## Warm Up

**Find the unknown side length in each right triangle with legs *a* and *b* and hypotenuse *c*.**

**1.** $a = 20, b = 21$ $c = 29$

**2.** $b = 21, c = 35$ $a = 28$

**3.** $a = 20, c = 52$ $b = 48$

# Objectives

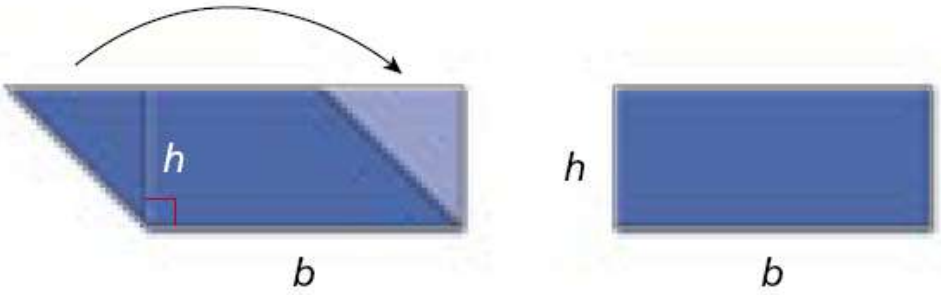
Develop and apply the formulas for the areas of triangles and special quadrilaterals.

Solve problems involving perimeters and areas of triangles and special quadrilaterals.

# 9-1 Developing Formulas for Triangles and Quadrilaterals

Recall that a rectangle with base $b$ and height $h$ has an area of $A = bh$.

You can use the Area Addition Postulate to see that a parallelogram has the same area as a rectangle with the same base and height.

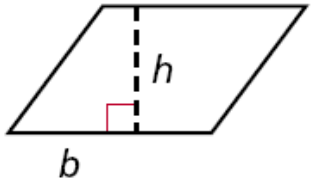



*A triangle is cut off one side and translated to the other side.*

# 9-1 Developing Formulas for Triangles and Quadrilaterals

**Area** **Parallelogram**

The area of a parallelogram with base $b$ and height $h$ is $A = bh$.




Remember that rectangles and squares are also parallelograms. The area of a square with side s is $A = s^2$, and the perimeter is $P = 4s$.

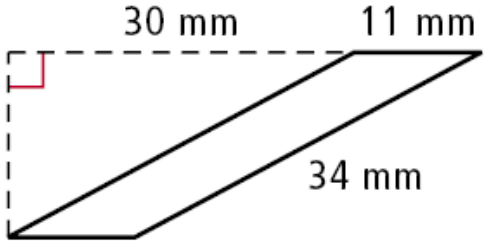
## Remember!

The height of a parallelogram is measured along a segment perpendicular to a line containing the base.

The perimeter of a rectangle with base $b$ and height $h$ is $P = 2b + 2h$ or $P = 2(b + h)$.

# Example 1A: Finding Measurements of Parallelograms

**Find the area of the parallelogram.**




**Step 1** Use the Pythagorean Theorem to find the height *h*.

$$30^2 + h^2 = 34^2$$
$$h = 16$$

**Step 2** Use *h* to find the area of the parallelogram.

$A = bh$ *Area of a parallelogram*

$A = 11(16)$ *Substitute 11 for b and 16 for h.*

$A = 176 \text{ mm}^2$ *Simplify.*

## Example 1B: Finding Measurements of Parallelograms

**Find the height of a rectangle in which $b = 3$ in. and $A = (6x^2 + 24x - 6)$ in$^2$.**

$A = bh$ *Area of a rectangle*

$6x^2 + 24x - 6 = 3h$ *Substitute $6x^2 + 24x - 6$ for A and 3 for b.*

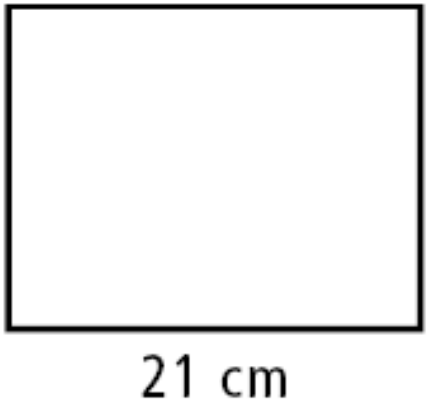
$3(2x^2 + 8x - 2) = 3h$ *Factor 3 out of the expression for A.*

$2x^2 + 8x - 2 = h$ *Divide both sides by 3.*

$h = (2x^2 + 8x - 2)$ in. *Sym. Prop. of =*

# Example 1C: Finding Measurements of Parallelograms

**Find the perimeter of the rectangle, in which $A = (79.8x^2 - 42)$ cm$^2$**




**Step 1** Use the area and the height to find the base.

$A = bh$ *Area of a rectangle*

$79.8x^2 - 42 = b(21)$ *Substitute $79.8x^2 - 42$ for A and 21 for h.*

$3.8x^2 - 2 = b$ *Divide both sides by 21.*

## Example 1C Continued

**Step 2** Use the base and the height to find the perimeter.

$P = 2b + 2h$ *Perimeter of a rectangle*

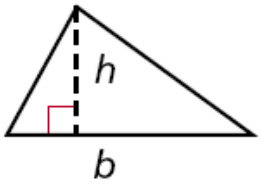
$P = 2(3.8x^2 - 2) + 2(21)$ *Substitute $3.8x^2 - 2$ for $b$ and 21 for $h$.*

$P = (7.6x^2 + 38)$ cm *Simplify.*

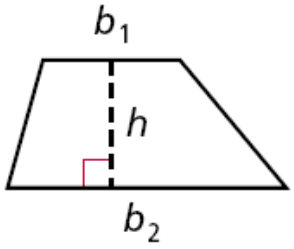
# 9-1 Developing Formulas for Triangles and Quadrilaterals

## Area Triangles and Trapezoids

The area of a triangle with base $b$ and height $h$ is $A = \frac{1}{2}bh$.




