Indonesia International Mathematics Competition 2011

Invitational World Youth Mathematics Intercity Competition

Team Contest

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

Invitational World Youth Mathematics Intercity Competition

TEAM CONTEST

20th July 2011 Bali, Indonesia

Team： ______________________________ Score： ________________

1. Find all real solutions of the equation $x^2 - x + 1 = (x^2 + x + 1)(x^2 + 2x + 4)$.

ANSWER: ______________________________________

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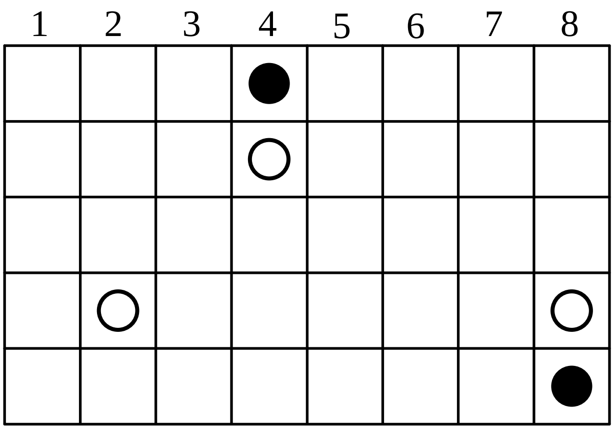
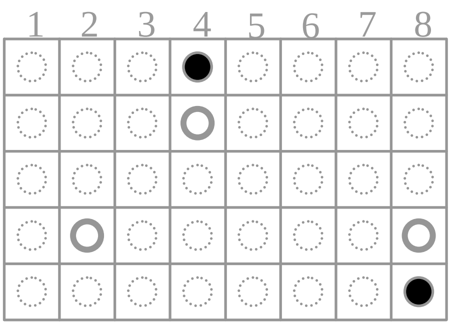
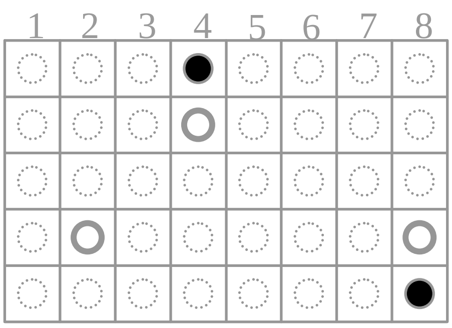
2. A domino is a 1×2 or 2×1 piece. Seventeen dominoes are placed on a 5×8 board, leaving six vacant squares. Three of these squares are marked in the diagram below with white circles. The two squares marked with black circles are not vacant. The other three vacant squares are in the same vertical column. Which column contains them?



(For rough work)





ANSWER: Column____

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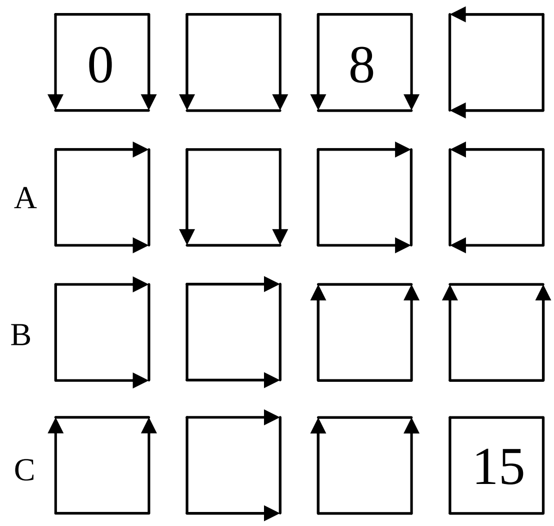
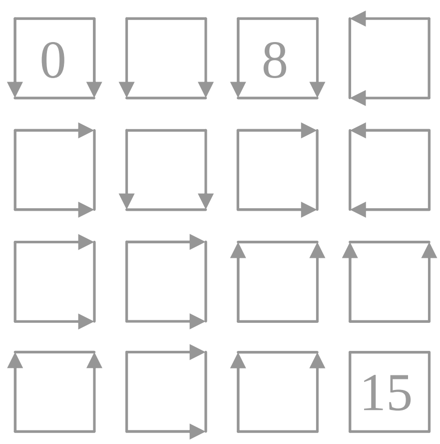
3. Place each of 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13 and 14 into a different vacant box in the diagram below, so that the arrows of the box containing 0 point to the box containing 1. For instance, 1 is in box A, B or C. Similarly, the arrows of the box containing 1 point to the box containing 2, and so on.



ANSWER:



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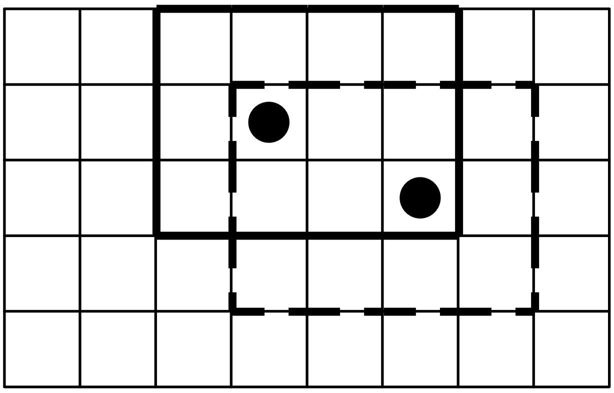
4. The diagram below shows a 5×8 board with two of its squares marked with black circles, and the border of two 3×4 subboards which contain both marked squares. How many subboards (not necessarily 3×4) are there which contain at least one of the two marked squares?



