

# Teaching of Geometry with GeoGebra software in students of the Primary Education Degree

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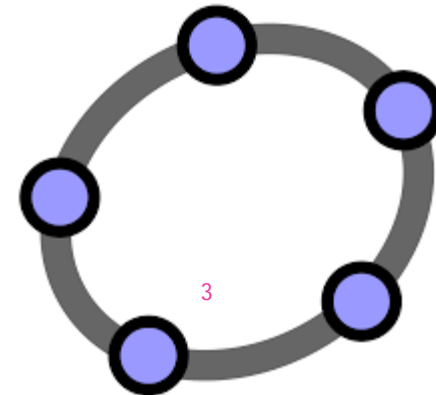
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# Outline

- ▶ Context
- ▶ Using GeoGebra in my lessons
- ▶ Objectives
- ▶ Proposed activities
  - ▶ Students' responses
  - ▶ Student group homework
  - ▶ Exams exercises
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# Context

- ▶ Future teachers have got numerous difficulties about geometrical concepts.
  - ▶ Most of the students are not capable of visualizing representations in the plane.
  - ▶ A training based on memoristic learning?
  - ▶ Without experimenting with any didactic resource for the acquisition of significant learning.



# Using GeoGebra in my lessons

- ▶ Expositive sessions: elements of the plane and space (4,5 hours).
- ▶ Interactive sessions: team practices (3 hours).
- ▶ Occasional support: proof (area and volume).
- ▶ Team work (3-5 students).



# Using GeoGebra in my lessons

- ▶ Properties of geometric figures.
  - ▶ Characteristics.
- ▶ Dynamic constructions.
- ▶ Pattern search: generalize.
- ▶ Visual and intuitive demonstrations.
- ▶ Design of practical activities.

# Objectives

- ▶ Encouraging the use of GeoGebra.
- ▶ Improving the acquisition of geometric concepts.
- ▶ Acquiring knowledge about the difficulties and mistakes my pupils make in their learning and in the use of this didactic tool.
- ▶ Encouraging modes of action that will be useful in their professional life as teachers in the digital era.

# Proposed activities

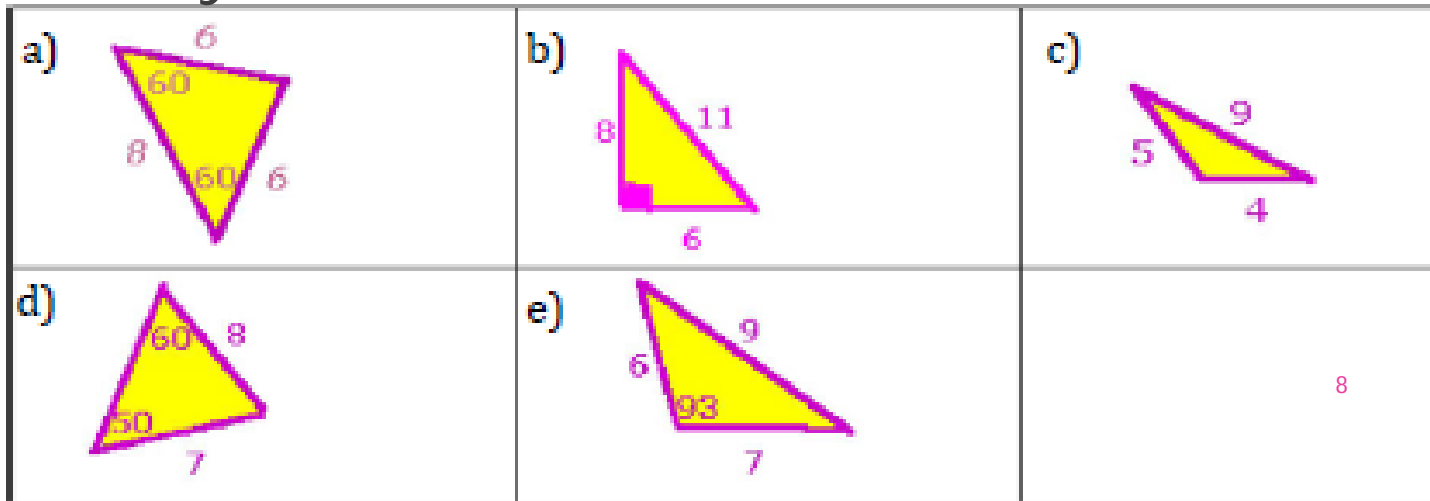
Students' responses, Student group homework and Exams.

