Oxford Mathematics Team Challenge 2026
Maps Round Question Booklet

Instructions

1. Do not open the paper until the invigilator tells you to do so.
2. Format. This round contains 46 numerical questions. All answers are non-negative integers; in your 9×9 grid, write down your answers as **non-negative integers** in the cells corresponding to the question.
3. Time limit. 75 minutes. You may not write anything into your Answer Booklet, including your team name, after the allotted time has expired.
4. No calculators, squared paper or measuring instruments. Lined paper and blank paper for rough working is allowed. You may use a pen or pencil to preference, however you may want to use a pencil for the Answer Sheet in order to edit your submission. Other mediums for working (e.g., digital devices, whiteboards, carving into *Ojos del Salado*) are strictly forbidden.
5. Scoring rules. Your team is awarded full points for any correctly-answered questions. Any correctly-answered question which is connected to the centre by a series of horizontal and vertical paths of correct answers scores **twice as many points**.

   The points for each question are in the bottom right of the cells in the Answer Sheet, as well as at the end of the questions in the Question Booklet, and are marked in [square brackets]. Each zone is out of 20 points; there are six zones.
6. Don't expect to complete the whole paper in the time! There are more questions than you have time to answer: think carefully about which zones you want to tackle in the time given, and note that questions worth more marks are generally harder.
7. Keep in mind that some questions further in a zone may use the ideas or results from previous questions in that zone.
8. You are also encouraged to think deeply, rather than to guess.
9. Good luck, and enjoy! ☺

Red Zone (R)

	R7	R4
R8	R5	R1
R6	R2	**F**
R3		

The Red Zone is out of **20 points**.

R1. A positive integer is called *portly* if the sum of its digits is equal to the product of its digits. What is the sum of all two-digit portly numbers? *[Hint: expand $(A-1)(B-1)$.]* [2]

R2. When the quadratic equation

$$x^2 + 2Bx + C = 0$$

has exactly one root at $x = \alpha$, what is the value of $-24C/\alpha B$? [1]

R3. In the equation

$$(x^2 + x + 1)(y^2 - y + 1) = 3,$$

how many integer solutions to (x, y) are there? [2]

R4. What is the sum of all three-digit portly numbers? *[For a definition of portly number, see R1.]* [3]

R5. The integer n satisfies

$$1 + \sqrt{n} \leq 1 + \sqrt{10 + \sqrt{100 + \sqrt{1000 + \sqrt{10000}}}} \leq 1 + \sqrt{n+1}$$

What does n equal? [3]

R6. When expanded, what is the sum of the coefficients of $(x^2+x+1)(x^2-x+1)$? [2]

R7. What is the value of

$$\frac{1}{\dfrac{1}{2001} + \dfrac{1}{2002} + \cdots + \dfrac{1}{2025}}$$

when rounded down to the nearest integer? [3]

R8. 100010001 has four distinct prime factors less than 100. What is their sum? [4]

Yellow Zone (Y)

The Yellow Zone is out of **20 points**.

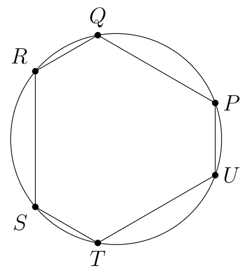
		Y3
F	Y2	Y6
Y1	Y5	Y8
Y4	Y7	

Y1. We say n is a flavourful number if n is an integer such that the function $f(n) = n/(n-7)$ is an integer. What is the sum of all flavourful numbers? *[Integers are all whole numbers:* $\ldots, -3, -2, -1, 0, 1, 2, 3, \ldots$*]* [2]

Y2. A triangle has side lengths 5, 5 and 6. What is its area? [2]

Y3. Consider the hexagon $PQRSTU$ where P, Q, R, S, T, and U all lie on a circle.

$QR = ST = UP = 3$, and $PQ = RS = TU = 6$. When fully simplified, the area of $PQRSTU$ is $c\sqrt{3}/d$. What is $c + d$?