ANSWER: ______________________________________

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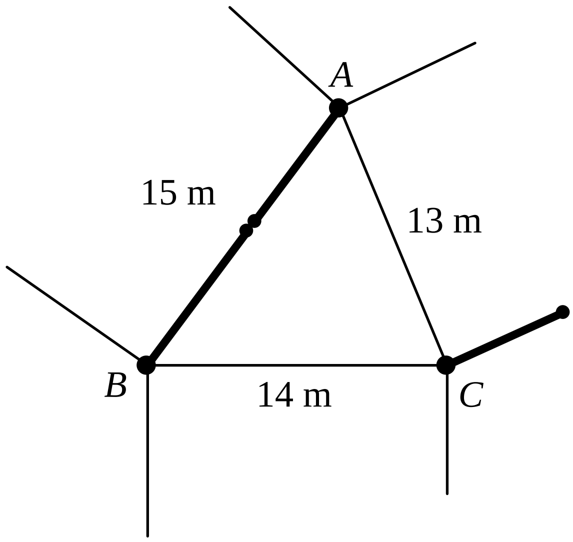
5. Three avenues, of respective widths 15 m, 14 m and 13 m, converge on Red Triangle in the outskirt of Moscow. Traffic is regulated by three swinging gates hinged at the junction points of the three avenues. As shown in the diagram below, the gates at A and B close off one avenue while the gate at C is pushed aside to allow traffic between the other two avenues through the Red Triangle. Calculate the lengths of the three gates if each pair closes off one avenue exactly.



ANSWER: Gate at A=____m, at B=_____m, at C=_____m

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6. Let $f(x)$ be a polynomial of degree 2010 such that $f(k)=-\frac{2}{k}$ where k is any of the first 2011 positive integers. Determine the value of $f(2012)$.

ANSWER: ______________________________

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7. A cat catches 81 mice, arrange them in a circle and numbers them from 1 to 81 in clockwise order. The cat counts them "One, Two, Three!" in clockwise order. On the count of three, the cat eats that poor mouse and counts "One, Two, Three!" starting with the next mouse. As the cat continues, the circle gets smaller, until only two mice are left. If the one with the higher number is 40, what is the number of the mouse from which the cat starts counting?

ANSWER: ______________________________

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8. In triangle ABC, $BC=AC$ and $\angle BCA=90°$. D and E are points on AC and AB respectively such that $AD = AE$ and $2CD = BE$. Let P be the point of intersection of BD with the bisector of $\angle CAB$. Determine $\angle PCB$.

ANSWER: ______________________________________

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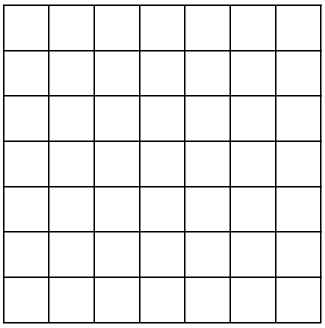
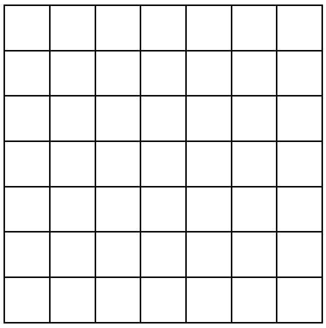
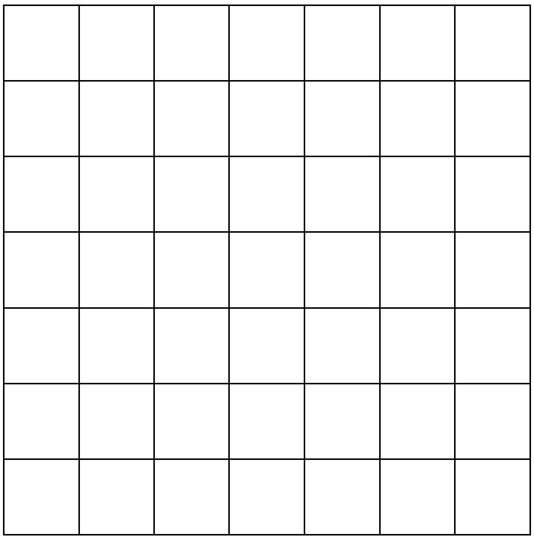
9. Paint 21 of the 49 squares of a 7×7 board so that no four painted squares form the four corners of any subboard.

(For rough work)







ANSWER: ____________________________________

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10. Arie, Bert and Caroline are given the positive integers a, b and c respectively. Each knows only his or her own number. They are told that $\frac{1}{a}+\frac{1}{b}+\frac{1}{c}=1$, and are asked the following two questions:
(a) Do you know the value of $a+b+c$?
(b) Do you know the values of a, b and c?
Arie answers "No" to both questions. Upon hearing that, Bert answers "Yes" to the first question and "No" to the second. Caroline has heard everything so far. How does she answer these two questions?

ANSWER: (a) ________________ (b) ________________