

Name _____

Adv Geo – _____

**9.4: The Pythagorean Theorem,
Geometry's Most Elegant Theorem**

Date _____

Ms. Kresovic

Objective: After studying this section, you will be able to apply the Pythagorean Theorem and its converse.

Prior knowledge:

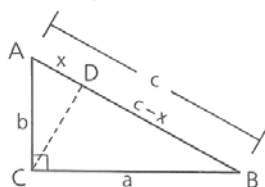
- Triangle Inequality Theorem (chapter 1): The third side of a triangle must be
 - Smaller than the sum of the other two sides, and
 - Larger than the difference.
- Used the Pythagorean Theorem before.

Theorem 69 *The square of the measure of the hypotenuse of a right triangle is equal to the sum of the squares of the measures of the legs. (Pythagorean Theorem)*

Given: $\triangle ACB$ is a right \triangle
with right $\angle ACB$.

Prove: $a^2 + b^2 = c^2$

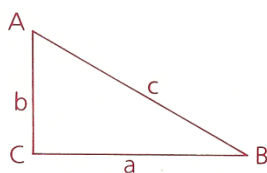
Proof:



1 $\angle ACB$ is a right \angle .	1 Given
2 Draw $\overline{CD} \perp$ to \overline{AB} .	2 From a point outside a line, only one \perp can be drawn to the line.
3 \overline{CD} is an altitude.	3 A segment drawn from a vertex of a $\triangle \perp$ to the opposite side is an altitude.
4 $a^2 = (c - x)c$	4 In a right \triangle with an altitude drawn to the hypotenuse, $(\text{leg})^2 = (\text{adjacent seg.}) (\text{hypot.})$.
5 $a^2 = c^2 - cx$	5 Distributive Property
6 $b^2 = xc$	6 Same as 4
7 $a^2 + b^2 = c^2 - cx + cx$	7 Addition Property
8 $a^2 + b^2 = c^2$	8 Algebra

Theorem 70 *If the square of the measure of one side of a triangle equals the sum of the squares of the measures of the other two sides, then the angle opposite the longest side is a right angle.*

If $a^2 + b^2 = c^2$,
then $\triangle ACB$ is a right \triangle
and $\angle C$ is the right \angle .



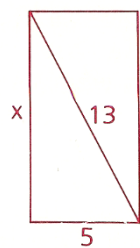
If, in the diagram above, we increased c while keeping a and b the same, $\angle C$ would become larger. Try it. Thus, a valuable extension of Theorem 70 can be stated:

If c is the length of the longest side of a triangle, and

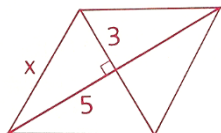
- $a^2 + b^2 > c^2$, then the triangle is acute
- $a^2 + b^2 = c^2$, then the triangle is right
- $a^2 + b^2 < c^2$, then the triangle is obtuse

Class Examples

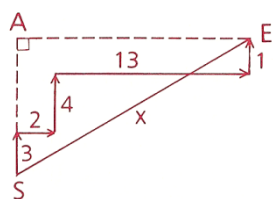
Problem 2 Find the perimeter of the rectangle shown.



Problem 3 Find the perimeter of a rhombus with diagonals of 6 and 10.

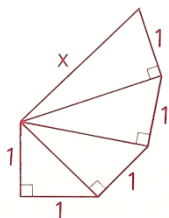


Problem 4 Nadia skipped 3 m north, 2 m east, 4 m north, 13 m east, and 1 m north. How far is Nadia from where she started?



Problem 5 Find the altitude of an isosceles trapezoid whose sides have lengths of 10, 30, 10, and 20.

Problem 7 Solve for x in the partial spiral.

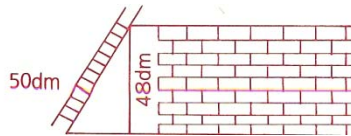


2 Find the length of the diagonal of a square with perimeter 12 cm.

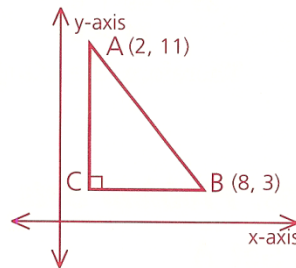
- 4 Find the perimeter of a rectangle whose diagonal is 17 mm long and whose base is 15 mm long.

- 6 \overline{PM} is an altitude of equilateral triangle PKO. If $PK = 4$, find PM.

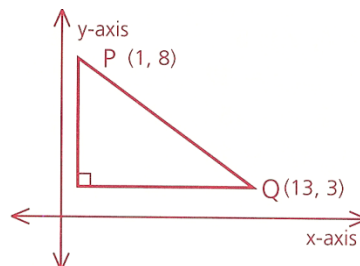
- 8 How far is the foot of the ladder from the wall?



- 9 $\overline{AC} \parallel y\text{-axis}$ and $\overline{CB} \parallel x\text{-axis}$.
- Find the coordinates of C.
 - Find AC and CB.
 - Find AB.
 - Is $AB = \sqrt{(8 - 2)^2 + (11 - 3)^2}$?



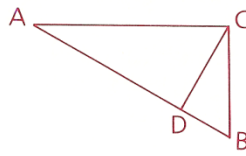
- 10 Use the method suggested by part d of problem 9 to find PQ.



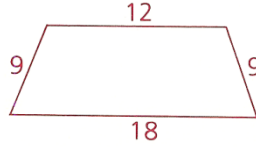
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12 $\angle ACB$ is a right angle and $\overline{CD} \perp \overline{AB}$.