The area of a trapezoid with bases $b_1$ and $b_2$ and height $h$ is $A = \frac{1}{2}(b_1 + b_2)h$, or $A = \frac{(b_1 + b_2)h}{2}$.



# Example 2A: Finding Measurements of Triangles and Trapezoids

**Find the area of a trapezoid in which $b_1 = 8$ in., $b_2 = 5$ in., and $h = 6.2$ in.**

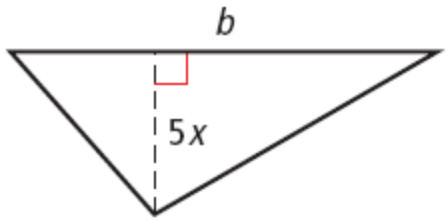
$$A = \frac{1}{2}(b_1 + b_2)h$$ *Area of a trapezoid*

$$A = \frac{1}{2}(8 + 5)(6.2)$$ *Substitute 8 for $b_1$, 5 for $b_2$, and 6.2 for h.*

$A = 40.3$ in$^2$ *Simplify.*

## Example 2B: Finding Measurements of Triangles and Trapezoids

**Find the base of the triangle, in which $A = (15x^2)$ cm².**




$A = \frac{1}{2}bh$ *Area of a triangle*

$15x^2 = \frac{1}{2}b(5x)$ *Substitute $15x^2$ for A and 5x for h.*

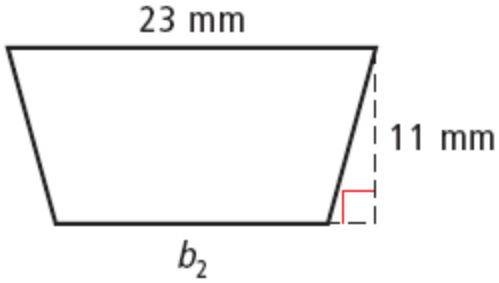
$15x = \frac{5}{2}b$ *Divide both sides by x.*

$6x = b$ *Multiply both sides by $\frac{2}{5}$.*

$b = 6x$ cm *Sym. Prop. of =*

## Example 2C: Finding Measurements of Triangles and Trapezoids

**Find $b_2$ of the trapezoid, in which $A = 231$ mm².**




$$A = \frac{1}{2}(b_1 + b_2)h$$ *Area of a trapezoid*

$$231 = \frac{1}{2}(23 + b_2)(11)$$ *Substitute 231 for A, 23 for $b_1$, and 11 for h.*

$42 = 23 + b_2$ *Multiply both sides by $\frac{2}{11}$.*

$19 = b_2$ *Subtract 23 from both sides.*

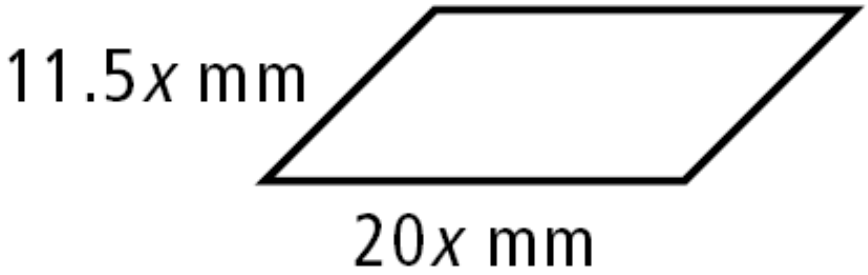
$b_2 = 19$ mm *Sym. Prop. of =*

## Lesson Quiz: Part I

**Find each measurement.**

**1.** the height of the parallelogram, in which $A = 182x^2$ mm$^2$

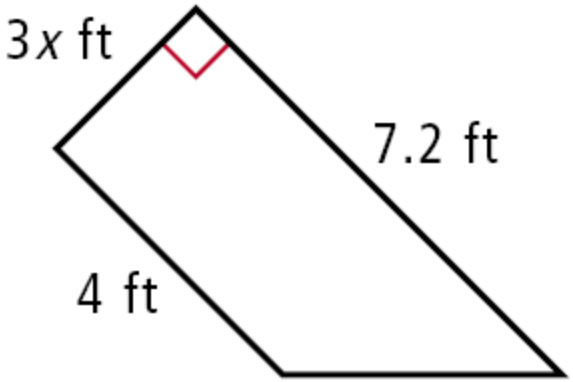
$h = 9.1x$ mm




**2.** the perimeter of a rectangle in which $h = 8$ in. and $A = 28x$ in$^2$

$P = (16 + 7x)$ in.

## Lesson Quiz: Part II




**3.** the area of the trapezoid

$A = 16.8x$ ft$^2$

**4.** the base of a triangle in which $h = 8$ cm and $A = (12x + 8)$ cm$^2$

$b = (3x + 2)$ cm