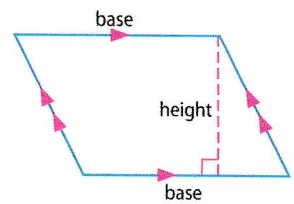
11-1 Areas of Parallelograms and Triangles

1 Areas of Parallelograms

In Lesson 6-2, you learned that a *parallelogram* is a quadrilateral with both pairs of opposite sides parallel. Any side of a parallelogram can be called the **base of a parallelogram**. The **height of a parallelogram** is the perpendicular distance between any two parallel bases.



You can use the following postulate to develop the formula for the area of a parallelogram.

Postulate 11.1 Area Addition Postulate

The area of a region is the sum of the areas of its nonoverlapping parts.

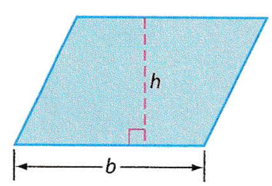
In the figures below, a right triangle is cut off from one side of a parallelogram and translated to the other side as shown to form a rectangle with the same base and height.

Recall from Lesson 1-6 that the area of a rectangle is the product of its base and height. By the Area Addition Postulate, a parallelogram with base b and height h has the same area as a rectangle with base b and height h.

KeyConcept Area of a Parallelogram

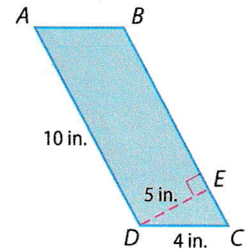
Words The area A of a parallelogram is the product of a base b and its corresponding height h.

Symbols $A = bh$



Example 1 Perimeter and Area of a Parallelogram

Find the perimeter and area of $\square ABCD$.



Perimeter

Since opposite sides of a parallelogram are congruent, $\overline{AB} \cong \overline{DC}$ and $\overline{BC} \cong \overline{AD}$. So $AB = 4$ inches and $BC = 10$ inches.

Perimeter of $\square ABCD = AB + BC + DC + AD$
$= 4 + 10 + 4 + 10$ or 28 in.

Area

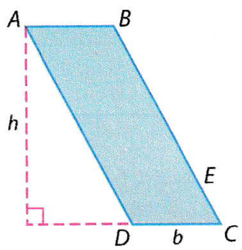
The height given, DE, is 5 inches. $\overline{BC}$ is the base, which measures 10 inches.

$A = bh$ — Area of a parallelogram

$= (10)(5)$ or 50 in^2 — $b = 10$ and $h = 5$

StudyTip

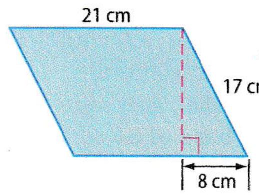
Heights of Figures The height of a figure can be measured by extending a base. In Example 1, the height of $\square ABCD$ that corresponds to base $\overline{DC}$ can be measured by extending $\overline{DC}$.



Guided Practice

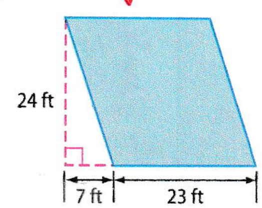
Find the ~~perimeter~~ and area of each parallelogram.

1A.



$A = bh$
$A = 21 \cdot 17$
$A = 357 \text{cm}^2$

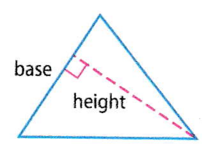
1B.



$A = bh$
$A = 23 \cdot 24$
$A = 552 \text{ft}^2$

2 Areas of Triangles

Like the base of a parallelogram, the **base of a triangle** can be any side. The **height of a triangle** is the length of an altitude drawn to a given base.

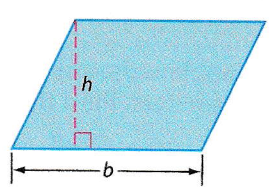


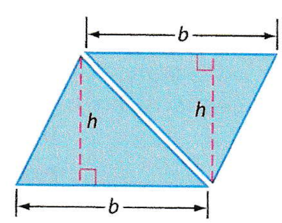
You can use the following postulate to develop the formula for the area of a triangle.

Postulate 11.2 Area Congruence Postulate

If two figures are congruent, then they have the same area.

In the figures below, a parallelogram is cut in half along a diagonal to form two congruent triangles with the same base and height.





By the Area Congruence Postulate, the two congruent triangles have the same area. So, one triangle with base b and height h has half the area of a parallelogram with base b and height h.

KeyConcept Area of a Triangle

Words The area A of a triangle is one half the product of a base b and its corresponding height h.

Symbols $A = \frac{1}{2}bh$ or $A = \frac{bh}{2}$