# Classroom practice activities

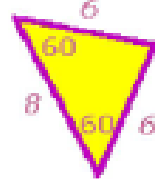
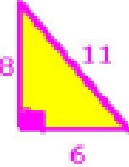

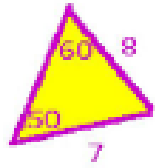
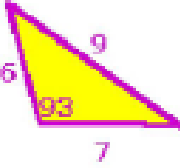
## ► Study and building of triangles.

Here is a series of triangles with certain measures. Indicate which triangles cannot be built and why (justify your answer).

To justify your answer you can use triangle properties that you already know or try to build them in GeoGebra.



# Classroom practice activities

a) 	b) 	c) 
d) 	e) 	

None can be built:

- a. Three equal sides, three equal angles.
- b. Right-angled triangles, Pythagoras theorem.
- c. Add two sides greater than the other.
- d. Greater side opposes greater angle.
- e. Obtuse triangle:  $c^2 > a^2 + b^2$ .

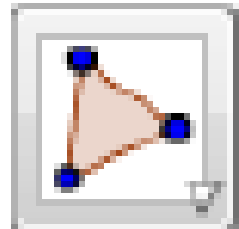
# Classroom practice activities

## ► Properties of four sided shapes

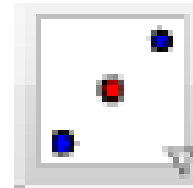
Build any quadrilateral. Calculate the midpoints and draw the quadrilateral that joins them. What can you say about it? List at least three of its characteristics.

