Program Information	[Lesson Title]	TEACHER NAME	PROGRAM NAME
	[Lesson Title] ***Pythagorean Theorem***	**TEACHER NAME** **Kathleen McDonnell**	**PROGRAM NAME** **Parma City School District**
	[Unit Title] ***Geometry***	**NRS EFL(s)** **3 – 4**	**TIME FRAME** **120 minutes**

Instruction

ABE/ASE Standards – Mathematics

Numbers (N)		Algebra (A)		Geometry (G)		Data (D)	
Numbers and Operation		Operations and Algebraic Thinking		Geometric Shapes and Figures		Measurement and Data	
The Number System		Expressions and Equations	**A.3.16** **A.4.5**	Congruence		Statistics and Probability	
Ratios and Proportional Relationships		Functions		Similarity, Right Triangles. And Trigonometry	**G.4.8** **G.4.9**	Benchmarks identified in RED are priority benchmarks. To view a complete list of priority benchmarks and related Ohio ABLE lesson plans, please see the Curriculum Alignments located on the Teacher Resource Center (TRC).	
Number and Quantity				Geometric Measurement and Dimensions			
				Modeling with Geometry			

Mathematical Practices (MP)

X	Make sense of problems and persevere in solving them. (MP.1)	☐	Use appropriate tools strategically. (MP.5)
X	Reason abstractly and quantitatively. (MP.2)	X	Attend to precision. (MP.6)
☐	Construct viable arguments and critique the reasoning of others.	☐	Look for and make use of structure. (MP.7)

	(MP.3)		
X	Model with mathematics. (MP.4)	☐	Look for and express regularity in repeated reasoning. (MP.8)

LEARNER OUTCOME(S)

- Students will identify parts of a right triangle.
- Students will calculate (find) the missing side of a right triangle by applying the Pythagorean Theorem.
- Students will apply the Pythagorean Theorem to finding the length of a line on the coordinate graph.

ASSESSMENT TOOLS/METHODS

- Formative: Walk around the room checking in with students to see if they are solving problems correctly.
- Ask the students what part of the right triangle they are trying to find. Ask them for the steps to find the correct part.
- Complete practice problems (worksheets) in class. Compare answers with a teacher prepared answer guide.
- Summative: Students will complete a worksheet with word problems and diagrams with 80% accuracy.
- Exit Ticket.

LEARNER PRIOR KNOWLEDGE:

- Students can calculate squares and square roots using the TI 30 XS calculator.
- Students can identify right triangles using perpendicular lines, 90^o or the box mark in a triangle.

INSTRUCTIONAL ACTIVITIES

1. Teacher will provide the students with student copies of *Pythagorean Theorem graph* (attached).
   a. Teacher will explain how the squares (blocks) represent 3^2 and 4^2.
   b. Students will add the 3^2 and 4^2 and find the square root of the total.
   c. Teacher will name the parts of the right triangle (legs and hypotenuse).
   d. Students will cut out the 5x5 square on the graph paper. Place the square on the hypotenuse of the

RESOURCES

Student copies of *Pythagorean Theorem graph* (attached)

Scissors for student use

TI 30-XS calculators for student use

Student copies of blank *graph paper* (attached)

Projector, overhead projector, ability to project

	triangle. Notice that it is 5 blocks long. 2. Teacher will direct the students to draw a 6 block by 8 block triangle in the middle of the student copies of blank graph paper (attached). a. Teacher will demonstrate how to make 6x6 and 8x8 squares. (use a transparency or opaque projector). b. Teacher will ask for the number of blocks in each square. Add them and take the square root of the total. c. Students will draw a 10x10 square on the graph paper and cut it out. d. Students will compare the square to the hypotenuse of the 6x8 triangle. e. Teacher will explain the Pythagorean Theorem using two formulas: i. $leg^2 + leg^2 = hypotenuse^2$ ii. $a^2 + b^2 = c^2$. 3. Teacher will demonstrate solving problems looking for the leg or the hypotenuse. Emphasize that the hypotenuse is the longest leg, so the squares are added. Legs are shorter, so the squares are subtracted. 4. Students will complete sample problems by supplying information to the teacher. a. For example, given the legs of 5 and 12 calculate the hypotenuse. b. Given the hypotenuse of 25 cm and a leg of 15 cm, calculate the missing leg. 5. Students will complete several worksheets: a. Students may work in pairs or small groups (Answer guides are available so that the students can check their own work.) b. Student copies of *Finding the Length of the Third*	Student copies of *Finding the Length of the Third Side* worksheet (attached) Student copies of *Finding the Length of the Hypotenuse* worksheet (attached) Student copies of *Four Pythagorean Theorem Word Problems* (attached) Student copies of *Summative Activity: Pythagorean Theorem Word Problems* (attached) *Common core basics: Building essential test readiness skills* (Mathematics). (2015). Columbus, OH: McGraw-Hill Education. Student copies of *Finding Distance Between Points* worksheet (attached) **Additional resources** Printable Tangrams (attached)

Side worksheet (attached)

    c. Student copies of *Finding the Length of the Hypotenuse* worksheet (attached)
    d. Student copies of *Four Pythagorean Theorem Word Problems* (attached)

6. Students will complete student copies of *Summative Activity: Pythagorean Theorem Word Problems* (attached). Students will submit the worksheet with word problems for teacher to correct.