[2]

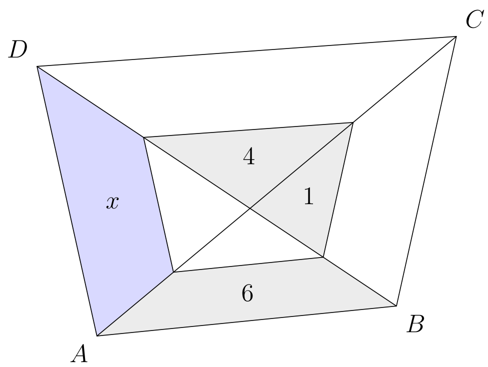
Y4. Shaun tiles the plane with regular n-sided polygons which each have a perimeter of 1 cm. What is the sum of the possible values of n that Shaun could have chosen? [2]

Y5. Nikky has a regular polygon lying on a table. When she rotates it 54° clockwise about its centre, she notices it covers the precisely same spots on the table as before. What is the smallest number of sides Nikky's polygon could have? [2]

Y6. Six points A, B, C, D, E and F lie on (the circumference of) a circle; Stewart measures that $AB = BC = CD = 5$ cm and $DE = EF = FA = 4$ cm. When fully simplified, the area of the hexagon $ABCDEF$ equals $a\sqrt{3}/b$ cm^2. What is $a + b$? [3]

Y7. Let ABC be a triangle. The points D and E lie on AC and AB respectively. Let BD and CE intersect at P. Given the areas $PBE = 10$, $PCD = 15$, and $PEAD = 17$, what is the area of ABC? [3]

Y8. A convex quadrilateral $ABCD$ has its diagonals joined, and the quadrilateral within is similar to $ABCD$. Given the shaded-in regions have areas as labelled, what is the area of the shaded region labelled 'x'?



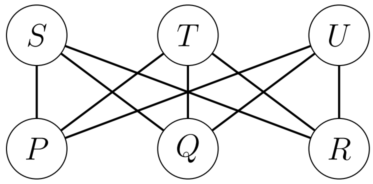
[4]

Amber Zone (A)

	A8		
A3	A5	A7	
A1	A2	A4	A6

The Amber Zone is out of **20 points**.

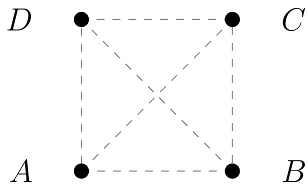
A1. The following diagram depicts six villages in East Oxfordshire, P, Q, R, S, T, U, connected by nine roads directly between villages. Raph starts at one of the villages, then travels along four (distinct) roads. He ends up in the village he started in and altogether visited four villages. How many distinct ways can Raph do this?



[2]

A2. Two triangles are placed on top of each other; their overlapping region forms a polygon with n sides. What is the sum of possible values of n? [2]

A3. West Oxfordshire contains the four villages Alvescot, Broadwell, Combe and Ducklington. A *plan for West Oxfordshire* consists of connecting each pair of villages by either a road or a river. How many distinct plans for West Oxfordshire are there?



[2]

A4. A convex pentagon and a convex hexagon are placed on top of each other; their overlapping region forms a polygon with n sides. What is the sum of possible values of n? *[Neither are necessarily regular polygons.]* [2]

A5. In West Oxfordshire, cyclists can only travel along roads, and boatsmen along rivers. How many plans for West Oxfordshire allow both cyclists and boatsmen to reach any of the villages? *[For a definition of a plan for West Oxfordshire, see A3.]* [3]

A6. Draw a straight line on a 2×1 cm^2 piece of paper that splits the paper into two regions, then fold the paper along that line. The outline of the folded shape forms a polygon with k sides. What is the sum of possible values of k? [2]

A7. With the construction in A6, the two regions overlap each other to form a polygon with ℓ sides. What is the sum of possible values of ℓ? [2]

A8. How many plans for West Oxfordshire allow cyclists (but not necessarily boatsmen) to reach any of the villages? *[For a definition of a plan for West Oxfordshire, see A3.]* [5]

Green Zone (G)

G6	G4	G2	G1
	G7	G5	G3
		G8	

The Green Zone is out of **20 points**.