Help yourself with GeoGebra to draw this construction with the

polygon button

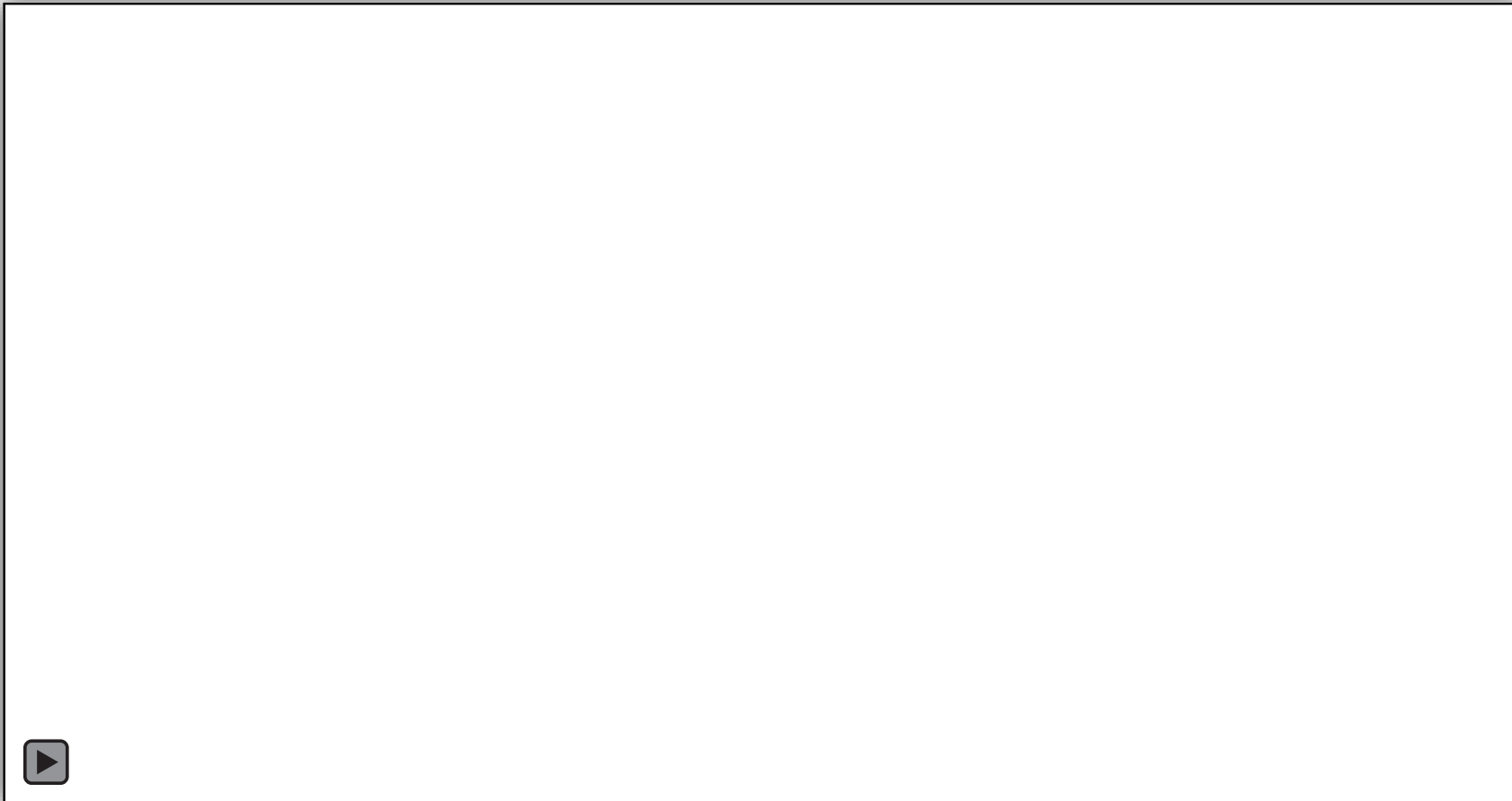


and midpoint



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# Classroom practice activities: correct answer



# Classroom practice activities: students' responses

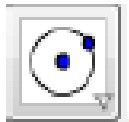
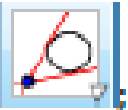
- ▶ No quadrilaterals: a particular one (rectangles).
- ▶ The starting quadrilateral must be deformed (otherwise, in the example of the rectangle a rhombus is observed).
- ▶ It is necessary to indicate the measure of the sides and the interior angles, because these properties are mentioned without having checked them.



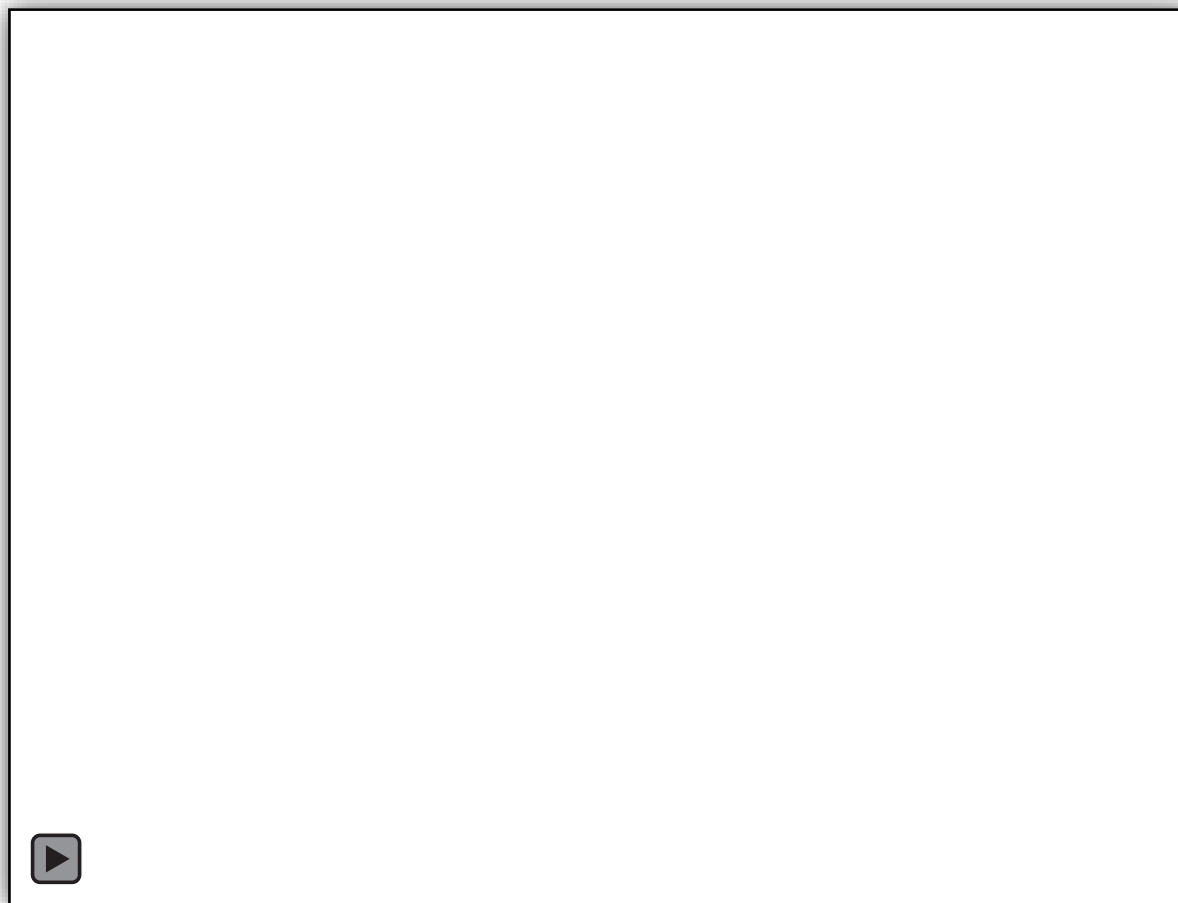
# Practice activities

## ► Relationships between lines and circumferences

What angle forms the radius of a circumference with its tangent line? If the line is not tangent, but secant with the circumference, what are the angles between the line and the radius? Justify the answer.