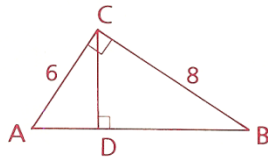
- a If $AD = 7$ and $BD = 4$, find CD .
- b If $CD = 8$ and $DB = 6$, find CB .
- c If $BC = 8$ and $BD = 2$, find AB .
- d If $AC = 21$ and $AB = 29$, find CB .



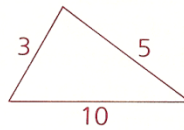
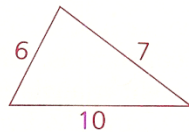
14 Find the altitude (length of a segment perpendicular to both bases) of the isosceles trapezoid shown.



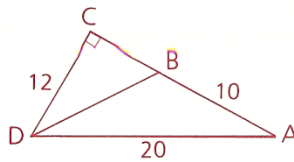
16 Given: Diagram as shown
Find: CD



22 Classify the triangles.



24 Find the perimeter of $\triangle DBC$.

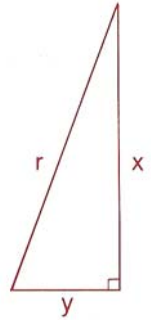


26 The perimeter of an isosceles triangle is 32, and the length of the altitude to its base is 8. Find the length of a leg.

Homework

1. Solve for the third side. Let x & y be the legs of a right triangle, and r be the hypotenuse.

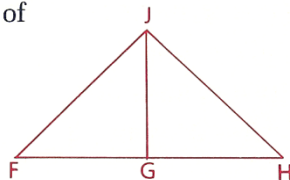
	x	y	r	work
a.	4	5		
b.	15		17	
c.		9	15	
d.	12		13	
e.	5	$5\sqrt{3}$		
f.	5		$\sqrt{29}$	
g.	$2\sqrt{5}$		$\sqrt{38}$	



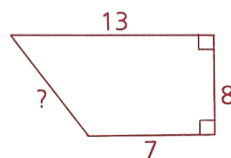
3 Find the perimeter of a rhombus with diagonals 12 km and 16 km.

5 Given: \overline{JG} is the altitude to base \overline{FH} of isosceles triangle JFH .
 $FJ = 15$, $FH = 24$

Find: JG



7 Find the missing length in the trapezoid.



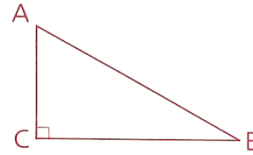
- 11** Find the missing length in terms of the variable(s) provided.

a $AC = x$, $BC = y$, $AB = \underline{\hspace{1cm}}?$

b $AC = 2$, $BC = x$, $AB = \underline{\hspace{1cm}}?$

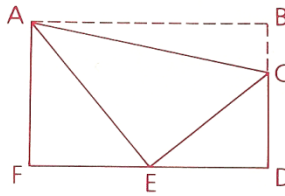
c $AC = 3a$, $BC = 4a$, $AB = \underline{\hspace{1cm}}?$

d $AB = 13c$, $AC = 5c$, $BC = \underline{\hspace{1cm}}?$

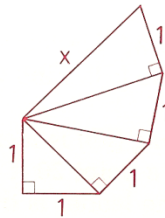


- 13** Al Capone walked 2 km north, 6 km west, 4 km north, and 2 km west. If Big Al decides to “go straight,” how far must he walk across the fields to his starting point?

- 15** A piece broke off rectangle $ABDF$, leaving trapezoid $ACDF$. If $BD = 16$, $BC = 7$, $FD = 24$, and E is the midpoint of \overline{FD} , what is the perimeter of $\triangle ACE$?



- 17** Solve for x in the partial spiral to the right.



- 19** Woody Woodpecker pecked at a 17-m wooden pole until it cracked and the upper part fell, with the top hitting the ground 10 m from the foot of the pole. Since the upper part had not completely broken off, Woody pecked away where the pole had cracked. How far was Woody above the ground?

- 21** The lengths of the diagonals of a rhombus are in the ratio 2:1. If the perimeter of the rhombus is 20, find the sum of the lengths of the diagonals.

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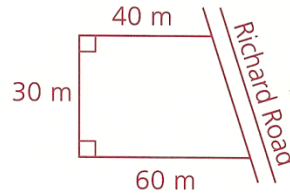
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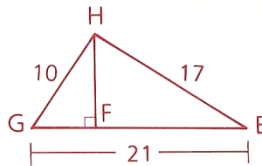
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- 23** George and Diane bought a plot of land along Richard Road with the dimensions shown.

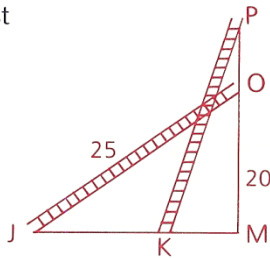
- a** Find the area of the plot.
b Find, to the nearest meter, the length of frontage on Richard Road.



- 25 a** Find HF.
b Is $\triangle EHF$ similar to $\triangle HGF$?



- 27** A ladder 25 ft long (JO) is leaning against a wall, reaching a point 20 ft above the ground (MO). The ladder is then moved so that $JK = 2(PO)$. Find KM.



- 31** Quadrilateral QUAD has vertices at $Q = (-7, 1)$, $U = (1, 16)$, $A = (9, 10)$, and $D = (1, -5)$.

- a** Plot the figure and indicate what type of quadrilateral QUAD is.
b Find the perimeter of QUAD.

(Hint: Use the properties of quadrilaterals that you learned in chapter 5.)