UK Maths Trust

Mathematical Competition for Girls

Thursday 25 September 2025

Organised by the United Kingdom Mathematics Trust

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INSTRUCTIONS

1. Do not turn over the page until told to do so.

2. Time allowed: 90 minutes.

3. Each question carries 10 marks.

4. The use of rough paper, rulers and compasses is allowed, but calculators and protractors are forbidden.

5. Use a pencil to fill in the Answer Sheet. Pay close attention to the instructions on the Answer Sheet that shows how to code your answers.

6. If you need to rub out an answer, do it as thoroughly as possible.
   Do not doodle on the Answer Sheet. Your answers will be marked by a machine, which may interpret any pencil markings in its own way, or reject the Answer Sheet.

7. All answers are three digit numbers, which may start with a zero. For example, if you think the answer is 25, you should enter 025 on the answer sheet.

8. Read the questions carefully, paying particular attention to what you are required to enter on the Answer Sheet for each part.
   In some questions you will be asked to enter, for example, the sum of the digits of the answer, rather than the answer itself.

9. The space for each question part and sub-part is clearly labelled on the Answer Sheet. The number of marks for each part is indicated on this Question Paper.

10. There are no negative marks. Partial marks may be awarded for specific incorrect answers, so you should enter your answer even if you are not completely sure.

11. Earlier questions tend to be easier. Questions have multiple parts. Often earlier parts introduce results or ideas useful in solving later parts of the problem.

12. The questions on this paper are designed to challenge you to think, rather than guess. Although you are only required to enter numerical answers, you should still derive your results carefully.

13. To accommodate candidates sitting in other time zones, please do not discuss the paper on the internet until 08:00 BST on Saturday 27th September, when the solutions video will be released at ukmt.org.uk/video-solutions-list.

Enquiries about the Mathematical Competition for Girls should be sent to:

*challenges@ukmt.org.uk*

www.ukmt.org.uk

Throughout this paper, you may use the fact that 2025 **has** 15 **factors and its prime factorisation is** $3^4 \times 5^2$**.**

1. Before you start this question, expand and simplify $(a + b)^3$.

    For each part of the question, enter your answer as follows. The first digit should be the number of digits of your answer, and the second two digits should be the sum of the digits of your answer. For example, if your answer is 2025, you should enter 409 on the answer sheet (2025 has 4 digits, and the sum of its digits is 09).

    (a) Find the cube root of 1030301.   [3 marks]

    (b) Find the square root of 16008001.   [3 marks]

    (c) Find the fourth root of 16096216216081.   [4 marks]

2. Tom has a large supply of two types of dominoes, Type A and Type B. Type B dominoes can be rotated 180° so that the grey square is on top.

    type A   type B
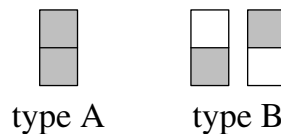
    Tom wants to select three dominoes and place them next to each other to create a 2×3 rectangle (so the dominoes remain vertical, as shown above). He wants both top and bottom rows of his rectangle to contain at least one square of each colour.

    (a) (i) How many sequences can Tom make which contain exactly one Type A domino?

                                                                          [2 marks]

        (ii) How many sequences of three dominoes can he make in total?   [2 marks]

    (b) Each of the white squares on Type B dominoes has a whole number between 1 and 6 (inclusive) written on it. Grey squares have no numbers on them. There are several copies of each numbered Type B domino.

        (The numbers do not change when a Type B domino is rotated; for example a 6 does *not* become a 9.)

        Tom wants to select and arrange three dominoes as before (with both top and bottom rows containing at least one square of each colour, and using dominoes of either type), but now he also wants the numbers on the top row to add up to 6 and the numbers on the bottom row to add up to 6.

        In how many ways can he do this?   [6 marks]

3. Consider the number $M = 99...99$ which consists of several digit nines. A single division sign is placed between two adjacent digits of M and the resulting calculation is evaluated to produce a whole number N.

  (a) In the case when M has nine digits,

    (i) How many possible values can N take?   [1 mark]

    (ii) How many digits does the smallest possible value of N have?   [2 marks]

  (b) In the case when M has 2025 digits,

    (i) How many possible values can N take?   [3 marks]

    (ii) How many digits does the smallest possible value of N have?   [4 marks]

4. (a) Positive (non-zero) whole numbers a and b satisfy $(a + b)(a - b) = 45$.

    (i) How many possible values of a are there?   [2 marks]

    (ii) What is the smallest possible value of a?   [2 marks]

 (b) Priya and Rhia each create a sequence of positive integers.

    Priya starts with 1000 and adds consecutive odd numbers, so that her sequence begins 1000, 1001, 1004, 1009.

    Rhia starts with 3025 and also adds consecutive odd numbers.

    (i) The number 3025 appears in both sequences. The next smallest number that appears in both sequences is a four-digit number $'3abc'$. Enter the digits $'abc'$ on your answer sheet.   [3 marks]

    (ii) How many numbers (including 3025) appear in both sequences?   [3 marks]

5. The diagram shows triangle ABC with side lengths $AB = 85$, $BC = 160$ and $CA = 103$ units. The bisector of angle ABC intersects the side AC at point D. The line through A perpendicular to BD intersects BD at M and BC at P.
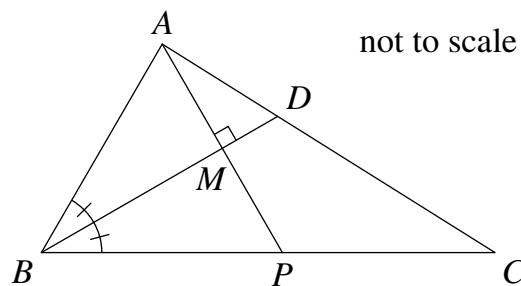
  (a) Which of the following statements are correct?

    (i) D is the midpoint of AC.

    (ii) M is the midpoint of AP.

    (iii) P is the midpoint of BC.

    Enter 1 for each correct statement and 0 for each incorrect statement. For example, if you think that statements (i) and (ii) are correct, you should enter 110.   [2 marks]

  (b) State the length of PC.   [2 marks]

  (c) The line through A perpendicular to the bisector of angle ACB intersects it at N.

    Find the length of MN.   [6 marks]