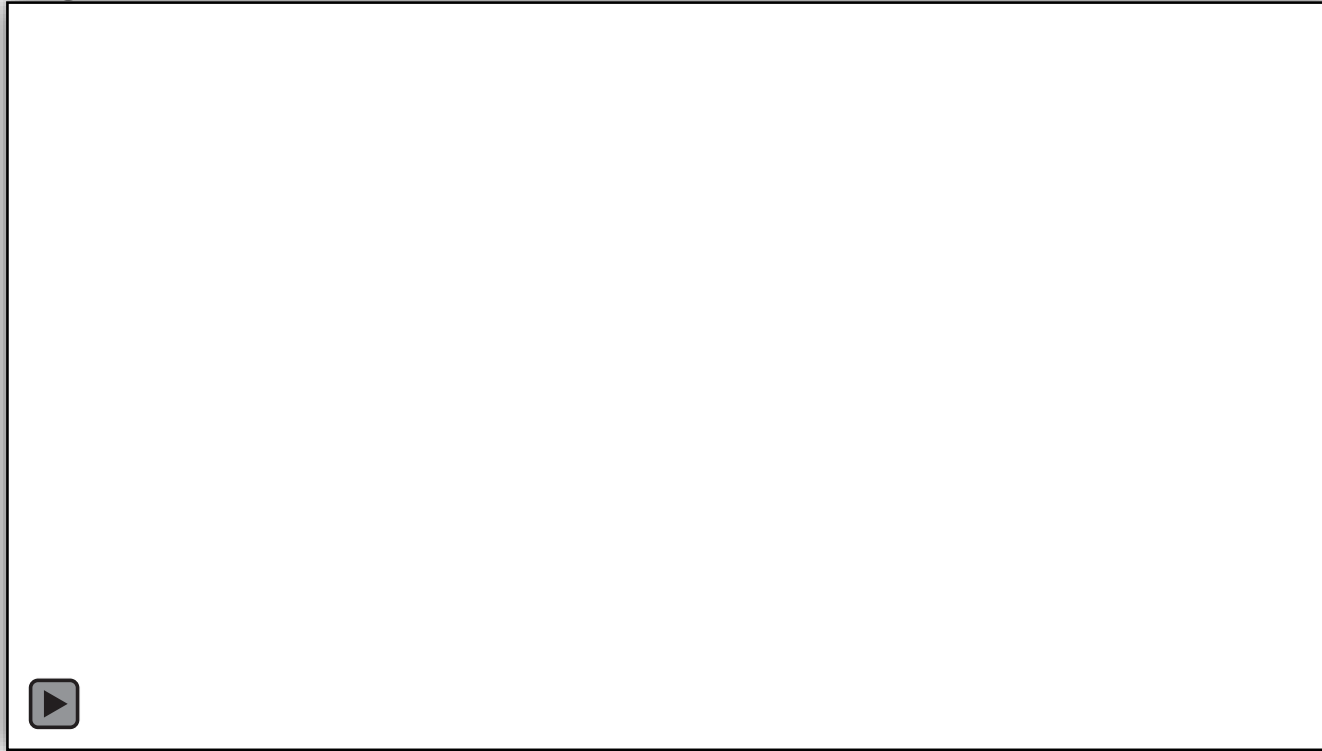
Help yourself with GeoGebra to solve this problem by building a circle with the center and point command  and then using another point outside the circle you can draw the tangent line or draw a secant line  with another point outside the circle, exploring what happens when moving the line.

