BIMC
BULGARIA INTERNATIONAL MATHEMATICS COMPETITION
Burgas, Bulgaria, 30th June ~ 5th July 2013

BIMC 2013
Invitational World Youth Mathematics Intercity Competition

BURGAS MUNICIPALITY

BURGAS

TEAM CONTEST

Time：60 minutes

Instructions:

- Do not turn to the first page until you are told to do so.
- Remember to write down your team name in the space indicated on every page.
- There are 10 problems in the Team Contest, arranged in increasing order of difficulty. Each question is printed on a separate sheet of paper. Each problem is worth 40 points and complete solutions of problem 2, 4, 6, 8 and 10 are required for full credits. Partial credits may be awarded. In case the spaces provided in each problem are not enough, you may continue your work at the back page of the paper. Only answers are required for problem number 1, 3, 5, 7 and 9.
- The four team members are allowed 10 minutes to discuss and distribute the first 8 problems among themselves. Each student must attempt at least one problem. Each will then have 35 minutes to write the solutions of their allotted problem independently with no further discussion or exchange of problems. The four team members are allowed 15 minutes to solve the last 2 problems together.
- No calculator or calculating device or electronic devices are allowed.
- Answer must be in pencil or in blue or black ball point pen.
- All papers shall be collected at the end of this test.

English Version

For Juries Use Only

No.	1	2	3	4	5	6	7	8	9	10	Total	Sign by Jury
Score												
Score												

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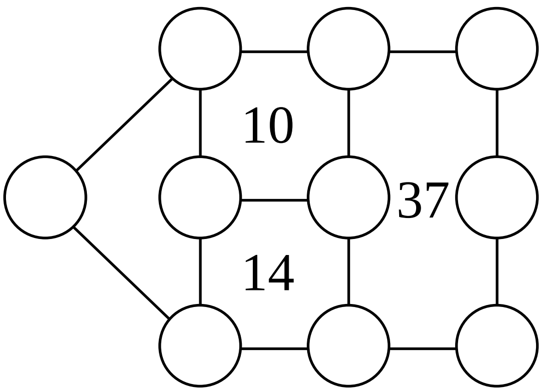
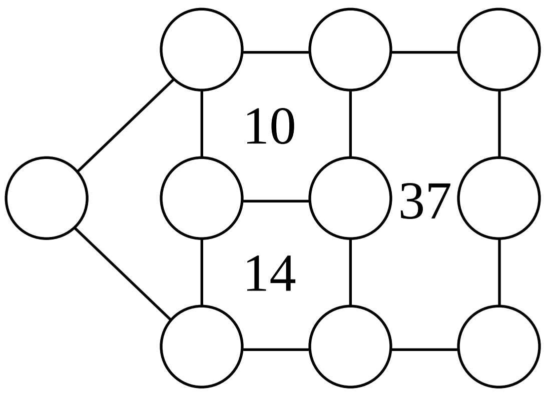
TEAM CONTEST

2^{nd} July 2013 Burgas, Bulgaria

Team： ______________________ Score： ______________

1. Each of the numbers 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 is to be put into a different circle in the diagram below. Consecutive numbers may not be put into two circles connected directly by a line segment. The sum of the numbers in the circles on the perimeter of each rectangle is equal to the number indicated inside. On the diagram provided for you to record your answer, put the numbers into the circles.





Answer: ______________________________

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Team: ____________________ Score: ______________

2. The side lengths, in cm, of a right triangle are relatively prime integers. The line joining its centroid and its incentre is perpendicular to one of the sides. What is the maximum perimeter, in cm, of such a triangle?

Answer: ______________________ cm

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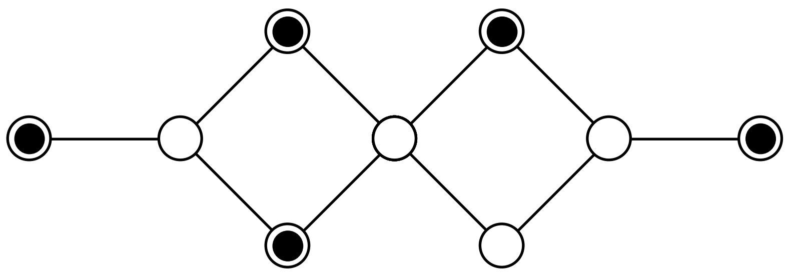
3. A marker is placed at random on one of the nine circles in the diagram below. Then it is moved at random to another circle by following a line segment. What is the probability that after this move, the marker is on a circle marked with a black dot?



Answer: ______________________________

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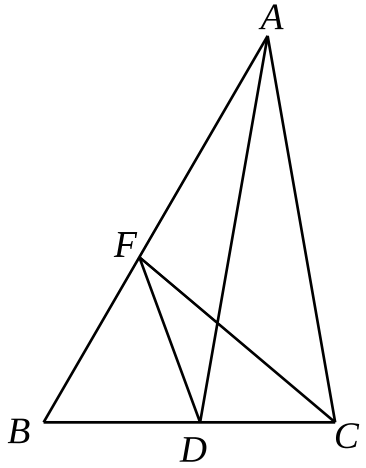
Team： ____________________ Score： ____________

4. In triangle ABC, $\angle A = 40°$ and $\angle B = 60°$. The bisector of $\angle A$ cuts BC at D, and F is the point on the line AB such that $\angle ADF = 30°$. What is the measure, in degrees, of $\angle DFC$?



