Oxford Mathematics Team Challenge 2026
Scenes Round Question Booklet

Instructions

1. Do not look at the first set of questions until the invigilator tells you to do so.

2. **Format.** This round contains two sections (the "acts"), which each contain four sets (the "scenes") of 3 questions each. You must submit solutions to your current scene in order to receive the next scene in the act. You cannot update your answers to any set once submitted.

3. **Time limit.** 30 minutes for each section. You may not submit any answers 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. Other mediums for working (e.g. digital devices, whiteboards, handheld chalkboard) are strictly forbidden.

5. **Scoring rules.** For the first seven scenes, your team is awarded full points for each correctly answer, and zero points otherwise. Answers must be fully simplified and in exact form; approximations will not be accepted. In the final set, which is the *estimathon*, your score for each question is $9 \times \frac{\min\{A,E\}}{\max\{A,E\}}$, rounded to the nearest integer, where A is the actual answer and E is your estimated answer.

6. Don't expect to solve every question in the time given! You may consider skipping to the estimation set at the end of the round, taking some time to attempt the questions to score partial credit.

7. You are also encouraged to think deeply, rather than to guess.

8. Good luck, and enjoy! ☺

Act	I				II			
Scene	1	2	3	4	1	2	3	4
Points per question	3	4	5	6	3	4	6	9

Act I, Scene 1

Questions in this scene are worth 3 points

1A. What is the remainder when

$$2 + 4 + 6 + \cdots + 4052$$

is divided by 9?

1B. The longest possible stick, of length ℓ m, is fitted into a sealed $1 \times 1 \times 1$ m^3 box. What is the value of ℓ^6?

1C. A drawer has ten pairs of socks, all of different colours. Two socks are randomly picked from the drawer. The probability that the socks are of the same colour is p. What is $1/p$?

Act I, Scene 2

Questions in this scene are worth 4 points

2A. When the expression

$$\left(x+\frac{1}{x}\right)\left(x^2+\frac{2}{x^2}\right)\left(x^3+\frac{3}{x^3}\right)\left(x^4+\frac{4}{x^4}\right)$$

is expanded and like terms are collected, one term is independent of x. What is its value?

2B. Suppose x and y are real numbers such that $x^2+y^2=25$. The maximum possible value of $x+y$ is $\frac{a}{\sqrt{b}}$ when fully simplified. What is $a+b$?

2C. Octo the Octopus randomly chooses three distinct vertices from a regular octagon. When fully simplified, the probability that the triangle formed from these vertices is a right angle is p/q. What does $p+q$ equal?

Act I, Scene 3

Questions in this scene are worth 5 points

3A. The two graphs

$$y = 8 - x^3, \qquad y = 2x^3 - 9x^2 + 20x - 20$$

intersect at exactly one point, (a, b). What does a equal?

3B. Carl writes down every positive integer less than 100 whose digits sum to an even number. What is the sum of Carl's numbers?

3C. Suppose α is a number satisfying $\alpha^2 + 2\alpha + 4 = 0$. It follows that $\alpha^{99} = x^y$, where x is a prime number and y is an integer. What is $x + y$? *[Hint: you do not need to calculate α.]*

Act I, Scene 4

Questions in this scene are worth 6 points

4A. Mrs Fifield fills in a 4×4 grid with four 1s, four 2s, four 3s and four 4s. She does it in such a way that each column, each row and the four sub-squares in the diagram each contain the numbers $1, 2, 3, 4$. For example:

2	4	3	1
3	1	2	4
1	3	4	2
4	2	1	3

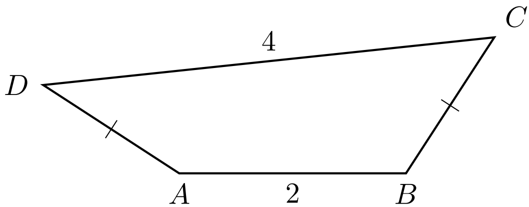
How many different ways could Mrs Fifield have filled in the grid?

4B. Anna has the functions

$$r(x) = 1/x \qquad \text{and} \qquad s(x) = 1 - x.$$

She starts with some number n, and repeatedly applies these two functions in order to obtain as many distinct numbers as she can. What is the largest number of distinct numbers she can make, including n?

4C. Consider a quadrilateral $ABCD$ with the lengths $AB = 2$, $CD = 4$, $BC = AD$, and $\angle DAB = 147°$, $\angle ABC = 123°$, and $\angle BCD = 49°$. Find the area of $ABCD$.