# Practice activities: correct answer



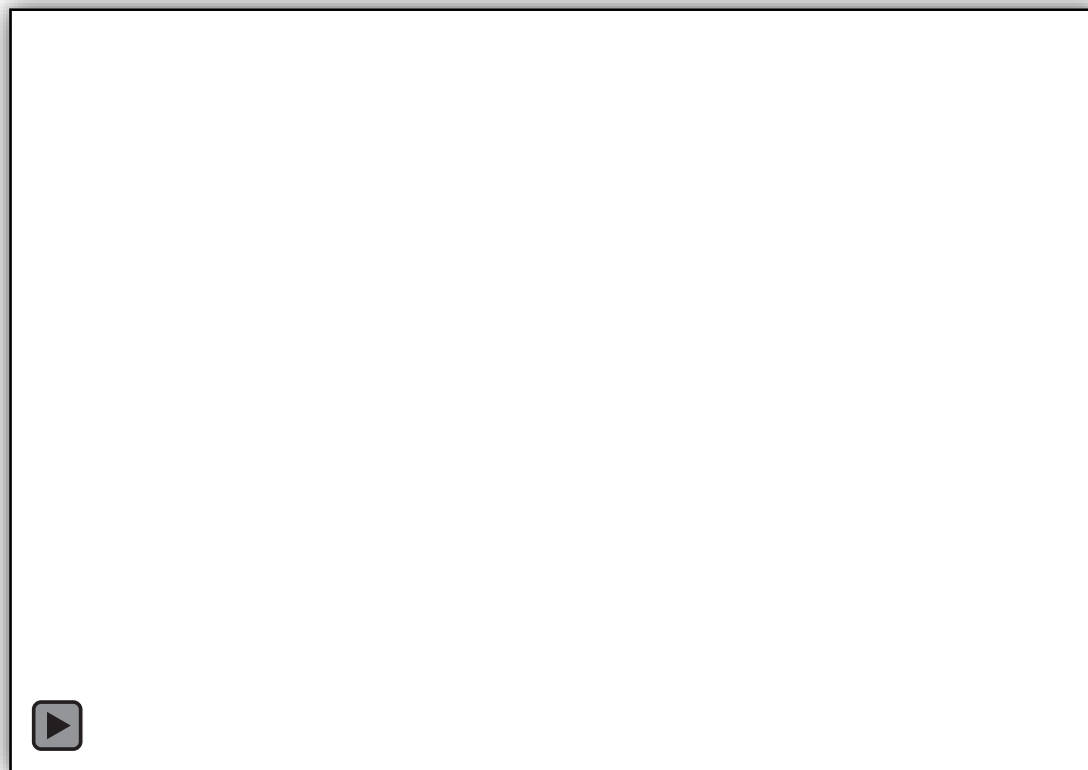
# Practice activities: students' responses

- ▶ In the construction of the tangent line, the tangency is lost when deformed.



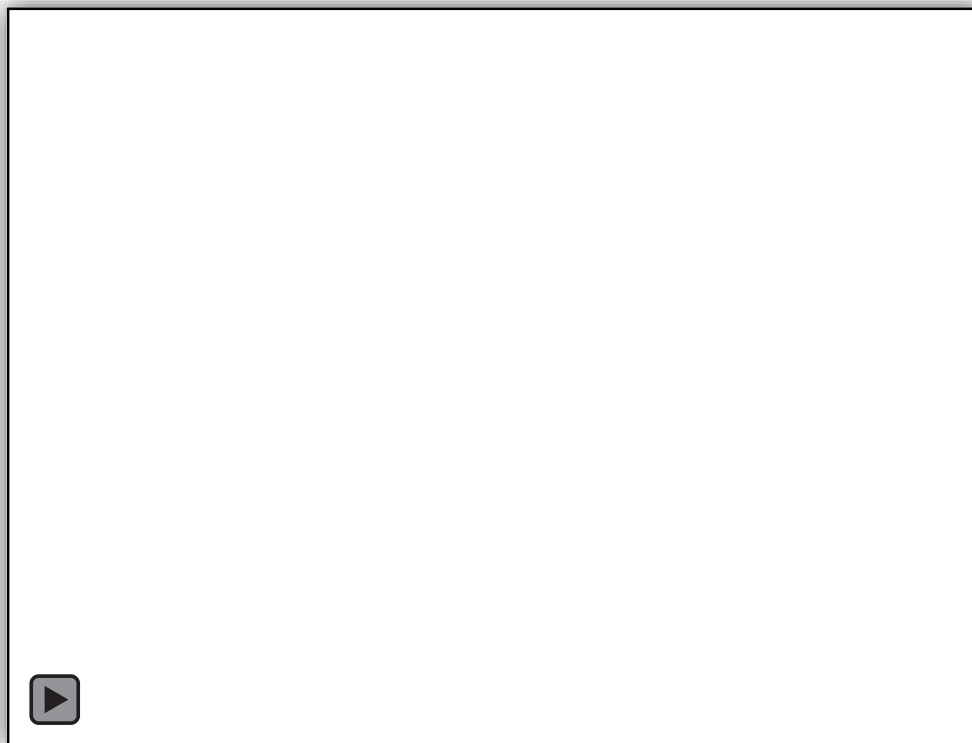
## Practice activities: students' responses

When marking angle  $\alpha$  (to conclude that the angle formed between the tangent and the radius is  $90^\circ$ ) it is because they are opposite angles by the vertex and in this case, there are four pairs of right angles.



