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# The Geometric Creativity Test (GCT)

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# The Geometric Creativity Test

## Directions

This geometric creativity test is a part of an educational research aiming at assessing your creativity in geometry. So write freely all you think of without fear or hesitation of your responses, cause that will help you to express your creative personality that is inside you and you may not know about it, and that also enables us to find how creative you are in geometry.

The items in the booklet provide you with opportunities to think freely in geometry, produce mathematical relationships, new geometric proofs, and solve non-routine geometric problems which have various and different methods of solution as well as give you the opportunity to pose some relevant problems toward a geometric situation. So try to respond to each item by the greatest number of unusual, various, and different ideas – things no one else in your class will think of. Let your mind go far and deep in thinking up ideas.

This geometric creativity test contains 12 items. You will have 100 minutes to complete the test. Make good use of your time and work as fast as you can without rushing. If you run out of ideas for a certain item go on to the next item. Respond to those items, mainly based upon your quick performance, recording your ideas, and use your mathematical knowledge in a creative (non-routine) fashion.

Record your ideas in the suitable place for each item. If you need more space to write, ask for extra copies of the question's paper. Do not erase any responses because we need to know everything about your geometric thinking. Do your best!

Do you have any questions?

**DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.**

Student's Data

Name ……………………………… School ……………………………

Teacher's Name ………………….. Grade …………………………….

Your Birth Date (D/M/Y) …………. Boy/Girl? …………………………

## Index of the mathematical symbols used in the test

| | |
|---|---|
| $\overline{AB}$ | The line segment whose endpoints A and B |
| $AB$ | The length of the line segment $\overline{AB}$ |
| $\overrightarrow{AB}$ | The ray whose starting point A and passes through B |
| $\overleftrightarrow{AB}$ | The straight line passes through A and B |
| $g \parallel h$ | g is parallel to h |
| $g \perp h$ | g is perpendicular to h |
| $\angle ABC$ | The angle ABC whose vertex at B and two arms $\overrightarrow{BA}$ and $\overrightarrow{BC}$ |
| $m(\angle ABC)$ | The measurement of $\angle ABC$ |
| $F \equiv G$ | F is congruent to G |
| $F \sim G$ | F is similar to G |

1. Write down as many geometric concepts and terminologies as possible that start with letter p.

   *For example: Polygon.*

   If you need more space, write on the back of this page.

2. Write down as many generalizations (theorems, definitions, properties, and corollaries) as you can that are related to the right-angled triangle.

   *For example: In the right-angled triangle, the length of the median from the vertex of the right angle is equal to half the length of the hypotenuse.*

   If you need more space, write on the back of this page.

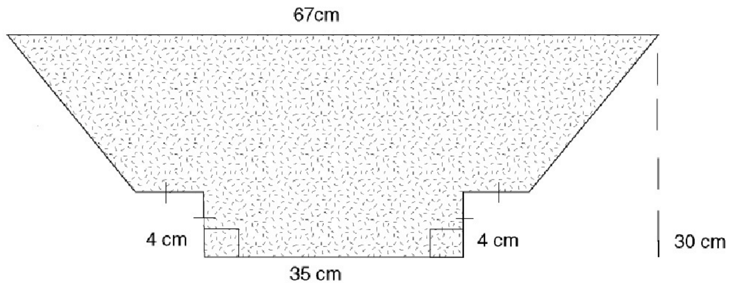
3. Suppose we (you and I) are playing a guessing game of determining the name of a geometric figure. In this game, I think of a geometric figure and you will ask me questions about the figure, I should answer, until you determine the figure.

   Your task is to list as many questions as you can which should be answered in order to determine the name of the figure.

   *For example: Is it a plane figure such as a rectangle? Is it a solid figure such as a sphere? Does it have vertices? How many?*

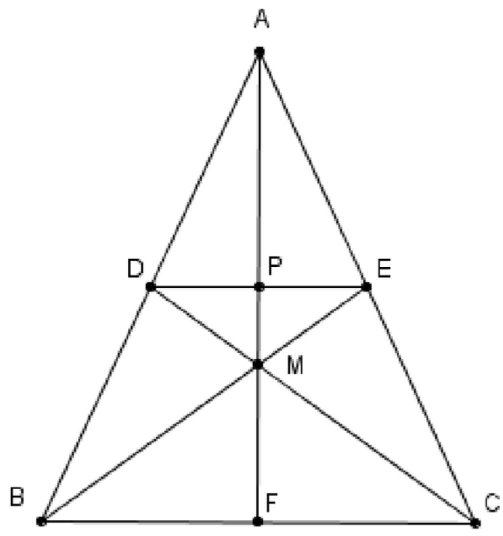
   If you need more space, write on the back of this page.