7. Teacher will direct the students' attention to Lesson 12.5 Pythagorean Theorem in Common core basics: Building essential test readiness skills (Mathematics).
    a. Teacher and students will work problems 7, 8, and 9 on pgs. 357 – 358 together.
    b. Teacher will practice with students finding lengths of line segments or the distance between two points on the coordinate plane.
    c. Students will solve problems 7, 8, 9, 10, 11, and 12 on pgs. 358 – 359 and turn in their word as their Exit Ticket.

8. For additional practice on finding the distance between two points, provide student copies of *Finding Distance Between Points* worksheet (attached)

	DIFFERENTIATION • Demonstrate solving for the hypotenuse or for a leg using explicit instruction. • Assist students who are having difficulty with the TI 30 XS calculator. • Encourage students to draw diagrams or pictures for word problems and/or to write measurements on the printed diagrams. Assist students in matching lengths to the diagrams in order to solve the problems. • Encourage students to assist each other in solving the problems. Students can be paired with a higher level and lower level student working together. (Some classes are very small and spontaneously form small groups.) • Students who complete the assignments quickly can be given two sets of tan-grams to see if they can create a demonstration of the Pythagorean Theorem with the tan-gram pieces.
Reflection	**TEACHER REFLECTION/LESSON EVALUATION** Students like the “hands-on” experience in discovering the Pythagorean Theorem. This theorem provides practice with the TI 30 XS calculatorl
	ADDITIONAL INFORMATION

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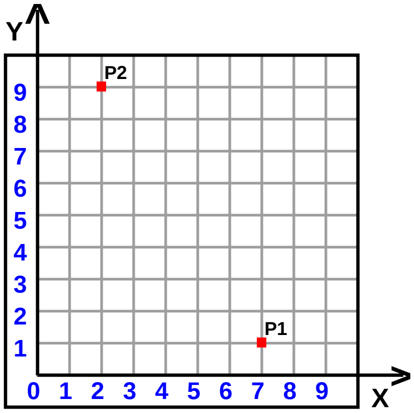
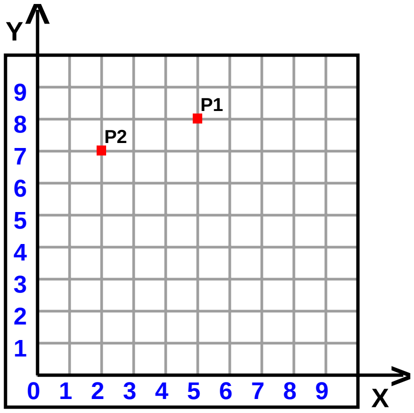
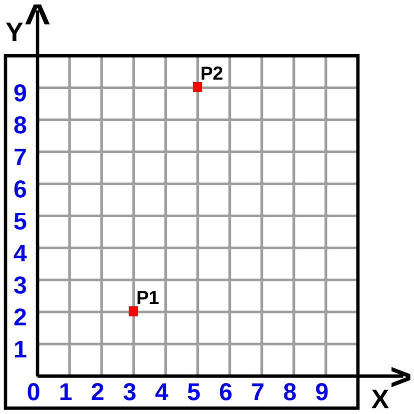
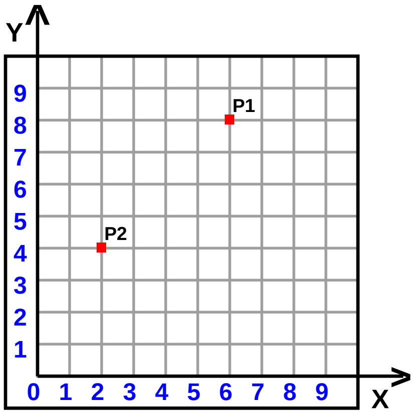
Teacher : ______________________ Date : ___________

Find the distance between the points.









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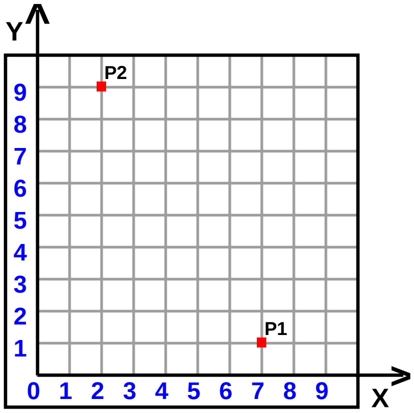
Teacher : ____________________ Date : __________

Find the distance between the points.