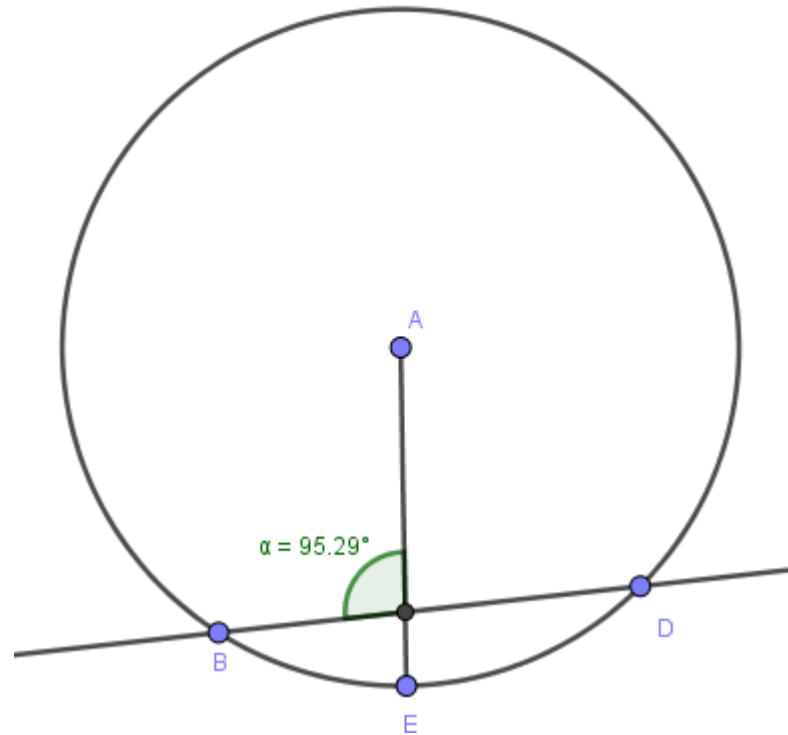
# Practice activities: students' responses

If the line is secant with the circumference, what are the angles between the line and the radius corresponding to the cutting points of the secant?



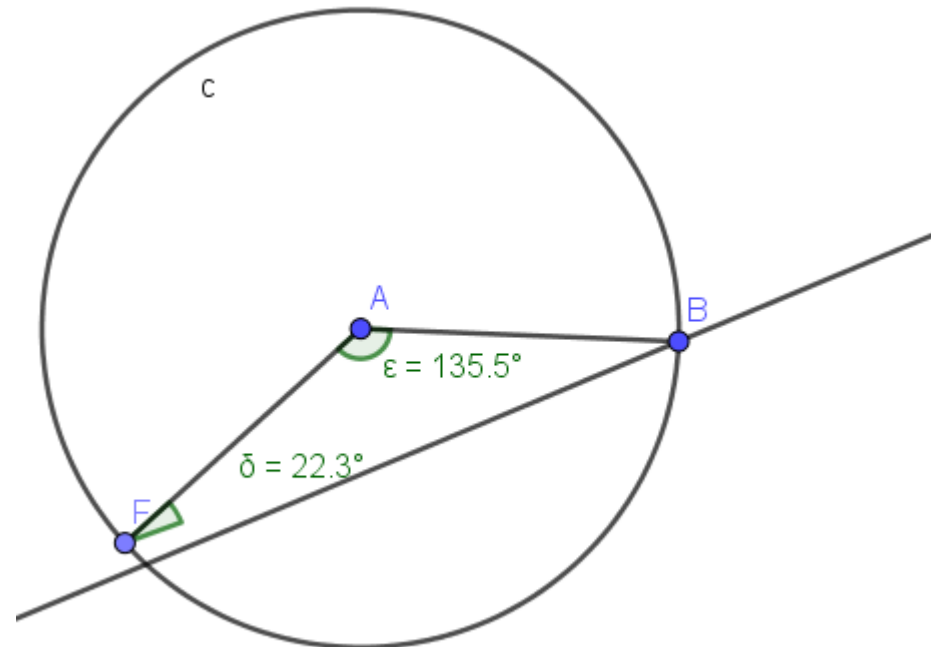
# Practice activities: students' responses

The angles formed between the radius (determined by points B and D at center A) and the secant line are not considered.