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Answer: ____________________

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Team： ______________ Score： ______________

5. The first digit of a positive integer with 2013 digits is 5. Any two adjacent digits form a multiple of either 13 or 27. What is the sum of the different possible values of the last digit of this number?

Answer: ______________

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Team: ______________________ Score: ______________

6. In a tournament, every two participants play one game against each other. No game may end in a tie. The tournament record shows that for any two players X and Y, there is a player Z who beats both of them. In such a tournament,
   (a) prove that the number of participants cannot be six;
   (b) show that the number of participants may be seven.

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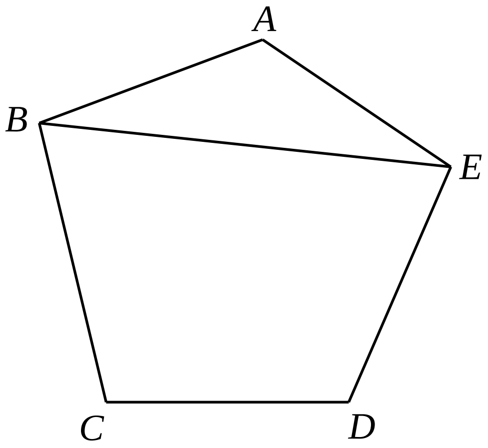
Team：________________ Score：________________

7. In the pentagon $ABCDE$, $\angle ABC = 90° = \angle DEA$, $AB = BC$, $DE = EA$ and $BE = 100$ cm. What is the area, in cm^2, of $ABCDE$?



Answer: ________________ cm^2

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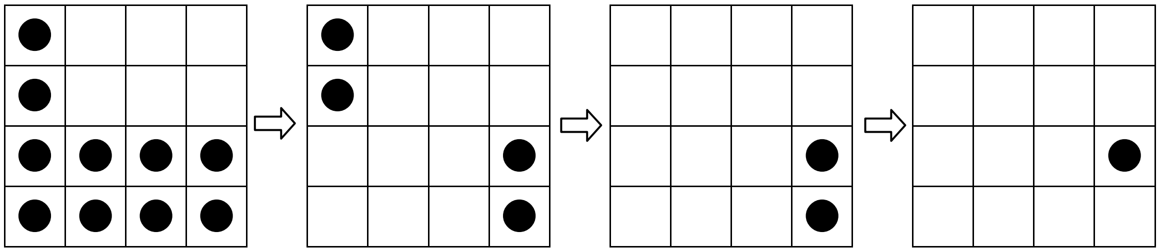
Team : ______________________ Score : ______________

8. A two-player game starts with a marker on each square of a 100 × 100 board. In each move, the player whose turn it is must remove a positive number of markers. They must come from squares forming a rectangular region which may not include any vacant square. The player who removes the last marker loses. A sample game on a 4 × 4 board is shown in the diagram below, where the first player loses. Which player has a winning strategy, the one who moves first or the one who moves second?



Answer: ______________________________

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Team : ______________________ Score : ______________

9. In a 5 × 5 display case there are 20 gems: 5 red, 5 yellow, 5 blue and 5 green. In each row and in each column, there is an empty cell and the other four cells contain gems of different colours. Twelve people are admiring the gems. Looking along a row or a column, each person reports the colour of the gem in the first cell, or the colour of the gem in the second cell if the first cell happens to be empty. Their reports are recorded in the diagram below, where R, Y, B and G stand for red, yellow, blue and green respectively. On the diagram provided for you to record your answer, enter R, Y, B or G in each of 20 of the 25 blank cells to indicate the colour of the gem in that cell.

	R		Y		R	
R						B
G						B
R						Y
	B		B		G	

	R		Y		R	
R						B
G						B
R						Y
	B		B		G	

Answer: ______________________

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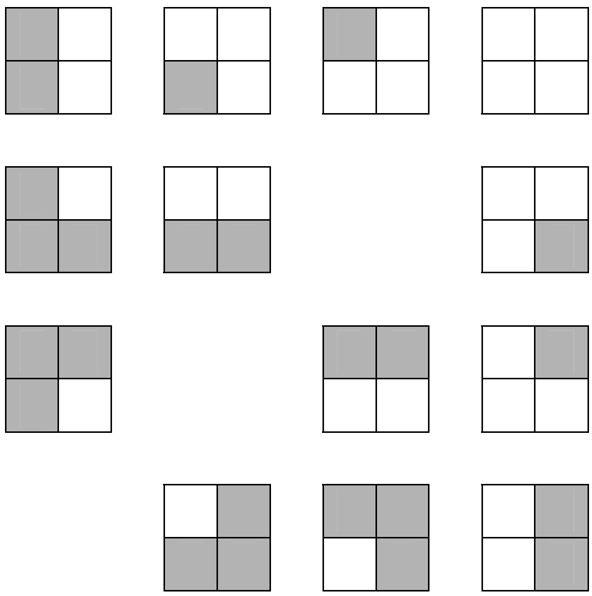
10. Four different stamps are in a 2×2 block. The diagram below shows the 13 different connected subblocks which can be obtained from this block by removing 0 or more of the stamps. The shaded squares represent stamps that have been removed. How many different connected subblocks of stamps can be obtained from a 2×4 block of eight different stamps?



Answer: ______________________________