# GEOMETRY PROBLEMS SOLVED WITH GEOGEBRA

**Adriana Bînzar**

**”Ion Mincu” Technical College, Timişoara, Romania**

**ABSTRACT:** In this paper one propose to solve some known geometry problems using Geogebra. The purpose is to highlight the usefulness of this software for writing the solutions especially in realization the drawing, which can simplify the understanding of the mathematical solution.

## 1. Introduction

Geogebra is a dynamic, free, open-source software which allows the exposure, the view and the practice of mathematics knowledge in order to rapidly share and understand the information. This software is characterized by versatility, dynamics, possibility to use it in a increasing number of languages, different versions of installation for using it online of online and also by the possibility of spreading the files on the web for everyone’s benefit. Geogebra includes facilities for several representations of mathematical objects, algebra, geometry and spreadsheet which are integrated in an easily to install and to use application.

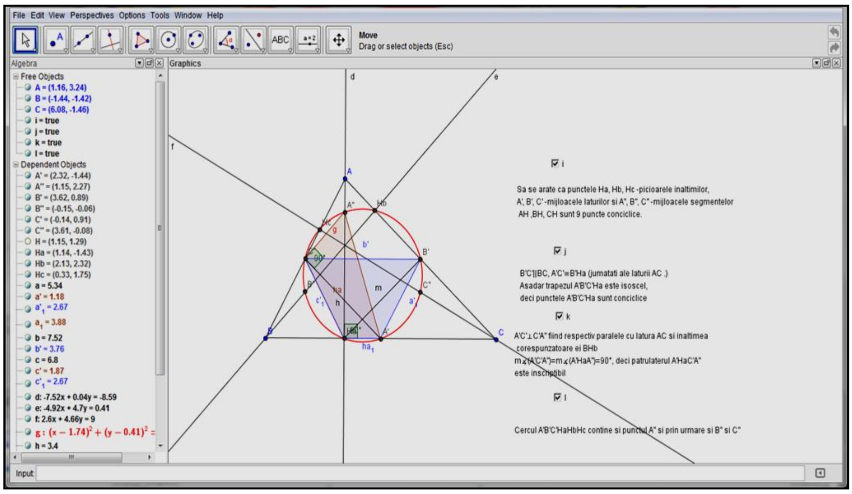
## 2. Applications

In the sequel, for a triangle ABC, the following notations will be used:
H – orthocenter, O – circumcenter , G – center of gravity.

**Problem 1: Euler's Circle**

Prove that points Ha, Hb, Hc-the foot of the heights, A ', B', C ', the means of the sides and A", B", C"-the means of the segments AH, BH, CH are 9 concyclic points.

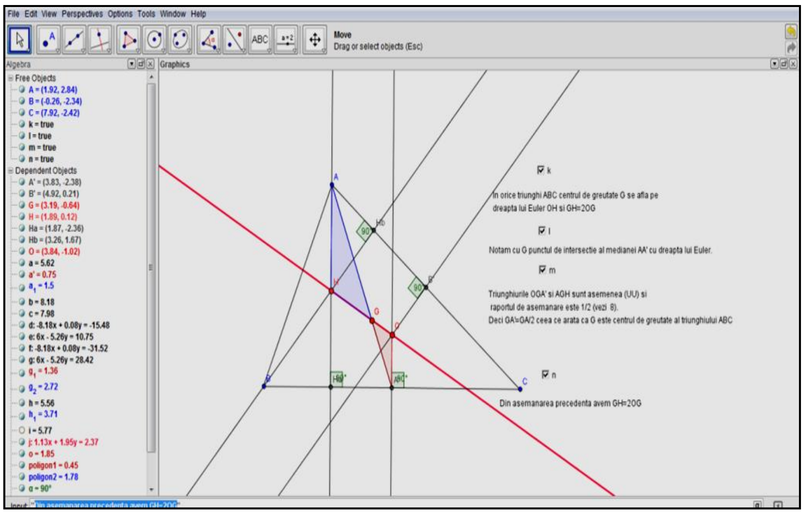
To solve this problem with Geogebra we constructed the triangle ABC and its highs, highlighting their intersection with the triangle sides. We drew then the means required in the hypothesis of the problem. It is immediately notice that the points A', B', C', Ha are concyclic points being the vertexes of a isosceles trapezoid. It can be also proved that the points A', Ha, C', A" are the vertexes of a inscribable quadrangular. The picture in Geogebra helps us to see quickly the two right angles formed by a side with a diagonal and the opposite side of the first one with the other diagonal. Therefore the circle A'B'C'Ha contains the point A" and analogously one can prove that Hb, Hc, B" and C" belongs to this circle.




