2009 Philippine Elementary Mathematics International Contest

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# TEAM CONTEST

Time：60 minutes 2009/11/30

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 problem is worth 40 points and the total is 400 points. Each question is printed on a separate sheet of paper. Complete solutions of problems 1, 2, 3, 5, 6, 7, 8 and 9 are required. Partial credits may be given depending on the solutions written down. Only final answers are required for Problem number 4 and 10.
- The four team members are allowed 10 minutes to discuss and distribute the first 8 problems among themselves. Each team member must solve at least one problem. Each will then have 35 minutes to write the solutions of the assigned problem/s 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 in pencil or in blue or black ball point pen.
- All papers will be collected at the end of the competition.

## English Version

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Team：____________________ Score：____________

1. Below is a 3×60 table. Each row is filled with digits following its own particular sequence. For each column, a sum is obtained by adding the three digits in each column. How many times is the most frequent sum obtained?

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Row A | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | … | 4 | 5 |
| Row B | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | … | 3 | 4 |
| Row C | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | … | 1 | 2 |

Answer：____________ times

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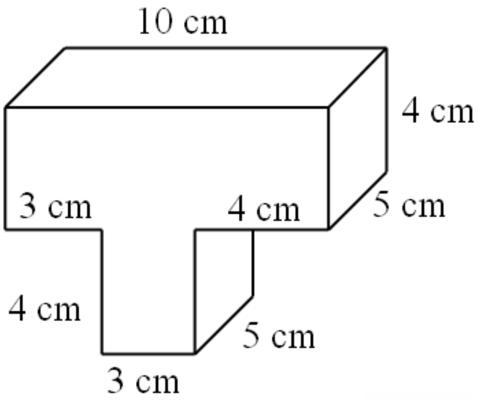
2. All surfaces of the T-shape block below is painted red. It is then cut into $1cm \times 1cm \times 1cm$ cubes. Find the number of $1cm \times 1cm \times 1cm$ cubes with all six faces unpainted.




Answer：__________ cubes

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3. Kiran and his younger brother Babu are walking on a beach with Babu walking in front. Each of Kiran's step measures 0.8 meter while each of Babu's step measures 0.6 meter. If both of them begin their walk along a straight line from the same starting point (where the first footprint is marked) and cover a 100 meter stretch, how many foot-prints are left along the path? (If a footprint is imprinted on the 100 meter point, it should be counted. Consider two foot-prints as recognizable and distinct if one does not overlap exactly on top of the other.)