4. Find by **all possible ways** the area of the opposite figure.




If you need more space, ask for extra papers of this test item.

5. In the opposite figure, ABC is an isosceles triangle, in which AB = AC. D is the mid point of $\overline{AB}$, E is the midpoint of $\overline{AC}$ and $\overline{BE}$ intersects $\overline{CD}$ at M. $\overrightarrow{AM}$ is drawn to cut $\overline{BC}$ at F, and $\overline{DE}$ is drawn to cut $\overrightarrow{AM}$ at P.

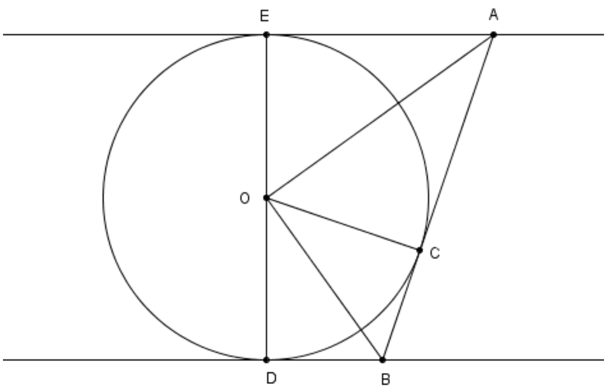



Imagine yourself a mathematician; try to pose the greatest number of various and different problems related to the opposite figure, which could be answered either in direct or indirect ways using the given information. You do not need to solve the problems you write.

*For example: Prove that: $\Delta DMB \equiv \Delta EMC$; Show that DECF is a parallelogram.*

If you need more space to write problems, ask for extra papers of this test item.

6. Two parallel lines are tangents to a circle with centre O, and a third line, also tangent to the circle, meets the two parallel lines at points A and B and the circle at C.




Pose as many various and different problems as possible that could be deduced from the given information. You do not need to solve the problems you write.

*For example: Prove that: ACOE is a cyclic quadrilateral; Show that AE = AC.*

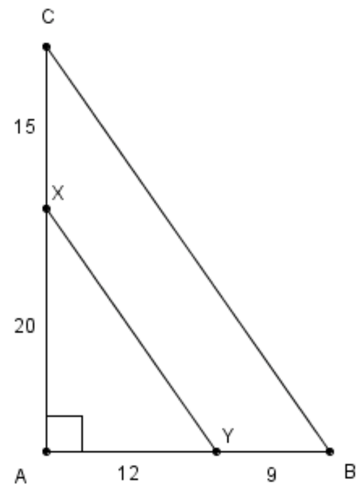
If you need more space to write problems, ask for extra papers of this test item.

7. By using the information given on this figure, prove **by all possible ways** that:

   $\overline{XY} \parallel \overline{CB}$.

   *You can construct any segment you think may help you to get the proof.*

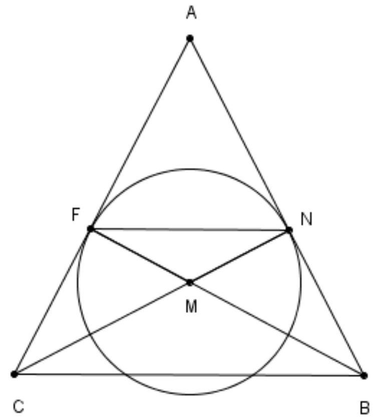
   If you need more space, ask for extra papers of this test item.



8. In the opposite figure, ABC is a triangle. $\overline{AB}$, $\overline{AC}$ touch a circle with centre M at N and F respectively, $\overline{BF} \cap \overline{CN} = \{M\}$.

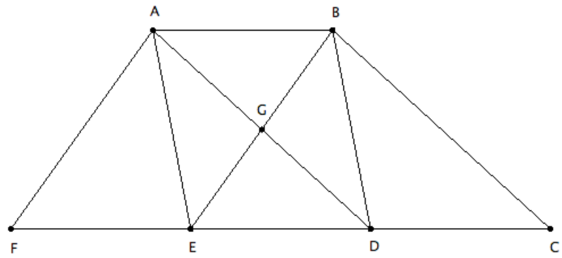
   Prove **by all possible ways** that:
   $\triangle$ ANF ~ $\triangle$ ABC.