**Problem 2**

In any triangle ABC, the center of gravity G belongs to the Euler's line OH and GH = 2OG

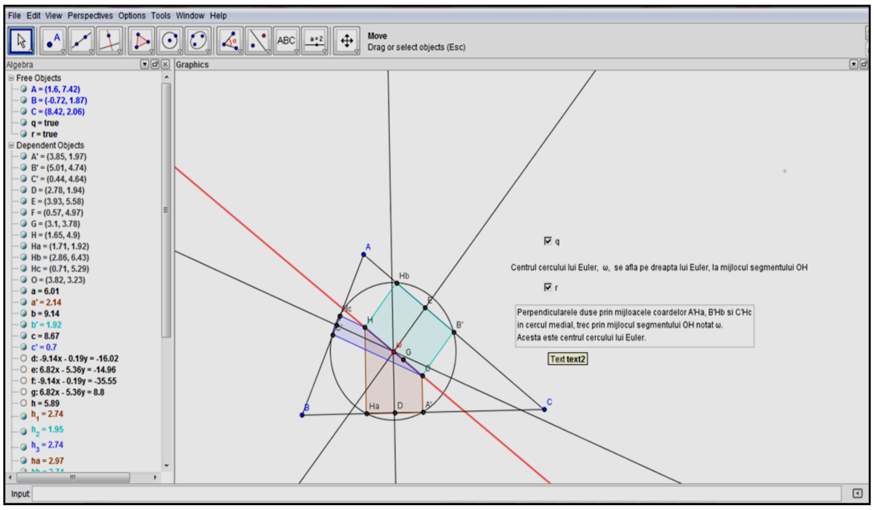
The triangles OGA' and AGH are similar and the similarity ratio is 1/2. Therefore GA '= GA / 2 which shows that G is the center of gravity of the triangle ABC. From our previous similarity GH = 2OG.




**Problem 3**

The center of Euler's circle, ω, belongs to the Euler's line, in the middle of the segment OH.

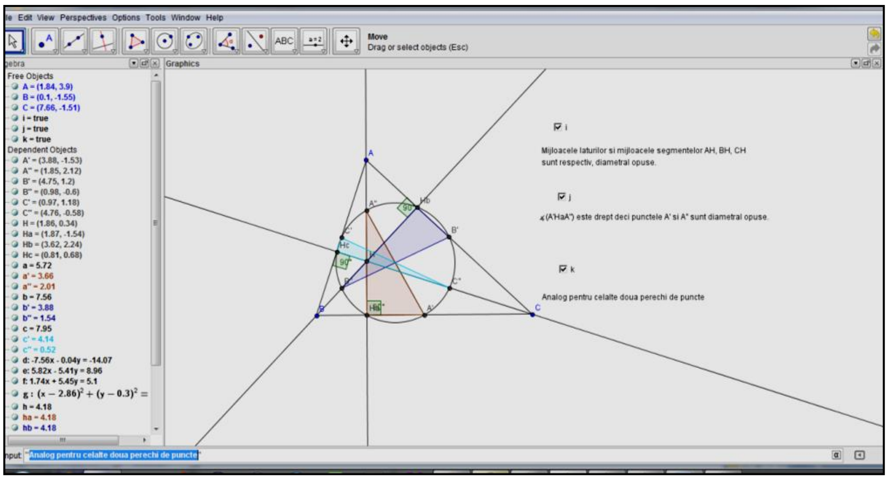
In this problem it is difficult to draw the picture on the sheet of paper because of the many auxiliary lines needed to construct all the points of the problem. The fact that Geogebra allows us to hide elements of the drawing makes it more airy and we can easy follow the proof of the problem. Thus, it is easy to see that the perpendicular through the means of the bisecants A'Ha, C'Hc and B'Hb in the medial circle, passes through the middle of the segment OH, denoted ω. This is the center of the Euler's circle .




**Problem 4**

The means of the sides and the means of the segments AH, BH, CH are respectively diametrically opposite.

The usefulness of making a drawing that would show the Euler circle is more than necessary. At this point, the problem becomes trivial. Note that ∡ (A'HaA") is right, therefore the points A' and A" are diametrically opposite. Analogously it results that the other two pairs of points B and B ', respectively C and C' are diametrically opposite.



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