G1. Alice, Bob and Charlie say the following:

Alice (1): Bob is lying.
Bob (2): Charlie is telling the truth.
Charlie (4): We are all lying.

For each person who is lying, add their bracketed number to get the *liars' score* of this problem (for example, if Alice and Charlie are lying, the liars' score is $1 + 4 = 5$). What is the liars' score in this case? [1]

G2. Felix, Gabby, Harry, Ivy and Jacob say the following:

Felix (1): My middle name is Sheldon.
Gabby (2): Between myself, Harry and Ivy, an even number of us are lying.
Harry (4): There are a square number of liars.
Ivy (8): $1 + 1 = 2$.
Jacob (16): Harry is lying.

What is the liars' score? *[See G1. for the definition of liars' score.]* [2]

G3. Kai, Laurel, Miguel, Nina and Oliver say the following:

Kai (1): There are exactly three liars.
Laurel (2): There are at least two liars.
Miguel (4): There are at least three liars.
Nina (8): There are at most two liars.
Oliver (16): There are at most three liars.

What is the liars' score? *[See G1. for the definition of liars' score.]* [2]

G4. Let $50 \leq k \leq 100$. The following 100 people, Terence and T_2 up to T_{100}, say:

Terence: 2 is a prime number.
T_2: At least $k\%$ of the people who spoke before me are lying.
$\vdots$ $\vdots$
T_n: At least $k\%$ of the people who spoke before me are lying.
$\vdots$ $\vdots$
T_{100}: At least $k\%$ of the people who spoke before me are lying.

If $k = 50$, how many people are lying? [2]

G5. The following 99 people, P_1 up to P_{99}, say the following:

$$\begin{array}{rl} P_1 \ (1): & \text{There is exactly one liar.} \\ P_2 \ (2): & \text{There are exactly two liars.} \\ \vdots & \quad \vdots \\ P_n \ (n): & \text{There are exactly } n \text{ liars.} \\ \vdots & \quad \vdots \\ P_{99} \ (99): & \text{There are exactly 99 liars.} \end{array}$$

What is the liars' score? *[See G1. for the definition of liars' score.]* [1]

G6. With the scenario in G4., let k' be the least percentage such that T_{100} is the twelfth person to tell the truth. Given that $k' = AB.\dot{C}\%$ for digits A, B, C, what is $A + B + C$? [6]

G7. With the scenario in G4., if $k = 66.\dot{6}\%$, how many people are lying now? [2]

G8. The following 99 people, Fawkes, R_1 up to R_{97}, and Tooth, say the following:

$$\begin{array}{rl} \text{Fawkes } (0): & \pi = 4. \\ R_1 \ (1): & \text{Fawkes is lying if and only if } R_2 \text{ is.} \\ R_2 \ (2): & R_1 \text{ is lying if and only if } R_3 \text{ is.} \\ \vdots & \quad \vdots \\ R_n \ (n): & R_{n-1} \text{ is lying if and only if } R_{n+1} \text{ is.} \\ \vdots & \quad \vdots \\ R_{97} \ (97): & R_{96} \text{ is lying if and only if Tooth is.} \\ \text{Tooth } (98): & \pi < 4. \end{array}$$

What is the liars' score? *[See G1. for the definition of liars' score.]* [4]

Cyan Zone (C)

The Cyan Zone is out of **20 points**.

