



SINUS - Thüringen

Steigerung der Effizienz des
mathematisch-naturwissenschaftlichen
Unterrichts

Documentation for the teaching material »Pythagoras«

School:	Staatliche Regelschule Friedrichroda (grades 5-10), Gymnasium Leinefelde (grades 5-12)
Grade:	Gymnasium grade 8/Regelschule grade 9
Subject:	Mathematics
Authors:	Wolfgang Häfner, Jörg Triebel
Target:	Project work to the topic »Pythagoras« with testpaper and material
Organization form/time needed:	Pair work (individual work in exceptional cases); 5-6 lessons without testpaper
Evaluation of the students' performances:	Assessment and grading of the students' results by the teacher, subsequent test paper (block period)
Material Requirements:	See realization
Methodical Indications:	Rules for pair work have to be known see realization
Students' Materials:	Hand-crafted and demonstration material
Literature:	Gymnasium: »Lambacher Schw. Grade 8«, Regelschule: »Klett Schnittpunkt 9« Baptist, P.: »Pythagoras und kein Ende?«

Complex Task of Introducing the Theorem of Pythagoras

■ Tasks Gymnasium (SINUS I):

■ Task 1:

Show Pythagoras as a real existing person (CV; photographs)!

Present your results to the class and on the blackboard!

Literature: Baptist, P.: Pythagoras und kein Ende? Page 18-24

■ Task 2:

Develop several versions about the history of the development of the theorem!

Provide your results to the class and prepare a display board for the wall newspaper!

Literature: Baptist, P.: Pythagoras und kein Ende? Page 35-37

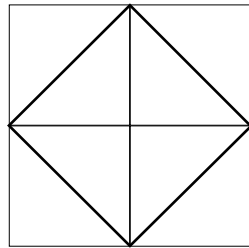
■ Task 3:

Use the oldest evidence, the clay tablet, to prove the theorem! Manufacture applications for it!

Present the historical finding and its importance on the wall newspaper too!

Literature: Baptist, P.: Pythagoras und kein Ende? Page 41-43, 44

Lambacher Swiss, class 8, page 80



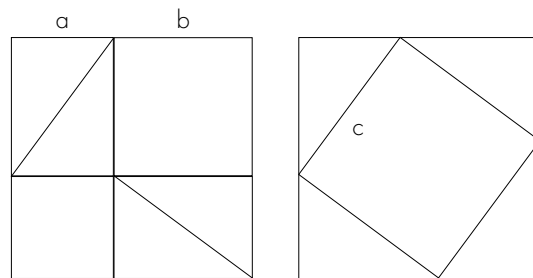
■ Task 4:

Accomplish the first proof of the theorem by using the predetermined illustration!

Design the proof with the help of colored applications!

Literature: Lambacher Swiss, class 8, page 81

Baptist, P.: Pythagoras und kein Ende? Page 47-48



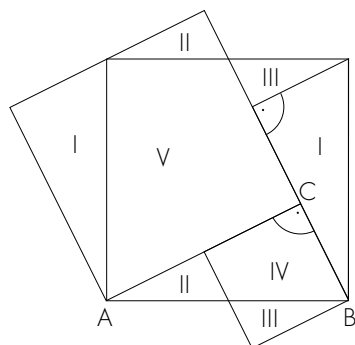
■ Task 5:

Perform a dissection proof with the help of the drawing!

Produce appropriate colored applications for the demonstration!

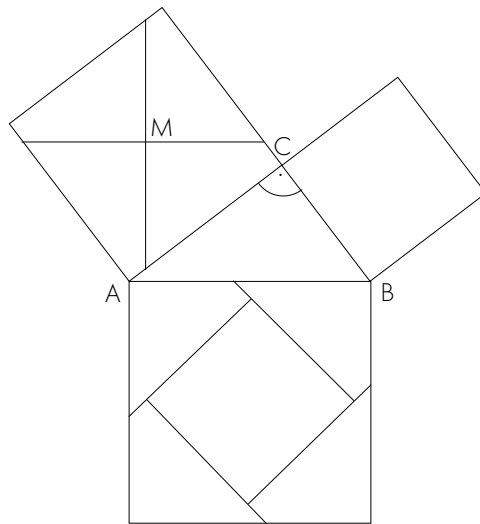
Literature: Lambacher Swiss, class 8, page 81

Baptist, P.: Pythagoras und kein Ende? Page 47-48



■ **Task 6:**

Perform a dissection proof with the help of the drawing!
Produce appropriate colored applications for the demonstration!



Complex Task of Introducing the Theorem of Pythagoras

■ Tasks Regelschule (SINUS-Transfer):

■ Task 1:

Show Pythagoras as a real existing person (CV; photographs)!

Present your results to the class and on the blackboard!

Literature: Baptist, P.: Pythagoras und kein Ende? Page 18-24

Textbook Klett, grade 9, page 39

■ Task 2:

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Provide your results to the class and prepare a display board for the wall newspaper!