$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ = distance

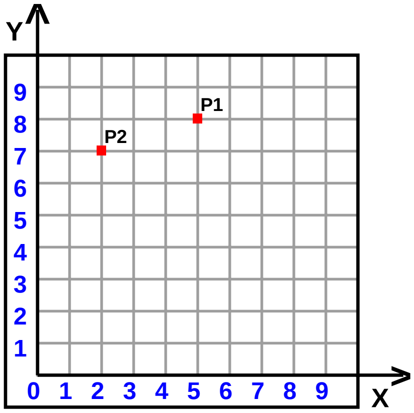
$\sqrt{(2 - 7)^2 + (9 - 1)^2}$ = distance

$\sqrt{-5^2 + 8^2}$ = distance

$\sqrt{25 + 64}$ = distance

$\sqrt{89}$ = distance

9.434 ≈ distance



$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ = distance

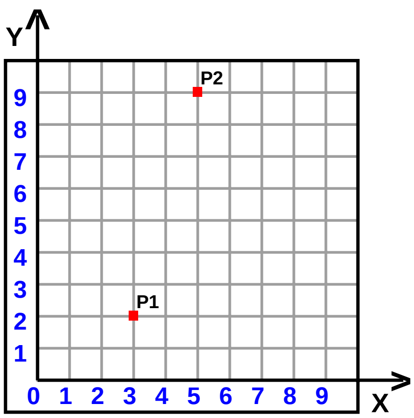
$\sqrt{(2 - 5)^2 + (7 - 8)^2}$ = distance

$\sqrt{-3^2 + -1^2}$ = distance

$\sqrt{9 + 1}$ = distance

$\sqrt{10}$ = distance

3.1623 ≈ distance



$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ = distance

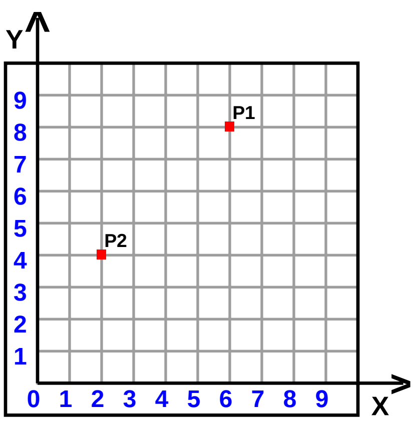
$\sqrt{(5 - 3)^2 + (9 - 2)^2}$ = distance

$\sqrt{2^2 + 7^2}$ = distance

$\sqrt{4 + 49}$ = distance

$\sqrt{53}$ = distance

7.2801 ≈ distance



$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ = distance

$\sqrt{(2 - 6)^2 + (4 - 8)^2}$ = distance

$\sqrt{-4^2 + -4^2}$ = distance

$\sqrt{16 + 16}$ = distance

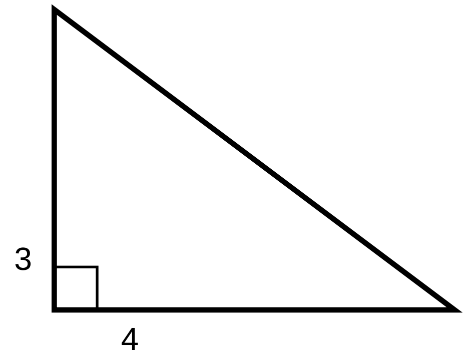
$\sqrt{32}$ = distance

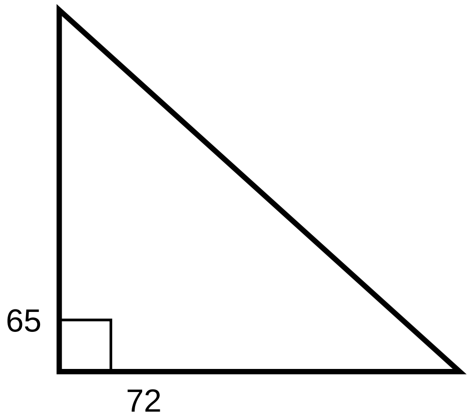
5.6569 ≈ distance

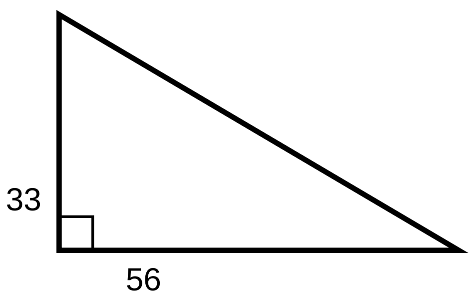
Name : ______________________ Score : ____________

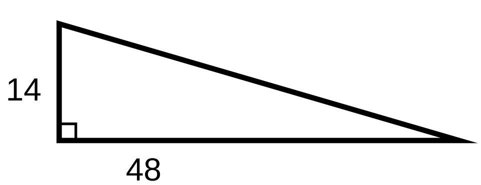
Teacher : ______________________ Date : ____________

Find the length of the third side of each triangle.









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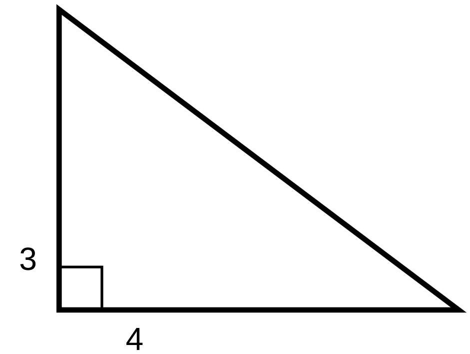
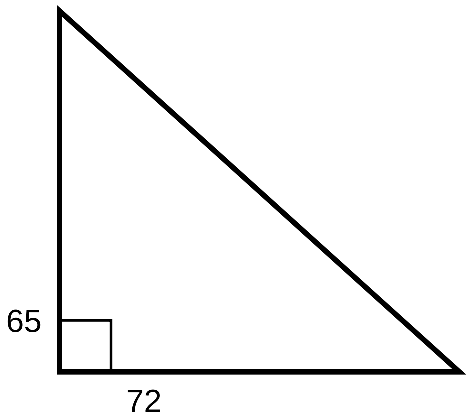
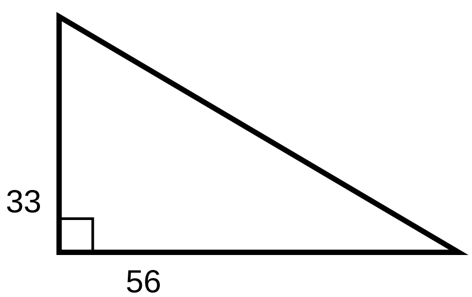
Find the length of the third side of each triangle.



