Taiwan International
Mathematics Competition 2012
(TAIMC 2012)

World Conference on the Mathematically Gifted Students
---- the Role of Educators and Parents
Taipei, Taiwan, 23rd~28th July 2012

Invitational World Youth Mathematics Intercity Competition

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												
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25th July 2012 Taipei, Taiwan

Team： _____ Score： _____

1. A positive real number is given. In each move, we can do one of the following: add 3 to it, subtract 3 from it, multiply it by 3 and divide it by 3. Determine all the numbers such that after exactly three moves, the original number comes back.

Answer: _____

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2. The average age of eight people is 15. The age of each is a prime number. There are more 19 year old among them than any other age. If they are lined up in order of age, the average age of the two in the middle of the line is 11. What is the maximum age of the oldest person among the eight?

Answer: _____

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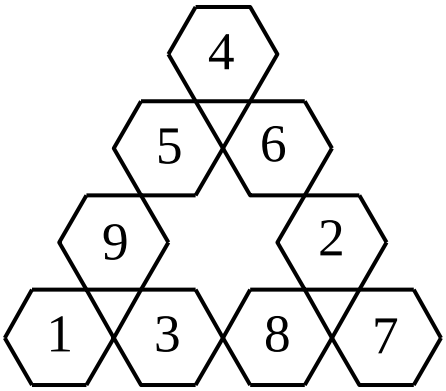
3. In the diagram below, the numbers 1, 2, 3, 4, 5, 6, 7, 8 and 9 are placed one inside each hexagon, so that the sum of the numbers inside the four hexagons on each of the three sides of the triangle is 19. If you are allowed to rearrange the numbers but still have the same sum on each side, what is the smallest possible sum and what is the largest possible sum?



Answer: The smallest possible sum is _____

The largest possible sum is _____

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4. There are 2012 evenly spaced points on a line. Each is to be painted orange or green. If three distinct points *A*, *B* and *C* are such that *AB* = *BC*, and if *A* and *C* are painted by the same color, so is *B*. Determine the number of all possible ways of painting these points.

Answer: _____

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5. Consider the four-digit number 2012. We can divide it into two numbers in three ways, namely, 2|012, 20|12 and 201|2. If we multiply the two numbers in each pair and add the three products, we get 2×012+20×12+201×2=666. Find all other four-digit numbers which yield the answer 666 by this process.

Answer: _____

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6. Let n be a positive integer such that $2n$ has 8 positive factors and $3n$ has 12 positive factors. Determine all possible numbers of positive factors of $12n$.

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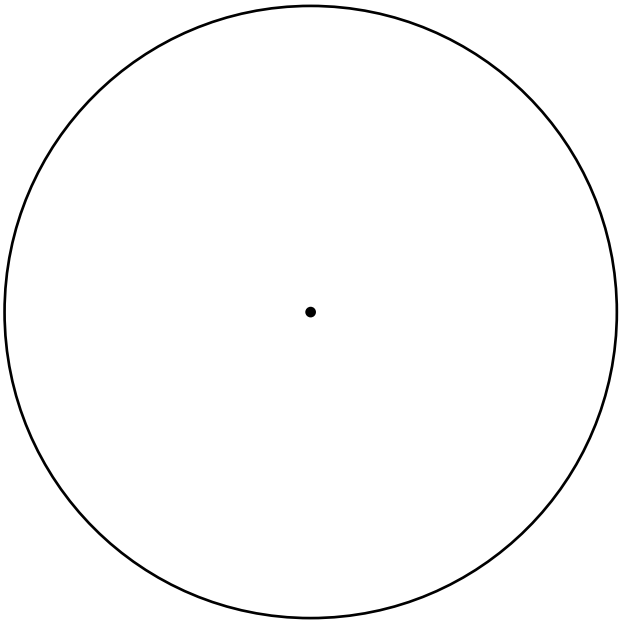
7. Use straight and circular cuts to dissect a circle into congruent pieces. There must be at least one piece which does not contain the centre of the circle in its interior or on its perimeter.



Answer: _____

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8. A machine consists of three boxes each with a red light that is initially off. After putting objects into the boxes, the machine may be used to run a check. For each box, if the total weight in that box is strictly less than the total weight in each of the other two boxes, the red light of that box will go on. Otherwise, the red light will go off. Use this machine twice to find a fake ball among seven balls which is heavier than the other six. The other six are of equal weight.

Answer: _____

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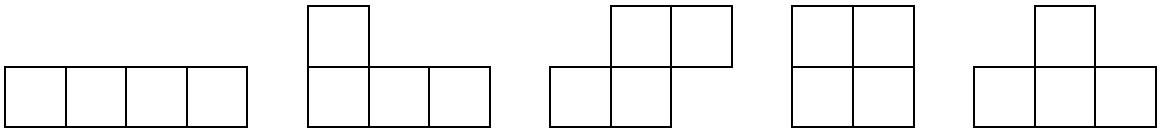
9. The diagram below shows all five pieces which can be formed of four unit squares. They are called the I-, L-, N-, O- and T-Tetrominoes.



(a) Use three different pieces to construct a figure with reflectional symmetry. Pieces can be rotated and reflected when used. Find five solutions.
(b) Use three different pieces to construct a figure with rotational symmetry. Pieces can be rotated and reflected when used. Find one solution.

(A figure consists of 12 connective unit squares joined edge to edge. Two figures are considered the same if one can be transformed into the other by rotation or reflection.)

(a)

(b)

Answer: _____

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10. The digits in base 10 have been replaced in some order by the letters *A*, *B*, *C*, *D*, *E*, *F*, *G*, *H*, *I* and *J*. We have three clues.

    (1) The two-digit number *AB* is the product of *A*, *A* and *C*.

    (2) The two-digit number *DE* is the product of *C* and *F*.

    (3) The two-digit number *BG* is the sum of *H*, *I* and the product of *F* and *G*.

    Here *A*, *B*, and *D* are nonzero. Which digits may be represented by the letter *J* ?

Answer: _____