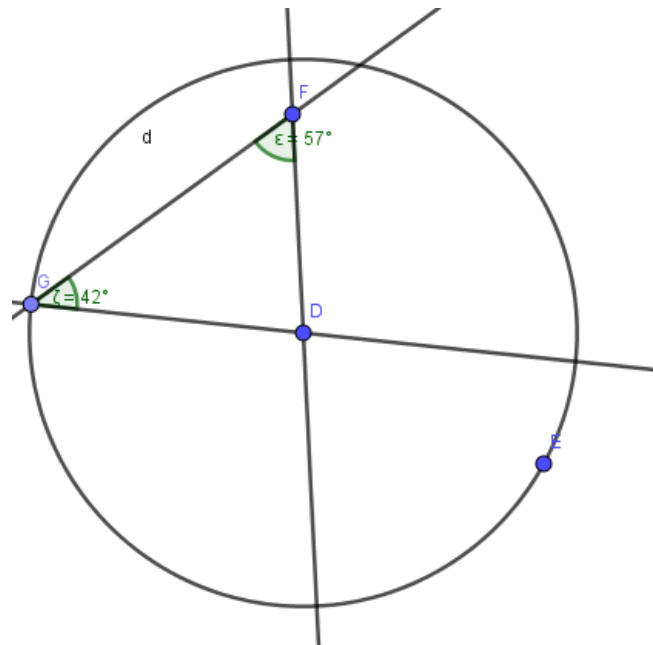
# Practice activities: students' responses

- ▶ Point F is not the intersection of the circumference with the secant line, but it is done by sight. Thus, when moving the secant line, the point is fixed and an isosceles triangle is not formed.
- ▶ Only the measure of the central angle and an interior angle is indicated.



## Practice activities: students' responses

- Point F is not the intersection of the circumference with the secant line. Thus, when moving the secant line, an isosceles triangle is formed without having two of its vertices in the circumference.





# Student group homework

## ► Group work (written report + oral presentation)

Carrying out an activity or resource, aimed at a Primary Education classroom.

It will be valued:

- the degree of achievement of the proposed objectives, the application of this activity at a primary school level, the order and clarity.
- the finished activity, the skill in managing the board, its originality, its relevance and interest of the contents analyzed.

# Student group homework

## Difficulties

- ▶ Simple drawing tool
- ▶ They reproduce examples of files, books, etc.
- ▶ They do not analyze the versatility of GeoGebra.
- ▶ Visual demonstrations replace mathematical reasoning.
- ▶ Lack of reflection.

# Student group homework

## Rigid plane movements

*Choreography (5th Primary Education).*

- ▶ Stage size
- ▶ Creation of the dancers (rigid figures of the plane).
- ▶ choice of movements to perform the dance.
- ▶ Trajectory of the dance (animation of a point: turns, translations, symmetries).

# Student group homework

## Rigid plane movements

- ▶ [Choreography 1](#)
- ▶ [Choreography 2](#)
- ▶ [Choreography 3](#)
- ▶ [Choreography 4](#)

# Student group homework

## Axial and central symmetry

*Spanish flags of the different autonomous communities and provinces (5th Primary Education).*

- ▶ Location of the different flags.
- ▶ Analysis: figures, symmetry

# Student group homework

## Axial and central symmetry

▶ Flag 1

▶ Flag 2

# Student group homework

## Proportionality: volumes, areas and lengths

- ▶ Craftwork: souvenirs (6th Primary Education).
- ▶ Shooting: Tower of Hercules and Millennium Obelisk.
- ▶ Analyze the type of spatial figures
- ▶ Obtaining the real measurements.
- ▶ Measures to scale.
- ▶ Construction in GeoGebra the artisan's sketch.