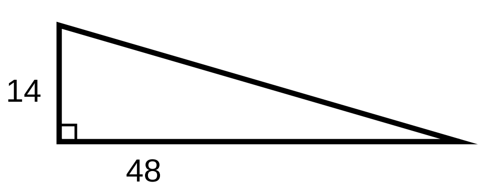
$$3^2 + 4^2 = c^2$$
$$9 + 16 = c^2$$
$$25 = c^2$$
$$\sqrt{25} = c$$
$$5 = c$$



$$65^2 + 72^2 = c^2$$
$$4225 + 5184 = c^2$$
$$9409 = c^2$$
$$\sqrt{9409} = c$$
$$97 = c$$



$$33^2 + 56^2 = c^2$$
$$1089 + 3136 = c^2$$
$$4225 = c^2$$
$$\sqrt{4225} = c$$
$$65 = c$$



$$14^2 + 48^2 = c^2$$
$$196 + 2304 = c^2$$
$$2500 = c^2$$
$$\sqrt{2500} = c$$
$$50 = c$$

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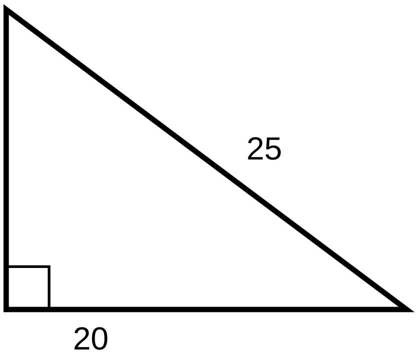
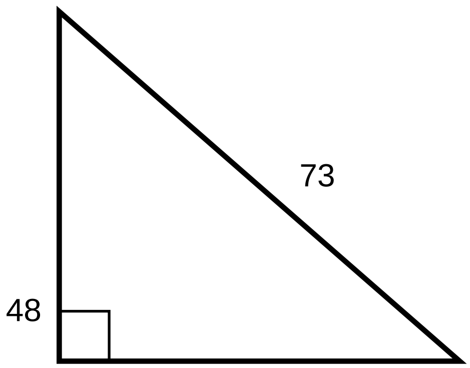
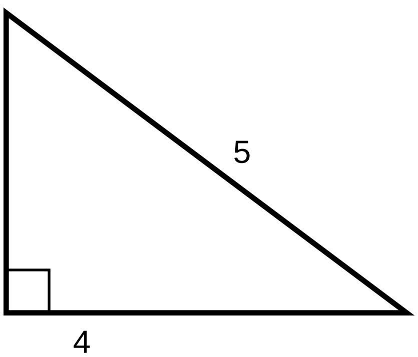
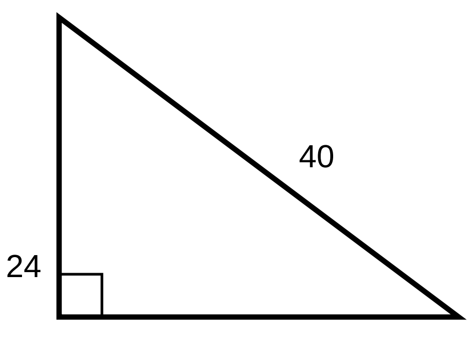
Teacher : ______________________ Date : __________

Find the length of the third side of each triangle.









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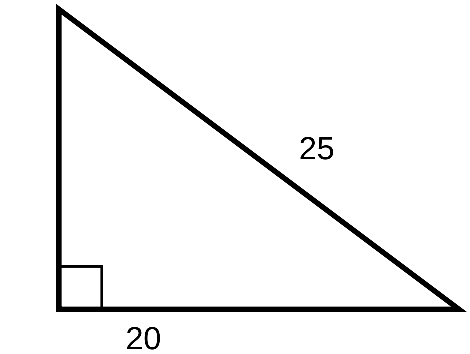
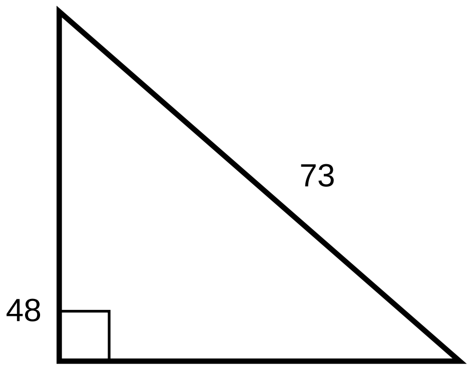
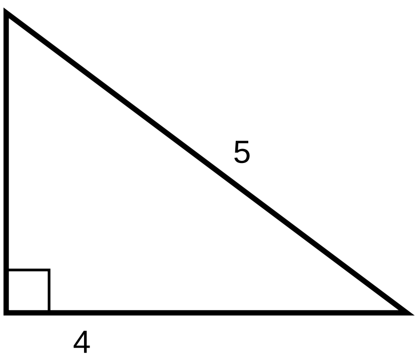
Find the length of the third side of each triangle.