   If you need more space to write, ask for extra papers of this test item.



9. In the opposite figure, $\overline{AB} \parallel \overline{FC}$ and AB = CD = DE = EF.

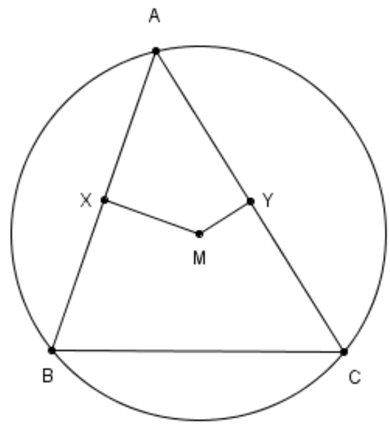
Write down, as many names of pairs of equivalent geometric figures – equal in area – as possible, which are included in the figure opposite. You do not need to show why the two figures, you write, are equivalent.




*For example: Triangle BCE and parallelogram ABDE is a pair of equivalent figures.*

If you need more space to write, ask for extra papers of this test item.

10. In the opposite figure, M is the centre of a circle, $\overline{MX} \perp \overline{AB}$, and Y is the mid-point of $\overline{AC}$. Prove that $\overline{XY} \parallel \overline{BC}$.

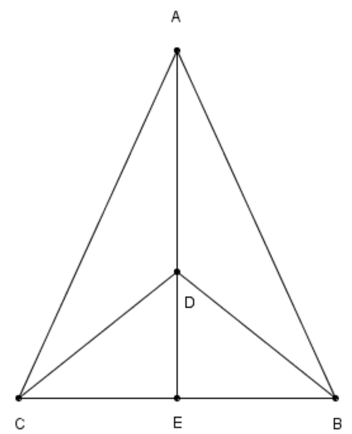



In this problem, It is not required to give a logical proof as usual but to pose as many problems as possible by elaborating–substituting, adapting, altering, expanding, eliminating, rearranging or reversing–the conditions of the given problem. You do not need to solve the problems you write.

*For example: In the opposite figure, given that: M is the centre of a circle, Y is the mid-point of* $\overline{AC}$*, and* $\overline{XY} \parallel \overline{BC}$*. Prove that:* $\overline{XY} \perp \overline{AB}$.

If you need more space to write problems, ask for extra papers of this test item.

11. In the opposite figure, AB = AC and $m(\angle DCB) = m(\angle DBC)$
Prove that $\overleftrightarrow{AE}$ is the axis of $\overline{BC}$.



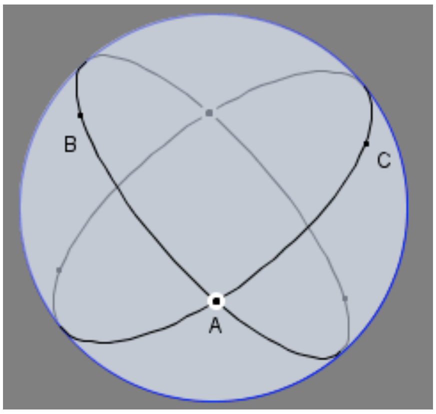

In this problem, it is not required to give a mathematical proof. Your task is to think carefully upon the particular aspects that govern the problem, redefine one or more of these aspects by substituting, adapting, altering, expanding, eliminating, rearranging or reversing to make up as many problems or situations as you can. You do not need to solve the problems you write.

*For example: In the opposite figure, given that: $\overleftrightarrow{AE}$ is the axis of $\overline{BC}$. Prove that: $m(\angle DCB) = m(\angle DBC)$.*

If you need more space to write problems, ask for extra papers of this test item.

12. [12]Write down as many ideas as you can on what could be happened as a result of doing Euclidean geometry on the spherical surface instead of doing it on a plane surface.

*For example: If we start drawing two intersecting lines on the spherical surface, we will eventually end up with two intersecting points as shown in the accompanying figure. Let your mind go far and deep in thinking up possible ideas for this situation.*




If you need more space to write ideas, write on the back of this page.

[12] Adapted from: Balka (1974b) in Mann, E. L. (2005). Mathematical creativity and school mathematics: Indicators of mathematical creativity in middle school students. Doctoral dissertation, Connecticut University, United States, pp. 79-80