		C5
	C6	C3	C1
C7	C4		
	C2		

C1. The *Ackermann function* is defined on non-negative whole numbers m, n as follows:

$$\begin{array}{lcl} \mathrm{A}(0,n) & = & n+1 \\ \mathrm{A}(m+1,0) & = & \mathrm{A}(m,1) \\ \mathrm{A}(m+1,n+1) & = & \mathrm{A}(m,\mathrm{A}(m+1,n)) \end{array}$$

Find the value of $\mathrm{A}(1,1)+\mathrm{A}(1,2)+\mathrm{A}(1,3)$. [2]

C2. The Fibonacci numbers are given by

$$F_1 = 1, \quad F_2 = 1 \qquad \text{and} \qquad F_{n+2} = F_{n+1} + F_n \quad \text{for } n > 0.$$

Let p/q be the probability that a randomly picked Fibonacci number is odd, when fully simplified. What does pq equal? [2]

C3. Find the value of $\mathrm{A}(2,1)$. *[For the definition of* A*, see C1.]* [2]

C4. Define the Fibonacci numbers F_n as we did in C2. When the series

$$F_1x + F_2x^2 + F_3x^3 + \cdots$$

has a limit for a given value of x, it tends to

$$\frac{x}{a - bx - cx^2}$$

where a, b, c are positive integers. What is $a+b+c$? *[Hint: consider the fact that* $F_{n+2}x^n = F_{n+1}x^n + F_nx^n$*.]* [4]

C5. By considering $\mathrm{A}(2,i)$ for $i = 0, 1, 2, 3$, or otherwise, find the value of $\mathrm{A}(2,4)$. *[For the definition of* A*, see C1.]* [2]

C6. By considering $\mathrm{A}(3,i)$ for $i = 0, 1, 2$, or otherwise, find the value of $\mathrm{A}(3,3)$. *[For the definition of* A*, see C1.]* [3]

C7. The series in C4 has a limit for a given value of x if, and only if,

$$|x| < \frac{d\sqrt{5} - 1}{e}$$

where d and e are positive integers. What is $d+e$? *[Hint: factorise the quadratic* $(a - bx - cx^2)$ *where* a, b, c *are the answers in C4.]* [5]

Blue Zone (B)

The Blue Zone is out of **20 points**.

		B2	
		B4	B7
B1	B3	B6	
	B5		

B1. The graph

$$|x| + |y| = 16$$

describes a polygon with an area A. What does A equal? [2]

B2. Sophie starts with a sphere of radius 1. Cai puts the sphere inside the smallest possible cube that can contain it. Sophie then puts the cube is into the smallest possible sphere that can contain it. The volume of the larger sphere is $k\pi$; what does k^2 equal? [2]

B3. The graph

$$|x + y| + |x - y| = 4$$

describes a polygon with area A. What does A equal? [3]

B4. Starting with a sphere of radius $\sqrt{3}/2$, Cai and Sophie take turns putting the previous object in the smallest cube and sphere that contains it, respectively, in the fashion of B2. Eventually, Cai puts a cube of side-length 243 around a sphere. At this point, how many spheres and cubes are there altogether? [3]

B5. For $\alpha > 1$, the graph

$$|x + \alpha y| + |x - \alpha y| + |\alpha x + y| + |\alpha x - y| = 1$$

describes an octagon. For the particular value $\alpha = \sqrt{a} + b$, this octagon is regular. What is $a + b$? [5]

B6. Dianna starts with the shape described by the graph $|x| + |y| = 16$ as in B1. Scott finds the value r_1 such that the shape described by $|x+y|+|x-y| = r_1$ fits exactly into Dianna's first shape. Dianna then finds the value r_2 such that the shape described by $|x| + |y| = r_2$ fits exactly into Scott's shape.

If they keep repeating this process, the areas of Dianna's shapes minus the areas of Scott's shapes approaches p^a/q where p, q are prime numbers. What is $p + a + q$? [2]

B7. Starting with a cube of side-length 2, Sophie puts the cube into the smallest possible sphere that can contain it and positions this cube to be parallel to the x-, y- and z-axes. The cube cannot slide, so instead Sophie spins it the cube in the sphere about the y-axis. The volume of the region that the cube occupies whilst being spun is $a\pi$; what does a equal? [3]