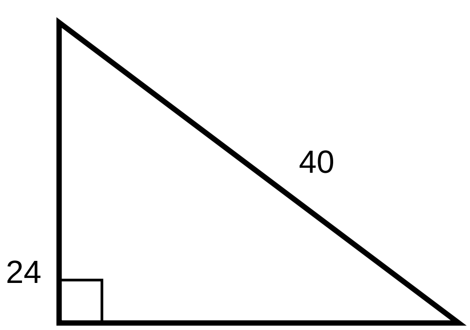
$$a^2 + 20^2 = 25^2$$
$$a^2 + 400 = 625$$
$$a^2 = 625 - 400$$
$$a^2 = 225$$
$$a^2 = \sqrt{225}$$
$$a = 15$$



$$48^2 + b^2 = 73^2$$
$$2304 + b^2 = 5329$$
$$b^2 = 5329 - 2304$$
$$b^2 = 3025$$
$$b^2 = \sqrt{3025}$$
$$b = 55$$



$$a^2 + 4^2 = 5^2$$
$$a^2 + 16 = 25$$
$$a^2 = 25 - 16$$
$$a^2 = 9$$
$$a^2 = \sqrt{9}$$
$$a = 3$$

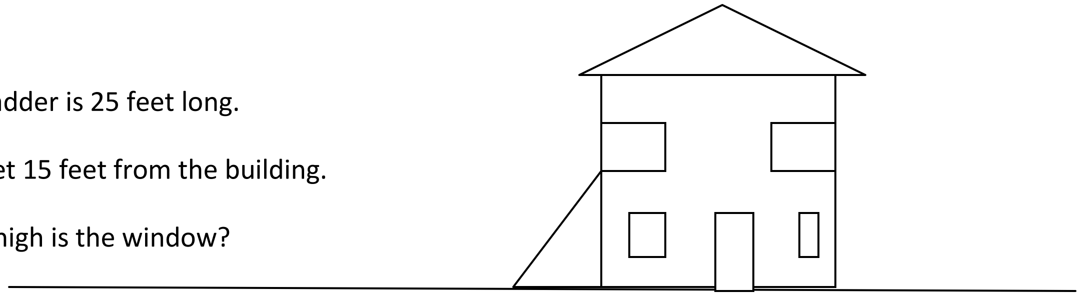


$$24^2 + b^2 = 40^2$$
$$576 + b^2 = 1600$$
$$b^2 = 1600 - 576$$
$$b^2 = 1024$$
$$b^2 = \sqrt{1024}$$
$$b = 32$$

The ladder is 25 feet long.

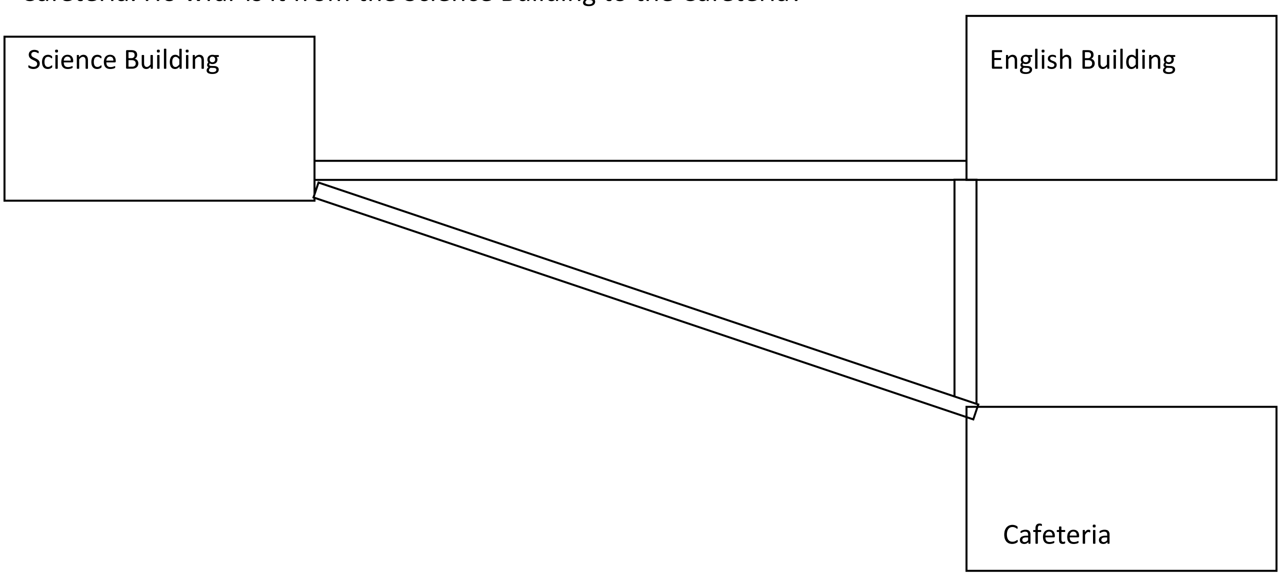
It is set 15 feet from the building.

