# Using Geogebra to solve a problem	Season	1
	Episode	AP06
	Time frame	1 period

Prerequisites : None.

Objectives :

- Using geogebra to conjuecture and solve a problem.

Materials :

- *Computer room.*
- *Exercise sheets.*

1 – Part A — 20 mins

Using geogebra and working by pairs, Students have to draw a figure and to conjecture the maximal value of an area.

2 – Part B — 20 mins

Students have to find out the function involved in the problem and then to draw it (using geogebra) in order to find the maximal value of the area.

3 – Part C — 20 mins

In this part, Students have to confirm their previous answers, this time using computations.

At the end of the session, the answer sheets are collected by the teacher to be marked.

Student 1		Student 2	

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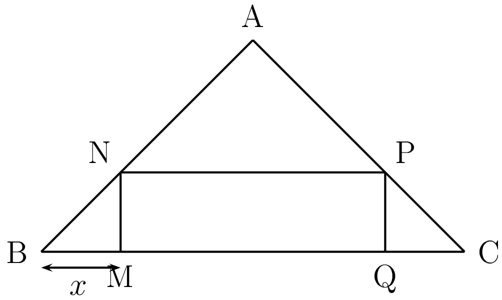
In the figure below, ABC is a right-angled isosceles triangle in A such that $BC = 8$ cm. $MNPQ$ is a rectangle inscribed in $\triangle ABC$. The length BM is variable, we denote it x, in cm.

The aim of this session is to find the position of the point M that maximizes the area of the rectangle $MNPQ$.



Part A – Using Geogebra

1. Use Geogebra to draw the figure. Don't forget to display the area of the rectangle on the figure.
2. Move the point M on the segment BC and conjecture the maximal value of the area of $MNPQ$.

Part B – Using the graph of a function

1. What is the minimal value for x ? Explain quickly your answer.
2. What is the maximal value for x ?
3. What are the measures of the angles of $\triangle ABC$? of $\triangle BMN$? Deduce the nature of the triangle BMN then the length of MN as a function of x.

4. Let f be the function that maps any adequate value of x to the corresponding area of $MNPQ$. Prove that
$$f(x) = 8x - 2x^2$$

5. Use Geogebra to draw the graph of f and give the maximal value of f and the value of x for which it is reached.

6. Deduce the maximal area of $MNPQ$ and the position of the point M for which it's reached.

Part C – Using computation

In this part, let's admit that the area of $MNPQ$ is given by the expression $8x - 2x^2$, where x represents the length BM.

1. What is the sign of the expression $-2(x-2)^2$?

2. Expand the expression $-2(x-2)^2$.

3. Using the two previous questions, deduce the maximal value of the area of $MNPQ$.

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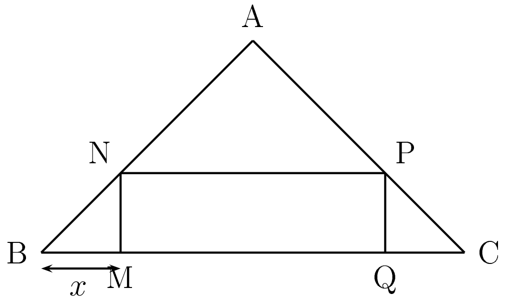

Part A – Using Geogebra

1. Use Geogebra to draw the figure. Don't forget to display the area of the rectangle on the figure.
2. Move the point M on the segment BC and conjecture the maximal value of the area of $MNPQ$.

   The maximum area for $MNPQ$ seems to be 8 cm^2.

Part B – Using the graph of a function

1. What is the minimal value for x? Explain quickly your answer.

   The minimal value for x is 0 because x represents a distance.

2. What is the maximal value for x?

   The maximal value for x is 4 because M can't be on the other side of the midpoints.

3. What are the measures of the angles of $\triangle ABC$? of $\triangle BMN$? Deduce the nature of the triangle BMN then the length of MN as a function of x.

   $\triangle ABC$ is a right-angled isosceles triangle in A so $\angle BAC = 90^o$ and $\angle ABC = \angle BCA = 45^o$.
   In $\triangle BMN$, $\angle BMN = 90^o$ because $MNPQ$ is a rectangle and $\angle MBN = \angle CBA = 45^o$. So $\triangle BMN$ is a right-angled isosceles triangle in B.
   We deduce that $MN = BC = x$.

4. Let f be the function that maps any adequate value of x to the corresponding area of $MNPQ$. Prove that
$$f(x) = 8x - 2x^2$$

   $f(x) = MN \times MQ = x \times (8 - 2x) = 8x - 2x^2$.

5. Use Geogebra to draw the graph of f and give the maximal value of f and the value of x for which it is reached.

   According to the graph, the maximal value of f seems to be 8 reached for $x = 2$.

6. Deduce the maximal area of $MNPQ$ and the position of the point M for which it's reached.

   The function represents the area so the maximal value of the area seems to be 8 cm^2 reached for $BM = 2$ cm.

Part C – Using computation

In this part, let's admit that the area of $MNPQ$ is given by the expression $8x - 2x^2$, where x represents the length BM.

1. What is the sign of the expression $-2(x - 2)^2$?

   $(x - 2)^2$ is a squared thus positive. As we multiply it by -2 which is negative, we deduce that $-2(x - 2)^2$ is negative.

2. Expand the expression $-2(x - 2)^2$.

   $-2(x - 2)^2 = -2(x^2 - 4x + 4) = -2x^2 + 8x - 8$.

3. Using the two previous questions, deduce the maximal value of the area of $MNPQ$.

   According to the first question $-2(x - 2)^2$ is negative so $-2(x - 2)^2 \leqslant 0$.
   According to the second question, we get $-2x^2 + 8x - 8 \leqslant 0$ thus $-2x^2 + 8x \leqslant 8$.
   The last inequation means that $f(x)$ can't be greater than 8.

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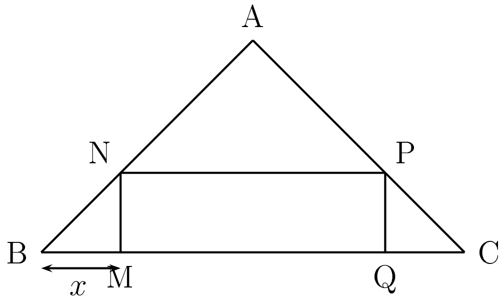

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