Second round
Dutch Mathematical Olympiad

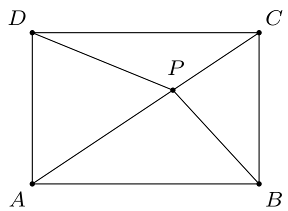
Friday, March 13, 2026

- Time available: 2.5 hours.
- The competition consists of five B-problems and two C-problems.
- You are not allowed to use a calculators or other electronic device, nor a formula sheet. You can only use a pen, compass, ruler, set square, and of course your mental skills.
- Good luck!

B-problems

In B-problems, you only have to give the answer (e.g. a number). An explanation is not required. You will get 4 points for a correct answer and 0 points for a wrong or incomplete answer. So work calmly and accurately, as a small miscalculation may result in your answer being wrong.
REMEMBER: give your answers in exact and simplified form such as $\frac{11}{81}$ or $2 + \frac{1}{2}\sqrt{5}$ or $\frac{1}{4}\pi + 1$ or 3^{100}.

B1. In rectangle $ABCD$, $|AB| = 12$ and $|BC| = 8$. On the diagonal AC lies a point P. The area of quadrilateral $ABPD$ is exactly twice the area of quadrilateral $BCDP$.
What is the area of triangle BCP?
Note: the image is not to scale.



B2. The top row of a 3×5 table contains the numbers 1 to 5 in ascending order. Manon may also write the numbers 1 to 5 in the middle row, where she may choose the order herself. In the bottom row, we write in each box what you get if you multiply the two numbers above it. You get the *value* of such a table by adding the four smallest numbers in the bottom row. For example, the table in the top right has a value of $3 + 10 + 6 + 5 = 24$ and the table in the bottom right has a value of $2 + 10 + 12 + 5 = 29$.
What is the maximum value Manon can achieve like this?

1	2	3	4	5
3	5	2	4	1
3	10	6	16	5

1	2	3	4	5
2	5	4	3	1
2	10	12	12	5

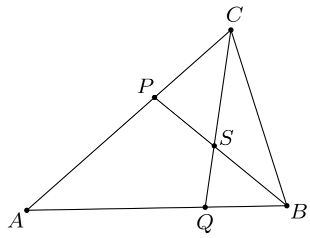
B3. For each positive integer we create a finite sequence of positive integers by repeatedly appending numbers to the sequence according to the following rule: if t is the last number in the sequence and t is at least 3, then the next number equals

- $t/5$ if t is divisible by 5;
- the multiple of 5 closest to t if t is not divisible by 5.

If the last number is 1 or 2, we stop. For example, the sequence corresponding to 53 is: 53, 55, 11, 10, 2.
For how many starting numbers from 1 up until 200 is the last number in the corresponding sequence equal to 1?

PLEASE CONTINUE ON THE OTHER SIDE

B4. In triangle ABC, point P lies on side AC such that $|AP| = |BP|$ and point Q lies on side AB such that $|AQ| = |CQ|$. The intersection point of BP and CQ is called S. Finally, $|BQ| = |BS|$.
What is the magnitude of $\angle A$ in degrees?
Note: the image is not to scale.



B5. Tim has a chalkboard with twice the number 1 on it. He may now repeatedly wipe out one of the two numbers and replace it with the result of adding the two numbers that were just on the board. Thus, after the first step, the numbers 1 and 2 are always on the board, and after two steps, either 1 and 3 are on the board, or 2 and 3. A pair $\{A, B\}$ is called *unreachable* if it is not possible for A and B to be on the board together.
What is the smallest number N such that the nine pairs $\{2, N\}, \{3, N\}, \{4, N\}, \ldots, \{10, N\}$ are all unreachable?

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C-problems

For the C-problems not only the answer is important; you also have to write down a clear reasoning that shows the correctness of your answer. A correct and well-explained answer is awarded 10 points. Partial solutions may also be worth some points. Therefore, write everything down clearly and hand in your drafts.

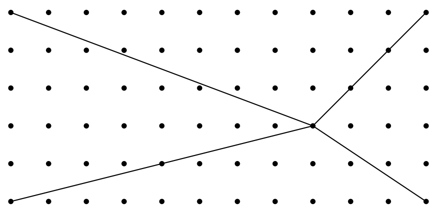
ATTENTION: Use separate sheets of paper for each C-problem and also hand in the drafts for each problem separately.

C1. We call an $n \times n$-square of integers *balanced* if each row and each column contains the numbers 1 to n in some order, and, moreover, in each 2×2-square, if you add the four numbers together, the result is even.

(a) Does a balanced square exist for $n = 6$? *(If yes, give an example and show it meets the requirements; if no, give a proof why not.)*

(b) Does a balanced square exist for $n = 7$? *(If yes, give an example and show it meets the requirements; if no, give a proof why not.)*

C2. In this problem we consider an exam hall with tables arranged according to a rectangular grid. The distance between two consecutive columns is always the same and this distance equals the distance between any two consecutive rows. The picture below shows an example with 6 rows and 12 columns, where each point represents a table. In this example, Esther sits at the table on the 4th row from the top and in the 9th column from the left and looks successively at the four tables at the corners. On the line segment between her table and the table on the top left, there is exactly 1 table apart from her own table, namely the one at the corner. On the line segment from her table to the top right there are 3 tables apart from her own table, on the line segment to the bottom right there is 1 table, and on the line segment to the bottom left there are 2 tables. (So we don't count her own table, but we do count the corner table.)



(a) Suppose Esther sits in the 6th row of an exam hall whose number of columns we do not know. What are now the possible numbers of other tables on the line segment from her table to the top left table? *(Prove your answer.)*

(b) Suppose Esther is sitting in the 11th row of an exam hall whose number of columns we do not know. What are now the possible numbers of other tables on the line segment from her table to the top left table? *(Prove your answer.)*

(c) In the example, Esther sees 1, 3, 1 and 2 tables successively in the four directions. Prove that there is no exam hall where Esther can sit in a place so that she sees 1, 6, 10 and 15 tables (in some order) in the four directions.