How high is the window?

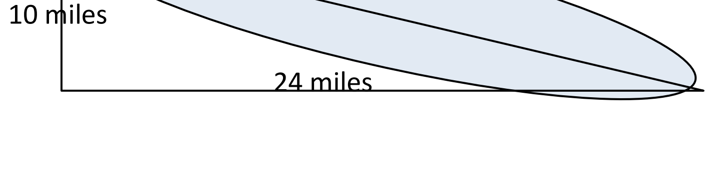


The dock is 5 feet high. The ramp starts 12 feet from the edge of the dock. How long is the ramp?

The Science Building is 1000 feet from the English Building. The English Building is 750 feet from the Cafeteria. Ho wfar is it from the Science Building to the Cafeteria?

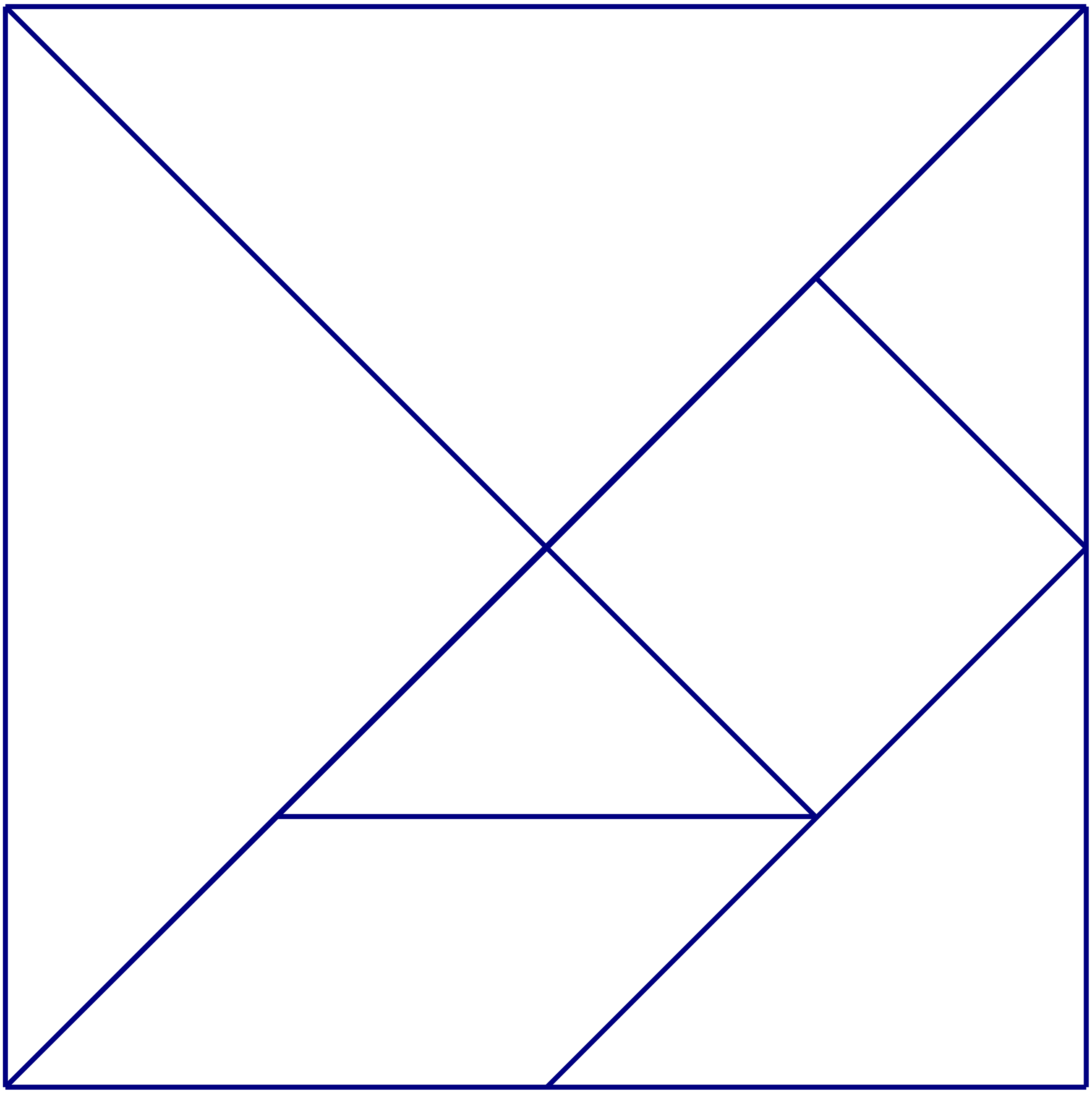


How far is it across the lake?



Printable Tangrams

Cut out the tangrams and use them for tangram activities.



