

Warm Up

Lesson Presentation

Lesson Quiz

Holt McDougal Geometry

Warm Up

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

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

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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. A tangram is an ancient Chinese puzzle made from a square. The pieces can be rearranged to form many different shapes. The area of a figure made with all the pieces is the sum of the areas of the pieces.

Postulate 9-1-1 (Area Addition Postulate

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

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.

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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.



Remember!

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

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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
- $A = 11(16) \qquad Substitute 11 for b and 16 for h.$
- $A = 176 \text{ mm}^2$ Simplify.

Example 1B: Finding Measurements of Parallelograms

Find the height of a rectangle in which b = 3 in. and $A = (6x^2 + 24x - 6)$ in².

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 $A = (79.8x^2 - 42)$ cm²

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

A = bh Area of a rectangle



21 cm

 $79.8x^2 - 42 = b(21)$ 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.

 $P = (7.6x^2 + 38) \text{ cm}$ Simplify.



Check It Out! Example 1

Find the base of the parallelogram in which h = 56 yd and A = 28 yd².

- A = bh Area of a parallelogram
- $28 = b(56) \qquad Substitute.$
- 56 56 *Simplify*.

 $b = 0.5 \, \text{yd}$

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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.

$$A = \frac{1}{2}(b_{1} + b_{2})h \quad Area \ of \ a \ trapezoid$$
$$A = \frac{1}{2}(8+5)(6.2) \quad Substitute \ 8 \ for \ b_{1}, \ 5 \ for \ b_{2}, \\and \ 6.2 \ for \ h.$$

A = 40.3 in² Simplify.

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Example 2B: Finding Measurements of Triangles and Trapezoids Find the base of the triangle, in which $A = (15x^2) \text{ cm}^2$.

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

Area of a triangle



 $15x^2 = \frac{1}{2}b(5x)$

Substitute 15x² for A and 5x for h.

 $15x = \frac{5}{2}b$

6x = b

Divide both sides by x.

Multiply both sides by $\frac{2}{5}$.

b = 6x cm

Sym. Prop. of =



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Check It Out! Example 2

Find the area of the triangle.

Find *b*. $b^2 + 12^2 = 20^2$ $b^2 + 144 = 400$ $b^2 = 256$ b = 16



 $A = \frac{1}{2}bh$ $A = \frac{1}{2}(16)(12)$

Area of a triangle

Substitute 16 for b and 12 for h.

 $A = 96 \text{ m}^2$ Simplify.

Remember!

The diagonals of a rhombus or kite are perpendicular, and the diagonals of a rhombus bisect each other.



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Example 3A: Finding Measurements of Rhombuses and Kites

Find d_2 of a kite in which $d_1 = 14$ in. and A = 238 in².

 $A = \frac{1}{2}d_{1}d_{2}$ Area of a kite $238 = \frac{1}{2}(14)d_{2}$ Substitute 238 for A and 14 for d_{1} . $34 = d_{2}$ Solve for d_{2} . $d_{2} = 34$ Sym. Prop. of =

Example 3B: Finding Measurements of Rhombuses and Kites

Find the area of a rhombus.

$$A = \frac{1}{2}d_1d_2$$
 Area of a rhombus

$$A = \frac{1}{2} (8x + 7) (14x - 6)$$

Substitute (8x+7) for d_1 and (14x-6) for d_2 .

 $d_2 = (14x - 6)$ cm

$$A = \frac{1}{2} \left(112x^2 + 50x - 42 \right)$$

Multiply the binomials (FOIL).

$$A = (56x^2 + 25x - 21) \text{ cm}^2 \quad Distrib. Prop.$$

Example 3C: Finding Measurements of Rhombuses and Kites

Find the area of the kite

Step 1 The diagonals d_1 and d_2 form four right triangles. Use the Pythagorean Theorem to find x and y.



35 in.

$$28^{2} + y^{2} = 35^{2} \qquad 21^{2} + x^{2} = 29^{2}$$
$$y^{2} = 441 \qquad x^{2} = 400$$
$$y = 21 \qquad x = 20$$

Example 3C Continued

Step 2 Use d_1 and d_2 to find the area. d_1 is equal to x + 28, which is 48. Half of d_2 is equal to 21, so d_2 is equal to 42.

 $A = \frac{1}{2}d_{1}d_{2}$ Area of kite $A = \frac{1}{2}(48)(42)$ Substitute 48 for d_{1} and 42 for d_{2} .

 $A = 1008 \text{ in}^2 \qquad Simplify.$

Check It Out! Example 3

Find d_2 of a rhombus in which $d_1 = 3x$ m and A = 12xy m².



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Example 4: Games Application

The tile design shown is a rectangle with a base of 4 in. and a height of 2 in. Use the grid to find the perimeter and area of the leftmost shaded parallelogram.

Perimeter:

Two sides of the parallelogram are vertical and the other two sides are diagonals of a square



of the grid. Each grid square has a side length of 1 in., so the diagonal is $\sqrt{2}$ in.) perimeter of the leftmost shaded parallelogram is P = 2(1)+2() = $(2\sqrt{2} 2)$) in. $\sqrt{2}$

Example 4 Continued

The tile design shown is a rectangle with a base of 4 in. and a height of 2 in. Use the grid to find the perimeter and area of the leftmost shaded parallelogram.

Area:

The base and height of the leftmost shaded parallelogram each measure 1 in., so the area is A = bh = (1)(1) = 1 in².





Check It Out! Example 4

In the tangram, find the perimeter and area of the large green triangle. Each grid square has a side length of 1 cm.

The perimeter is $P = (4 + 4\sqrt{2})$ cm.

The area is A = 4 cm².



Lesson Quiz: Part I

Find each measurement.

- **1.** the height of the parallelogram, in which $A = 182x^2 \text{ mm}^2$
 - h = 9.1x mm 1



20*x* mm

2. the perimeter of a rectangle in which h = 8 in. and A = 28x in²

P = (16 + 7x) in.

Lesson Quiz: Part II

3. the area of the trapezoid $A = 16.8x \text{ ft}^2$

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

b = (3x + 2) cm

5. the area of the rhombus $A = 1080 \text{ m}^2$







Lesson Quiz: Part III

6. The wallpaper pattern shown is a rectangle with a base of 4 in. and a height of 3 in. Use the grid to find the area of the shaded kite.

 $A = 3 in^{2}$