Answer：________ foot-prints

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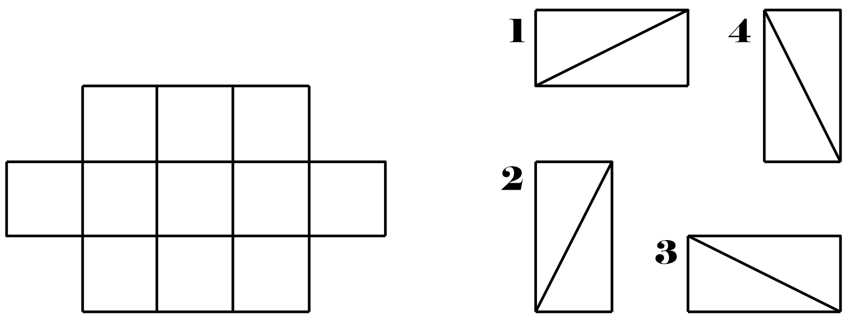
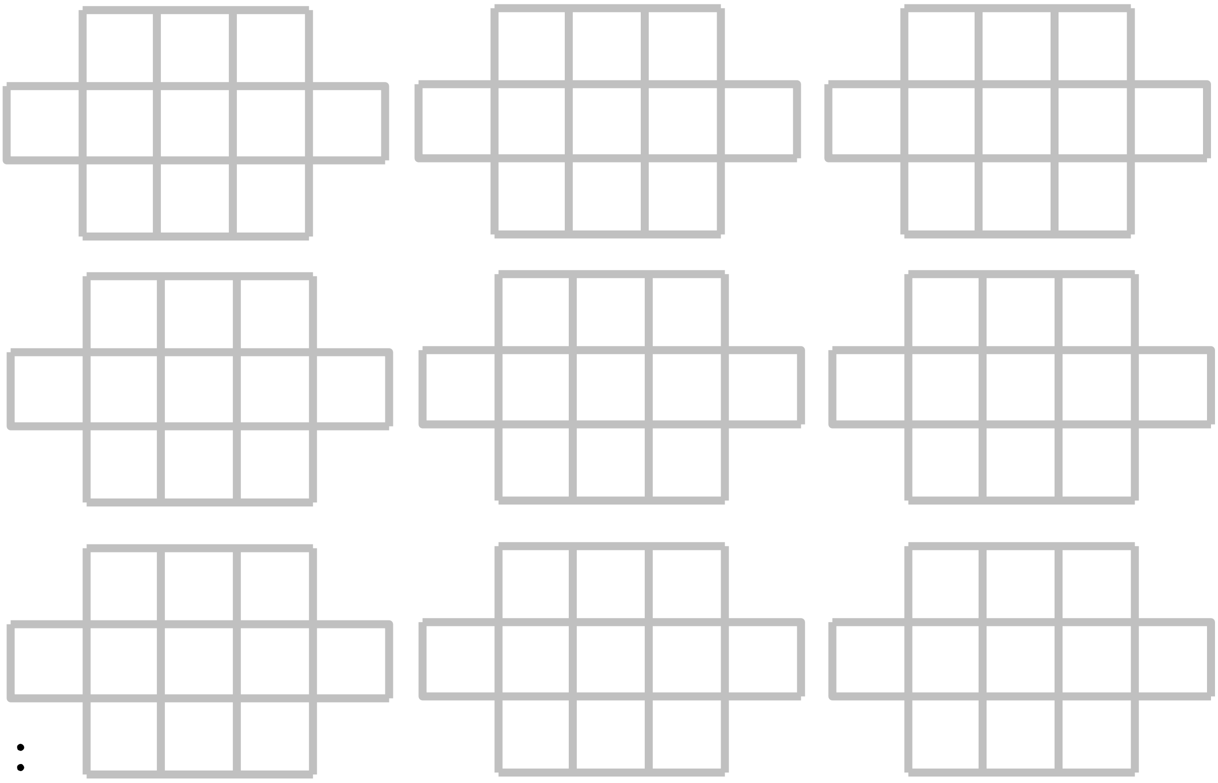
4. Four $2 \times 1$ cards, shown on the right in the following figure, are to be placed on the board shown on the left below, without overlapping and such that the marked diagonals of any two cards do not meet at a corner. The cards may not be rotated nor flipped over. Find all the ways of arranging these cards that satisfy the given conditions.




Answer :



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5. Water is leaking out continuously from a large reservoir at a constant rate. To facilitate repair, the workers have to first drain-off the water in the reservoir with the help of water pumps. If 20 pumps are used, it takes 5 full hours to completely drain-off the water from the reservoir. If only 15 pumps are used, it will take an hour longer. If the workers are given 10 hours to complete the job of draining-off the water, what is the minimum number of water pumps required for the job?

Answer： ________________ water pumps

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6. As shown in the following figure, we arranged the positive integers into a triangular shape so that the numbers above or on the left must be less than the numbers below or on the right and each line has one more number than those above. Let us suppose $a_{ij}$ stands for the number which is in the $i$-th line from the top and $j$ is the count from the left in the triangular figure(e.g. $a_{43}$=9). If $a_{ij}$ is 2009, what is the value of $i+j$?

$$
\begin{array}{ccccccc}
 & & & 1 & & & \\
 & & 2 & & 3 & & \\
 & 4 & & 5 & & 6 & \\
7 & & 8 & & 9 & & 10 \\
 & & & \cdots & & &
\end{array}
$$

Answer：__________________

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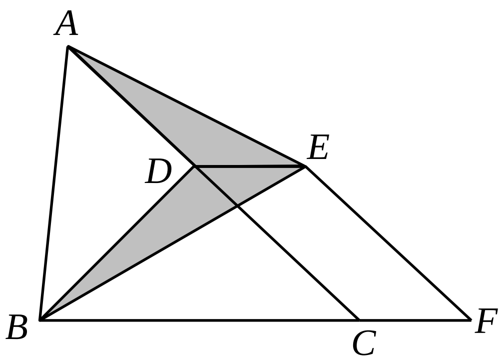
7. In the figure below, the area of triangle $ABC$ is 12 $\text{cm}^2$. $DCFE$ is a parallelogram with vertex $D$ on the line segment $AC$ and $F$ is on the extension of line segment $BC$. If $BC = 3CF$, find the area of the shaded region, in $\text{cm}^2$.