Printable Tangrams

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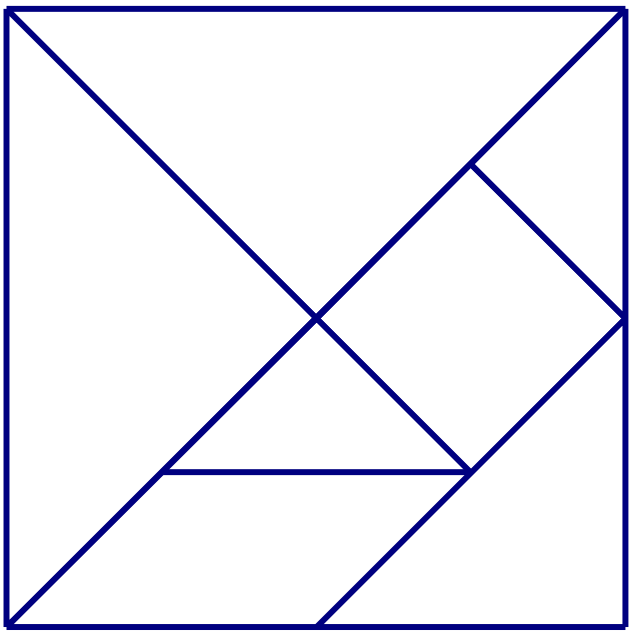
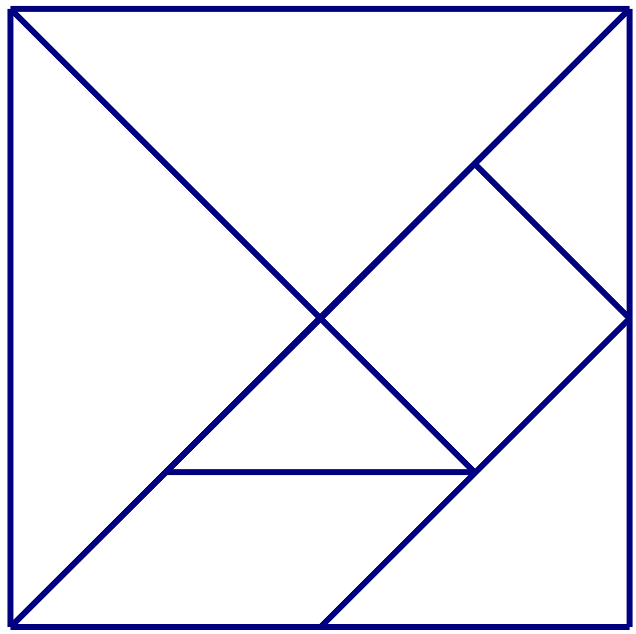
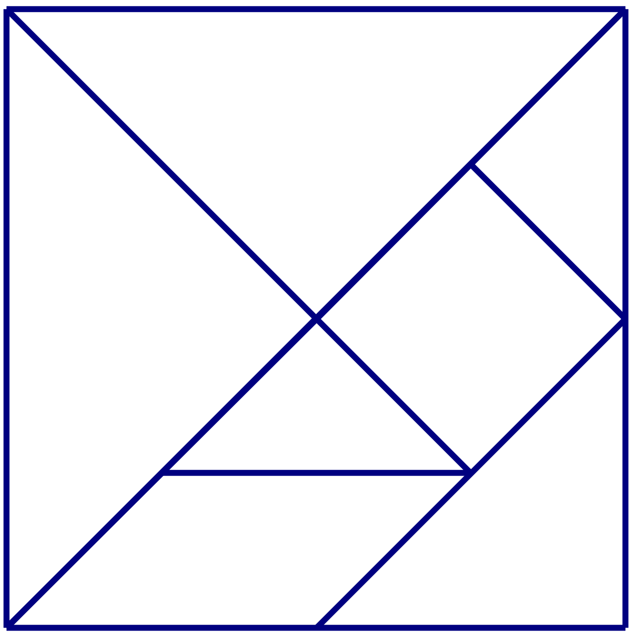
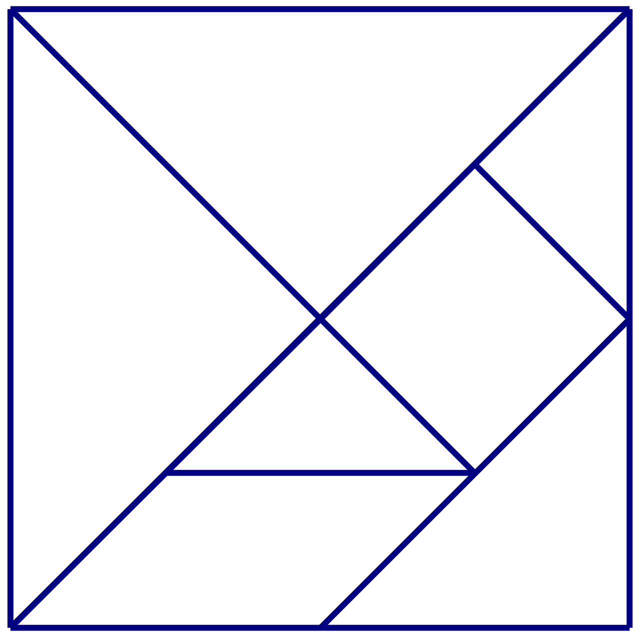
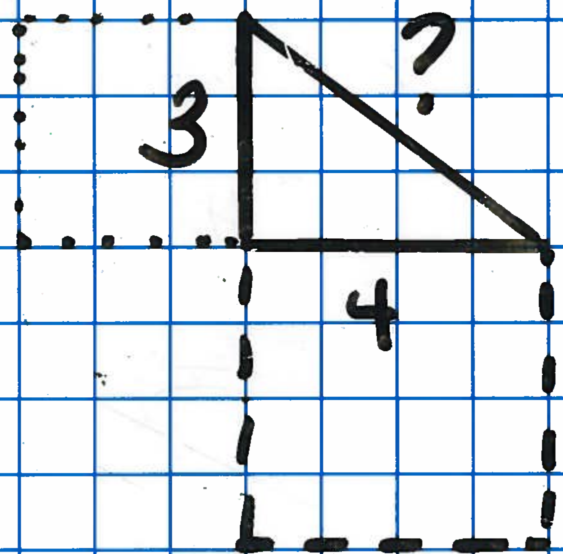