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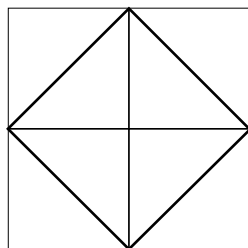
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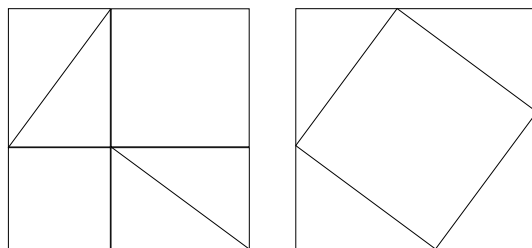
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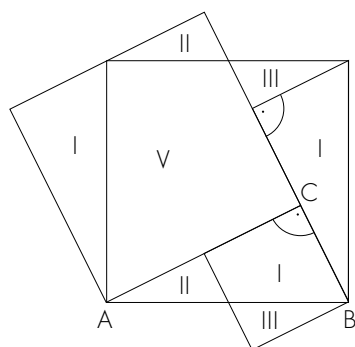
Baptist, P.: Pythagoras und kein Ende? Page 47-48



■ Task 5:

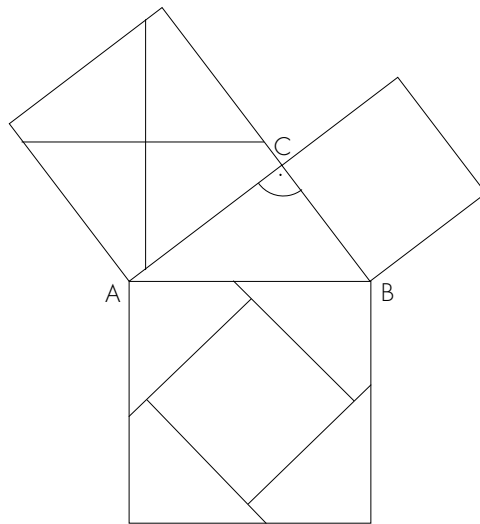
Perform a dissection proof with the help of the drawing!

Produce appropriate colored applications for the demonstration!



■ **Task 6:**

Perform a dissection proof with the help of the drawing!
Produce appropriate colored applications for the demonstration!



■ **Task 7:**

Manufacture three puzzles to the Pythagorean Theorem
and present them with coloured applications to the class.
Literature: Textbook Klett, grade 9, page 49 (Frame)

■ Realization

Phase 1

- One or two weeks before the topic is introduced, the students are informed about the project.
The students are divided into six groups by lot.
- Then they are presented the tasks. The experience shows that the six tasks are estimated to be very different regarding complexity, so the assignment of the tasks should be decided by lot as well.
- The teacher determines a responsible student for each group, submits the task to him and hands out the copies and prepared material.
Task: All students work on the task. They shift through and collect additional material.
Further arrangements are made within the group.

Phase 2

After the teacher has introduced the terms regarding the right-angled triangle, two lessons (recommended are a double period and two rooms) are used for working on the project within the six project groups. This double period has to be particularly confirmed by the purchase of materials (cardboard, pens, glue ...). It should be ensured that the students can use the possibilities of the computer for gathering information.
Homework: Completion of the project

Phase 3

The groups present their results within two lessons. During the lecture of the students (1–3) of the various groups, all the other students take notes on both the content and the quality of the lecture. It will influence the student's learning attitude, his communication and his creativity positively, if it is not determined ahead, who of the students will give the lecture. So they assume that the teacher appoints the lecturers of each group. Of course, this can also be determined by the group members. Usually there are no problems occurring. The teacher takes notes during the lecture as the basis for the evaluation.

Phase 4

The assessment of the student's presentations take one lesson and are done within the group and the class. From experience, these estimations are very critical and objective, especially towards the students who showed little activity.

Phase 5

The students' performance will be assessed and graded by the teacher.
Not all students of a group have to receive identical marks.
The working results are presented in the classroom.

Phase 6 – applications/exercises (6–8 lessons)

Assessment (in keywords):

- high activity of the students in the groups
- students enjoyed mathematics
- safe control of the Theorem of Pythagoras and its reversion
- students assessed the lessons as interesting
- self-evaluation, presentation and self expression are taught

The students appreciated this form of teaching as a very interesting experience and **wanted** to learn.

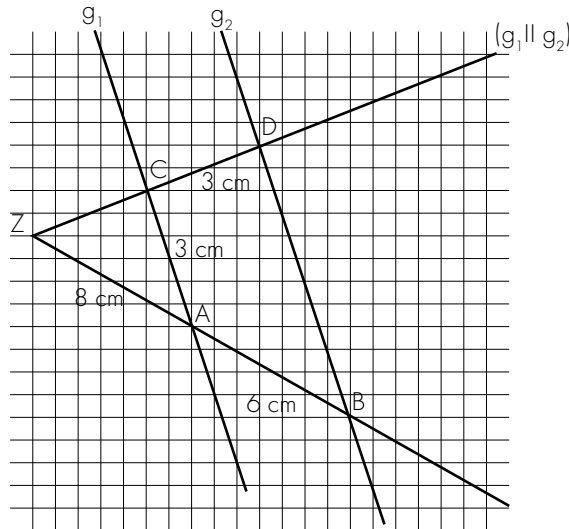
Test paper mathematics grade 9

Similarity/Pythagorean Theorem Proofs

■ Part 1 – Basic Tasks

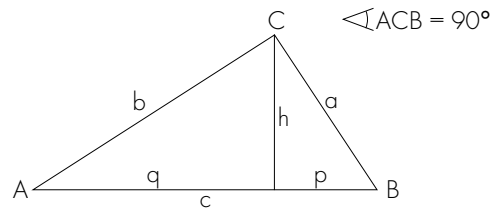
■ Task 1:

Calculate all four missing segment lengths in the following figure. (Sketch doesn't have to be to scale)



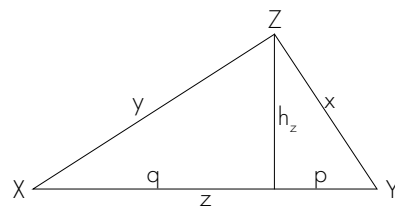
■ Task 2:

Formulate as many (at least four) mathematical laws for the following illustration!



■ Task 3:

Complete the following table for the right-angled triangle XYZ.



	Task a)	Task b)	Task c)
cathetus y			
cathetus x	6,3		
hypotenuse z	8,0		7,0
hypotenuse segment q	5,0	2,5	4,4
hypotenuse segment p			
height h_z		6,0	

Describe your calculation method for **one** task from a) to c) precisely stating the law you applied.

Task d) Check your results from a) to c) by constructing the triangles on unlined paper.

Task e) Use the scale factor $k=2$ to draw a stretched copy of the triangle from task c) with an arbitrary selectable scale center S.

Task f) Calculate the surface areas of the triangle from task c) and the stretched copy triangle from task e).

Test paper mathematics grade 9

Similarity/Pythagorean Theorem Proofs

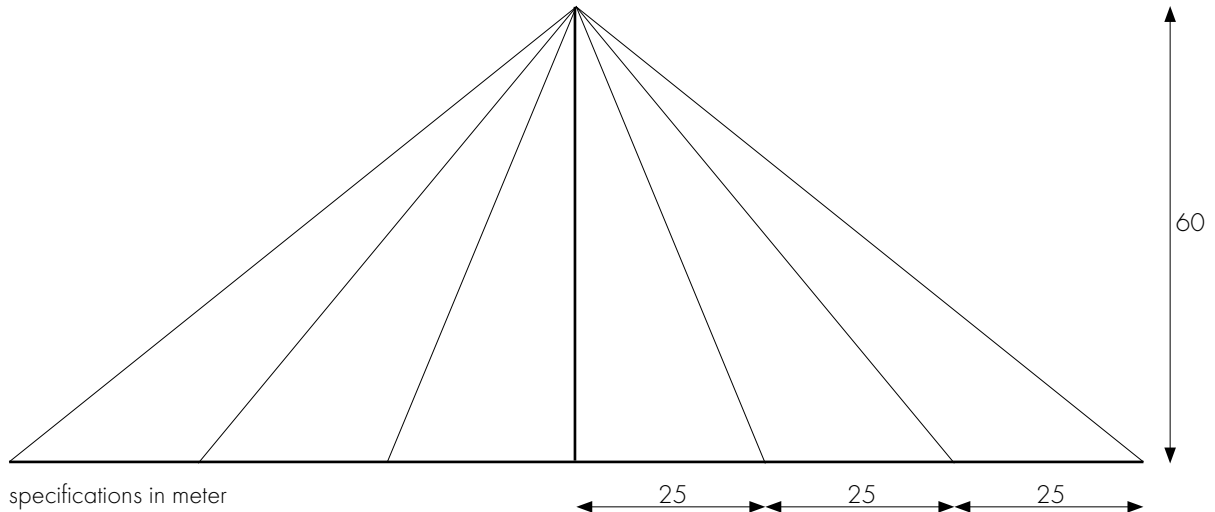
■ Part 2 – Applications

■ Task 1:

Construct a coextensive square to a rectangle with 30 cm^2 surface area.

■ Task 2:

A bridge is secured by 6 steel cables (see the sketch that is not to scale)
Calculate the total length of all cables.



■ Task 3:

A 10-story tower is 30 meters high. The emergency access road allows the fire truck to approach the house up to 10 meters. The largest of the fire trucks enables an extension of the ladder up 31 meters.
Is a rescue of people from the roof of the house possible with the ladder?
Explain with a calculation.

■ Task 4:

From an observation point in 60 m height, a security guard should watch the border area up to 35 km to the naked eye (assuming a clear view). Is it possible?
Justify your opinion by an appropriate calculation (Note: earth's radius is about 6,370 kilometers).

■ Extra task:

You should only solve this task when you're done with all the other tasks!
(Two extra points for correct solution and demonstration of solution approach!)
An cableway bridges an elevation gap of 540 m.
On a map with the scale 1 : 50,000 a segment length of 5 cm for a railway line is measured.
Which cable length has to be guyed for one direction?