# Student group homework

Proportionality of volumes, areas and lengths

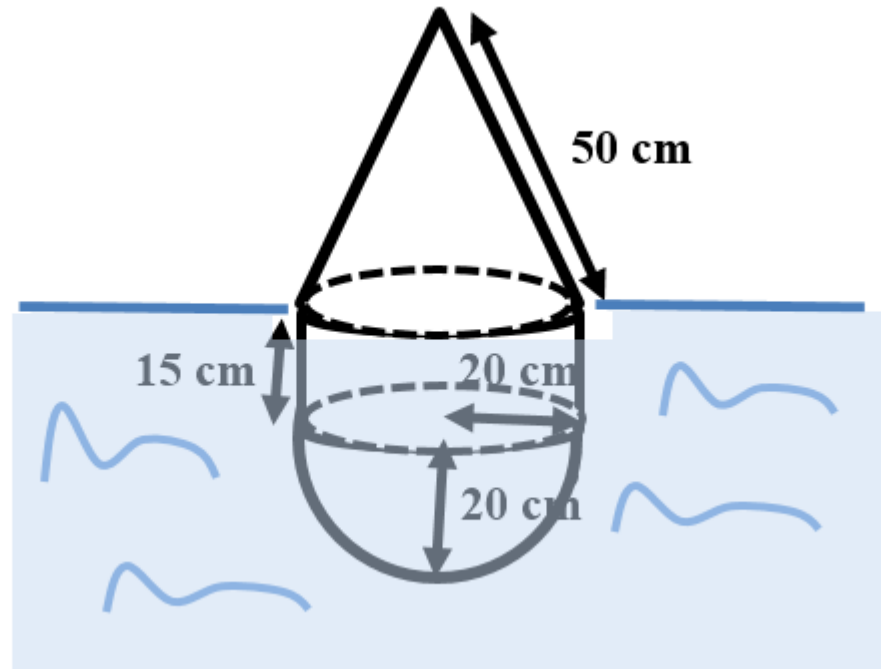




# Exams exercises

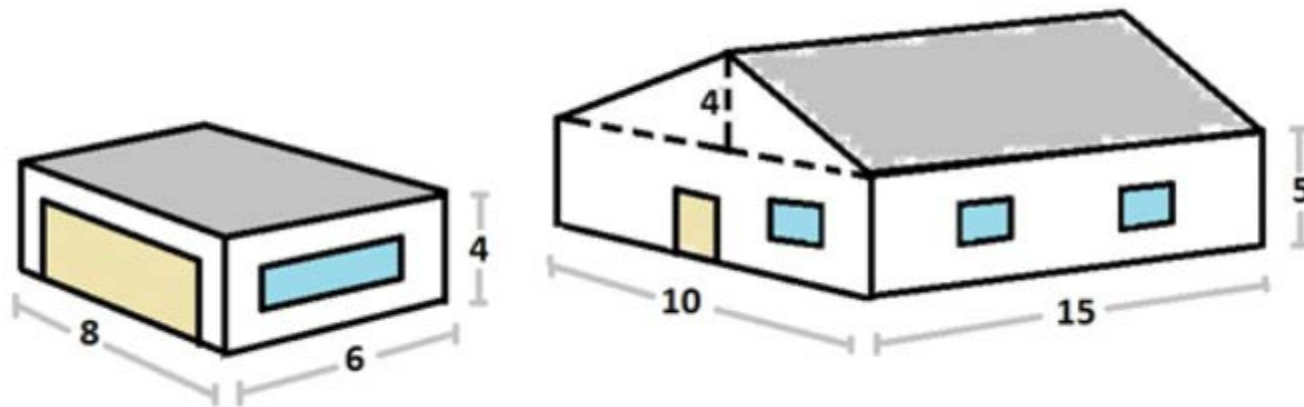
On the pier there is a buoy like the one shown in the image floating in the water.

- a) Calculate the volume of the entire buoy.
- b) Calculate the surface area of the buoy that is in contact with the water.



# Exams exercises

After you have painted the garage, you realize that you have spent 12 kg of paint to paint the walls and 8 kg to paint the roof with waterproof paint. Taking into account this data, calculate how many kilos of each type of paint you will need to paint the walls and the roof of the house with each type of paint. The measurements are given in meters and we know that the garage door is  $6 \times 3$  m, that of the house is  $1 \times 2$  m, the only garage window is  $4 \times 1.5$  m and the six windows of the house are  $2 \times 1.5$  m (there are three other windows on the facades which are not visible). You want to make reproductions of both buildings in solid plastic, at 1: 100 scale. Calculate the volume of the plastic that is necessary.



## Exams exercises

You have a glass jug with straight walls with a base consisting of a rectangle of dimensions 8 x 12 cm and a semicircle attached to its shorter side. The thickness of the walls is 1.5 mm and its height is 25 cm. You want to stick a decorative ribbon along its edge of the jug. Calculate the capacity of the jug and the length of the tape. Justify all your calculations.

# Conclusions

- ▶ Forcing students to use technological tools in their daily work
- ▶ Collaborative learning environments are generated
- ▶ The involvement and interest in autonomous work outside the classroom by the student was increased.
- ▶ Allowing the detection of many of the students' difficulties that helped the teacher reorient their teaching,
- ▶ Promote the knowledge of GeoGebra in Primary Education is useful in their professional life as teachers in the digital era.