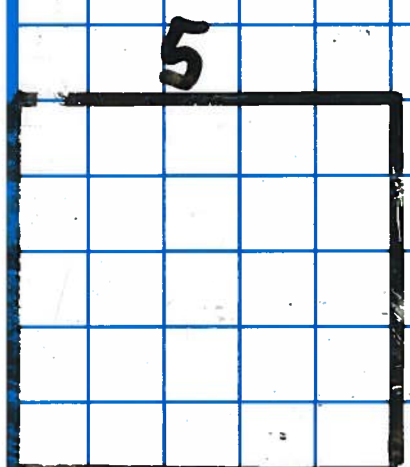
Pythagorean Theorem



$3^2 + 4^2 =$

$\sqrt{25} =$

Missing side =



Summative Activity
Pythagorean Theorem Word Problems
$A^2 + B^2 = C^2$

Sum of the legs squared is equal to the hypotenuse squared

In the spaces, do the following: draw **a diagram (picture)**, apply the Pythagorean Theorem, solve using steps, and label answers. Use a calculator.

1. The bottom of a ladder must be placed 3 feet from a wall. The ladder is 12 feet long. How far above the ground does the ladder touch the wall?

2. A soccer field is a rectangle 90 meters wide and 120 meters long. The coach asks players to run from one corner to the corner diagonally across. What is this distance?

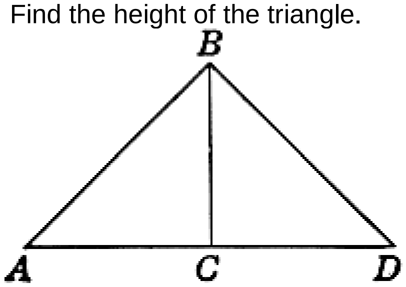
3. How far from the base of the house do you need to place a 15-foot ladder so that it exactly reaches the top of a 12-foot tall wall?

4. What is the length of the diagonal of a 10 cm by 15 cm rectangle?

5. The diagonal of a rectangle is 25 in. The width is 15 inches. What is the length?

6. The area of a square is 81 square centimeters. Find the length of a side. Find the length of the diagonal. ($A = s^2$)

7. An isosceles triangle has equal sides of 20 cm. The base is 32 cm.
Find the height of the triangle.



AB = BD =20 cm
AD = 32 cm
AC or CD = ?
Find BC

ANSWER KEY

Pythagorean Theorem Word Problems

$$A^2 + B^2 = C^2$$

Sum of the legs squared is equal to the hypotenuse squared

In the spaces, do the following: draw **a diagram (picture)**, apply the Pythagorean Theorem, solve using steps, and label answers. Use a calculator.

1. The bottom of a ladder must be placed 3 feet from a wall. The ladder is 12 feet long. How far above the ground does the ladder touch the wall?

11.6 feet

2. A soccer field is a rectangle 90 meters wide and 120 meters long. The coach asks players to run from one corner to the corner diagonally across. What is this distance?

150 meters

3. How far from the base of the house do you need to place a 15-foot ladder so that it exactly reaches the top of a 12-foot tall wall?

9 feet

4. What is the length of the diagonal of a 10 cm by 15 cm rectangle?

19.03 cm

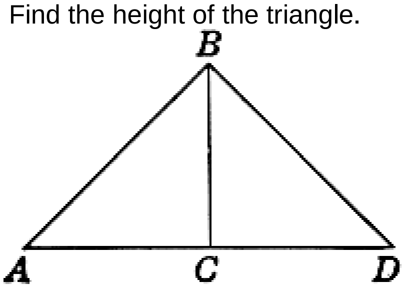
5. The diagonal of a rectangle is 25 in. The width is 15 inches. What is the length?

20 inches

6. The area of a square is 81 square centimeters. Find the length of a side. Find the length of the diagonal. ($A = s^2$)

9 cm

7. An isosceles triangle has equal sides of 20 cm. The base is 10 cm.
Find the height of the triangle.



AB = BD =20 cm
AD = 32 cm
AC or CD = ?
Find BC

12 cm