Answer：______________ $\text{cm}^2$

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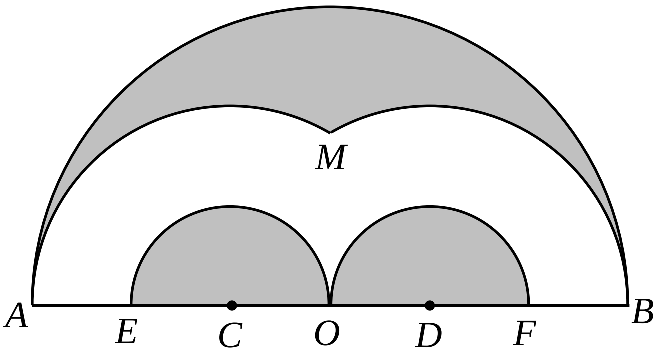
8. In the figure, the diameter *AB* of semi-circle *O* is 12 cm long. Points *C* and *D* trisect line segment *AB*. An arc centered at *C* and with *CA* as radius meets another arc centered at *D* and with *DB* as radius at point *M*. Take the distance from point *M* to *AB* as 3.464 cm. Using *C* as center and *CO* as radius, a semi-circle is constructed to meet *AB* at point *E*. Using *D* as center and *DO* as radius, another semi-circle is constructed to meet *AB* at point *F*. Find the area of the shaded region. (Use $\pi = 3.14$ and give your answer correct to 3 decimal places.)




Answer：______________ $cm^2$

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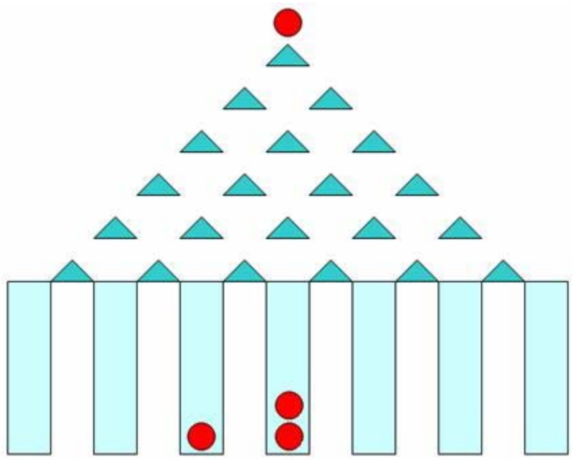
9. The following figure shows a famous model, designed by Galton, a British biostatistician, to test the stability of frequency. Some wooden blocks with cross-sections in the shape of isosceles triangles are affixed to a wooden board. There are 7 bottles below the board and a small ball on top of the highest block. As the small ball falls down, it hits the top vertices of some wooden blocks below and rolls down the left or right side of a block with the same chance, until it falls into a bottle. How many different paths are there for the small ball to fall from the top of the highest block to a bottle?



Answer： ____________ paths

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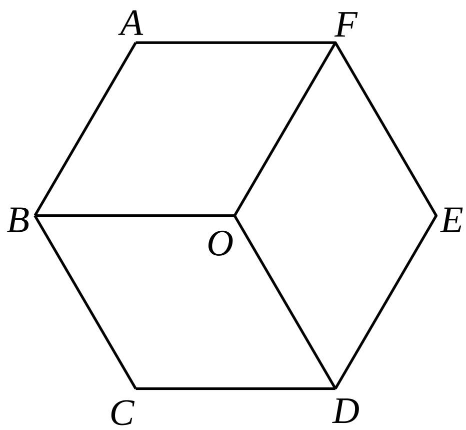
10. In the following figure, assign each of the numbers 1, 2, 3, 4, 5, 6, 7 to one of the six vertices of the regular hexagon $ABCDEF$ and its center $O$ so that sums of the numbers at the vertices of the rhombuses $ABOF$, $BCDO$ and $DEFO$ are equal. If solutions obtained by flipping or rotating the hexagon are regarded as identical, how many different solutions are there?




Answer：