

Geometry and Spatial Sense

Exploring the Pythagorean Theorem

The Task

This task required each student to draw or construct as many non-congruent squares as possible on either five by five geopaper or a five by five geoboard, and to determine the area of each of the squares. Each student was then asked to construct a right-angled triangle, to draw a square on each side of the triangle, and to determine the area of each of the squares formed on the sides of the triangle. Students then compared the sizes of the squares drawn on the sides of the right-angled triangles and stated the relationship among the squares – the Pythagorean theorem. Finally, they were asked to construct semicircles on the sides of a right-angled triangle and to determine whether the area of the semicircle on the hypotenuse is equal to the combined areas of the semicircles on the other two sides.

The Geometer's Sketchpad software, which is referenced for use in this task, is licensed to the Ontario Ministry of Education (1999).

Expectations

This task gave students the opportunity to demonstrate their achievement of all or part of each of the following selected overall and specific expectations from the strand Geometry and Spatial Sense. Note that the codes that follow the expectations are from the Ministry of Education's *Curriculum Unit Planner* (CD-ROM).

Students will:

1. investigate geometric mathematical theories to solve problems (8m59);
2. use mathematical language effectively to describe geometric concepts, reasoning, and investigations (8m60)
3. investigate the Pythagorean relationship using area models and diagrams (8m65);
4. apply the Pythagorean relationship to numerical problems involving area and right triangles (8m70);
5. explain the Pythagorean relationship (8m73).

Prior Knowledge and Skills

To complete this task, students were expected to have some knowledge or skills related to the following:

- the concepts of area, perimeter, square root, and perfect squares
- the properties of right-angled, obtuse, and acute triangles
- the difference between drawing a figure and constructing one

For information on the process used to prepare students for the task and on the materials, resources, and equipment required, see the Teacher Package reproduced on pages 56–61 of this document.

Task Rubric – Exploring the Pythagorean Theorem

Expectations*	Level 1	Level 2	Level 3	Level 4
Problem solving				
	The student:			
1, 3, 4	<ul style="list-style-type: none"> – selects and applies a problem-solving strategy to determine the areas of few of the different-sized squares that can be drawn on a 5×5 geoboard or on 5×5 geopaper, arriving at an incomplete or inaccurate solution – selects and applies a problem-solving strategy to solve a problem related to the Pythagorean theorem, arriving at an incomplete or inaccurate solution 	<ul style="list-style-type: none"> – selects and applies an appropriate problem-solving strategy to determine the areas of some of the different-sized squares that can be drawn on a 5×5 geoboard or on 5×5 geopaper, arriving at a partially complete and/or partially accurate solution – selects and uses an appropriate problem-solving strategy to solve a problem related to the Pythagorean theorem, arriving at a partially complete and/or partially accurate solution 	<ul style="list-style-type: none"> – selects and applies an appropriate problem-solving strategy to determine the areas of many of the different-sized squares that can be drawn on a 5×5 geoboard or on 5×5 geopaper, arriving at a generally complete and accurate solution – selects and uses an appropriate problem-solving strategy to solve a problem related to the Pythagorean theorem, arriving at a generally complete and accurate solution 	<ul style="list-style-type: none"> – selects and applies an appropriate problem-solving strategy to determine the areas of most or all of the different-sized squares that can be drawn on a 5×5 geoboard or on 5×5 geopaper, arriving at a thorough and accurate solution – selects and uses an appropriate problem-solving strategy to solve a problem related to the Pythagorean theorem, arriving at a thorough and accurate solution
Understanding of concepts				
	The student:			
1, 3	<ul style="list-style-type: none"> – demonstrates a limited understanding of the Pythagorean theorem when analysing the data and looking for relationships 	<ul style="list-style-type: none"> – demonstrates some understanding of the Pythagorean theorem when analysing the data and looking for relationships 	<ul style="list-style-type: none"> – demonstrates a general understanding of the Pythagorean theorem when analysing the data and looking for relationships 	<ul style="list-style-type: none"> – demonstrates a thorough understanding of the Pythagorean theorem when analysing the data and looking for relationships
Application of mathematical procedures				
	The student:			
4	<ul style="list-style-type: none"> – applies mathematical procedures with many errors and/or omissions when investigating the Pythagorean theorem 	<ul style="list-style-type: none"> – applies mathematical procedures with some errors and/or omissions when investigating the Pythagorean theorem 	<ul style="list-style-type: none"> – applies mathematical procedures with few errors and/or omissions when investigating the Pythagorean theorem 	<ul style="list-style-type: none"> – applies mathematical procedures with few, if any, minor errors and/or omissions when investigating the Pythagorean theorem

Expectations*	Level 1	Level 2	Level 3	Level 4
Communication of required knowledge				
The student:				
2, 5	– uses mathematical language and notation with limited clarity to analyse and describe geometric relationships and concepts	– uses mathematical language and notation with some clarity to analyse and describe geometric relationships and concepts	– uses mathematical language and notation clearly to analyse and describe geometric relationships and concepts	– uses mathematical language and notation clearly and precisely to analyse and describe geometric relationships and concepts

*The expectations that correspond to the numbers given in this chart are listed on page 12.

Note: This rubric does not include criteria for assessing student performance that falls below level 1.