}{2}$</td>
</tr>
</tbody>
</table>
Example: Find the area of the following shape.

I need to identify the name of the shape. This is a trapezoid.

Area formula: $\text{Area} = \frac{(B+b)h}{2}$

$b$ is the length of the shorter of the parallel sides

$B$ is the longer of the lengths of the parallel sides.

$h$ is the distance between the parallel sides (The $h$ is often drawn as a dashed line.)

For our trapezoid: $B = 9$ ft, $b = 4$ ft, $h = 6$ ft

$\text{Area} = \frac{(9\, ft+4\, ft)(6\, ft)}{2}$

$\text{Area} = \frac{(13\, ft)(6\, ft)}{2}$

$\text{Area} = \frac{78\, \text{square feet}}{2}$

Answer: Area 39 square feet, or $39\, \text{ft}^2$
**Example:** Find the area of the following shape.

I need to identify the name of the shape. This is a parallelogram

Area formula: $\text{Area} = b \times h$

$b$ is length of one of the bases. (The bases are the sides that the height touches.)

$h$ is the distance between the bases.

In this problem $b = 8 \text{ cm}$ and $h = 4 \text{ cm}$

Area = $(8 \text{ cm})(4 \text{ cm})$

Answer: $\text{Area} = 32 \text{ cm}^2$
**Example:** Find the area of the circle. Leave your answer in terms of $\pi$.

I will use $\text{Area} = \pi r^2$

Area = $\pi (2 \text{ in})^2$

Answer: Area = 4$\pi$ square inches or 4$\pi$in$^2$

Homework: #13 – 24 Find the area of each figure. Use appropriate units.

13) Assume the lengths are in inches.

14)

15)

16)
17) Find “a”, then find the area of the triangle. Assume lengths are given in inches.

18) Find “a”, then find the area of the triangle. Assume lengths are given in inches.

19) Find “t”, then find the area of the triangle. Assume lengths are given in centimeters.

20) Find “b”, then find the area of the triangle. Assume lengths are given in centimeters.

21) Find “a”, then find the area of the rectangle. Assume lengths are given in centimeters.

22) Find “b”, then find the area of the rectangle. Assume lengths are given in centimeters.
31)

32)

33) Assume units are given in inches.

34)
The next group of problems involves finding the area of a shaded region.

**Example:** Find the area of the shaded region. Use 3.14 for \( \pi \) and round your answer to 2 decimals.

Step 1: Calculate the area of the shape as if the entire shape was shaded.

Area with entire figure shaded = \((16 \text{ in})(16 \text{ in}) = 256 \text{ square inches}\)

Step 2: Find the area of the unshaded region.

In this problem I will be finding the area of a circle is radius 8. I am going to use 3.14 for \( \pi \) and round my answer to 2 decimals.

Area of unshaded region = \((3.14)(8 \text{ in})^2 = 3.14(64 \text{ in}^2) = 200.96 \text{ square inches}\)

Step 3: Subtract the results.

Shaded area = 256 square inches \(-\) 200.96 square inches

Answer: 55.04 square inches
Homework #41-56: Find the area of the shaded region. Use appropriate units.

41) Use 3.14 for $\pi$

42)

43) Leave your answer in terms of $\pi$. Assume measurements are given in feet.

44) Leave your answer in terms of $\pi$

45) Use 3.14 for $\pi$. Assume measurements are given in meters.

46) Find the length of the diagonal “d”, then find the shaded area. Use 3.14 for $\pi$. Assume measurements are given in meters.
47) Find the length of the diagonal “d” rounded to 2 decimals. Use “d” to find the radius. Round the radius to 2 decimals. Then find the shaded area. Use 3.14 for π. Assume measurements are given in meters.

48) Find the length of the diagonal “d” rounded to 2 decimals. Use “d” to find the radius. Round the radius to 2 decimals. Then find the shaded area. Use 3.14 for π. Assume measurements are given in meters.

49) Assume units are in centimeters.

50) Assume units are in centimeters.

51) Assume units are in centimeters.

52)
53) Use 3.14 for \( \pi \). Assume lengths are given in centimeters. Round your answer to 2 decimals.

\[ \text{54) Use 3.14 for } \pi. \text{ Round your answer to 2 decimals.} \]

Answers: 1) \( 28\pi \text{ m} \) 3) \( 16\pi \text{ cm} \) 5) \( 24 \text{ cm} \) 7) \( 28 \text{ cm} \) 9) \( 436 \text{ ft} \) 11) \( 20 \text{ in} \) 13) \( 225 \text{ square inches} \) 15) \( 70 \text{ m}^2 \) 17) \( a = 7, \text{ area = 84 square inches} \) 19) \( t = 5, \text{ area = 30 cm}^2 \) 21) \( 30 \text{ cm}^2 \) 23) \( 63.86 \text{ cm}^2 \) 25) \( 109.18 \text{ square meters} \) 27) \( 130 \text{ cm}^2 \) 29) \( 18 \text{ m}^2 \) 31) \( 144 \text{ square centimeters} \) 33) \( 64 \text{ square inches} \) 35) \( 16\pi \text{ cm}^2 \) 37) \( 9\pi \text{ in}^2 \) 39) \( 64\pi \text{ cm}^2 \) 41) \( 165.76 \text{ cm}^2 \) 43) \( 75\pi \text{ ft}^2 \) 45) \( 29.5 \text{ m}^2 \) 47) \( d = 2.83 \text{ m}, \text{ } r = 1.42 \text{ m} \text{ area = 2.33 m}^2 \) (your answer will be different if you round different than the instructions) 49) \( 200 \text{ mm}^2 \) 51) \( 208 \text{ cm}^2 \) 53) \( 30.96 \text{ cm}^2 \)