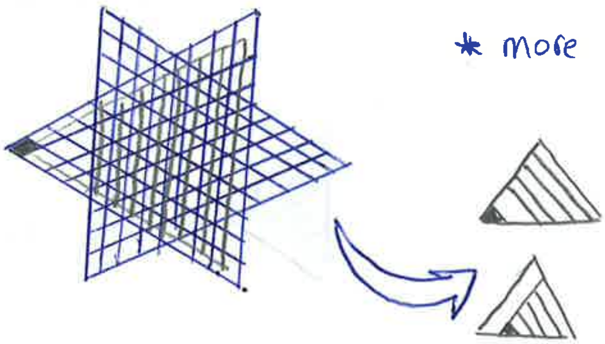
International mathematical Olympiad
"Formula of Unity" / "The Third Millennium"
2018/2019 year, final round

SOLUTIONS TO THE SECOND ROUND FOR PARTICIPANTS.

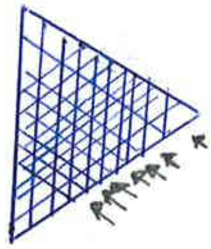
GRADE: 9 NUMBER: 23

4.

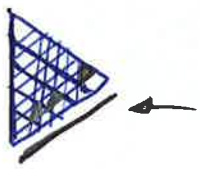
The picture on the right is like two triangle displayed opposite, we can think about how many triangles can be form with a little triangle, that contein that triangle, so we start in the left:



It seeing how many triangles can you form that contain a single (little) triangle so we know that from the left to the right we can obtain 9,9,9,9,8,7,6,5,4,3,2,1 from the bottom, so now, we need to see the "colums"



All triangles that are in the same line (top draw) can take part from the same number of triangle so if we multiplie the number of the triangle form in the botton to the triangle that are in the same line with a lateral looking to the bottom of the side tha we're starting.



if we start from here, the triangle that I mencioned are this

If we multiplied all we know that are 668 triangles in total.

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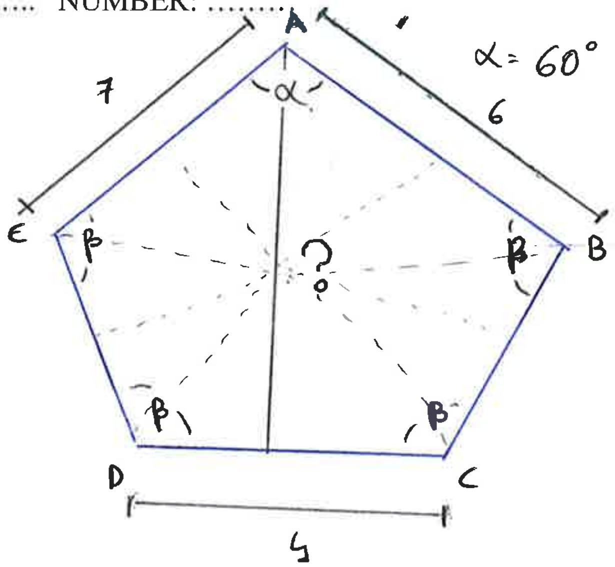
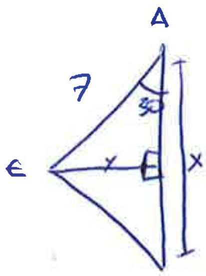
2.





$tg\ 30° = \frac{7}{x}$

SOLUTIONS TO THE SECOND ROUND FOR PARTICIPANTS.

GRADE: 9 NUMBER: 3

3:

$(y+\sqrt{x})(y-x^2)\sqrt{1-x} \le 0$;

$(y^2-yx^2+y\sqrt{x}-x^2\sqrt{x})\sqrt{1-x} \le 0$;

$y^2\sqrt{1-x} - yx^2\sqrt{1-x} + y\sqrt{x-x^2} - x^2\sqrt{x-x^2} \le 0$;

$(y^2-yx^2)\sqrt{1-x} + (y-x^2)\sqrt{x-x^2} \le 0$;

$(y^2-yx^2)\sqrt{1-x} \le -(y-x^2)\sqrt{x-x^2}$;

$(y^4+y^2x^4-2y^3x^2)(1-x) \le -(y^2+x^4-2yx^2)(x-x^2)$;

$y^4+y^2x^4-2y^3x^2-xy^4-y^2x^5+2y^3x^3 \le -(y^2x+x^5-2yx^3-y^2x^2$
$-x^6+2yx^4)$;

$y^4+y^2x^4-2y^3x^2-xy^4-y^2x^5+2y^3x^3 \le -y^2x-x^5+2yx^3+y^2x^2$
$+x^6-2yx^5$;

$y^4+y^2x^4-2y^3x^2-xy^4-y^2x^5+2y^3x^3+y^2x+x^5-2yx^3-y^2x^2-x^6+2yx^4 \le 0$

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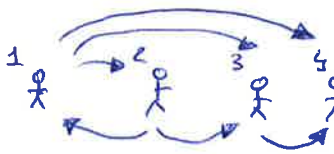
4:

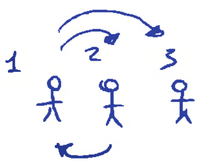
Knowing tha anybody can give more than one present to the same child , and that everybody have to give a differt number of present (a child can give 0 present) so we're in the situation that in a grupe of 2 and on a grup of 4

GIVE	1	0
RECIVE	0	1.



3	2	1	0
1	1	2	2

So the number of present give on N grupe of children is N-1, N-2, N-3 ... 0 , if we see the situation of N=3



GIVE	2	1	0
RECIVE	1	1	1

We see that if the sum of N-1, N-2, ... 0 (present given) is a multiplied of N, N is possible.

For example the N = 11 the sum of N-1, N-2, ... 0 is 55, and if you do it, it is possible.