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Act II, Scene 1

Questions in this scene are worth 3 points

1A. 'Gnatty Nety' thinks of a positive integer n such that n is not prime and n is not a factor of $(n-1)!$.

What is the largest number that Nety could've thought of?

1B. For $0^\circ \leq x \leq 360^\circ$, how many solutions does the equation

$$\sin(2x + 90^\circ) + \cos(2x - 90^\circ) = 1$$

have?

1C. Quincy chooses a, b, c to be whole numbers in the set $\{1, 2, 3, 4\}$, potentially choosing the same values. The quadratic

$$ax^2 + bx + c$$

has at least one real root. How many choices of (a, b, c) could Quincy have chosen?

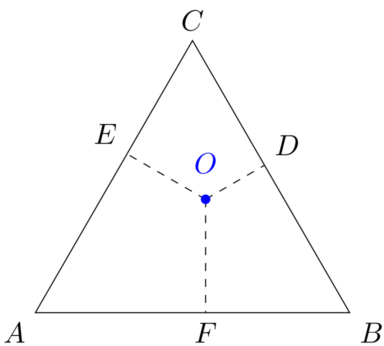
Act II, Scene 2

Questions in this scene are worth 4 points

2A. A fake scoop of ice cream is used for a display and is modelled as follows. The cone has a base radius of R and height $3R$; placed on top of it is a hemisphere of radius R, glued onto the base of the cone. The cone is then cut horizontally to remove a cone with a base kR, so that the volume of the remaining model is twice that of the volume of the hemisphere.

It follows that $k = 3 - 3^{u/v}$ where u/v is fully simplified. What does $u + v$ equal?

2B. Let ABC be an equilateral triangle with a point O in its interior. The point O is put inside the triangle and three lines are drawn to meet each side of the triangle perpendicularly, at the points D, E and F. Given $OD = 3$, $OE = 4$ and $OF = 5$, it follows that the area of ABC is $a\sqrt{b}$ when fully simplified. What is $a + b$?



2C. How many integer solutions (x, y) are there to the equation

$$x^3 - 117y^3 = 5?$$

[Hint: what are the remainders of x^3 when divided by 9?]

Act II, Scene 3

Questions in this scene are worth 6 points

3A. Robin the Robot rolls around a rectangular $m \times n$ grid of rooms. He visits each room exactly once and ends up in a room next to the room he started in.

Given that there are between 10 and 20 rooms, inclusive, and $m \leq n$, how many different ordered pairs (m, n) could Robin be rolling around?

3B. Danny has a dataset $\{5, 5, 7, 8, 12, 12\}$. He wants to add two (not necessarily distinct) positive integers x, y to it such that there is a unique mode which is also equal to the mean. What are the sum of the values of $x + y$ for all possible ordered pairs (x, y) that Danny can add to his dataset?

3C. Consider an isosceles triangle ABC with $AB = AC$, and let D, E be points on AB and AC respectively such that

$$AE = DE = DB = BC.$$

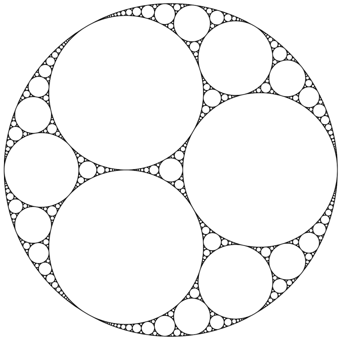
Find the angle $\angle BAC$ in degrees. *[Hint: draw the line EB.]*

Act II, Scene 4: Estimathon

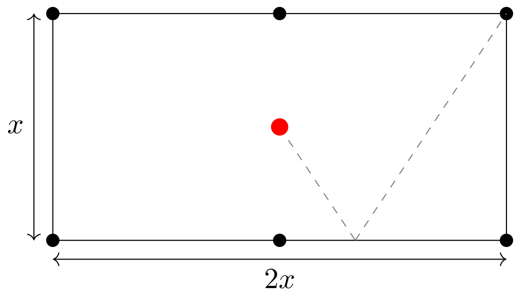
Questions in this scene are worth up to 9 points: where A is the actual answer and E is your estimate for a question, your score is $9 \times \frac{\min(A,E)}{\max(A,E)}$ points, rounded to the nearest integer

4A. The *Apollonian Gasket* is a fractal, built by considering recursively the inner tangent circle to three kissing circles (mutually touching circles).

Given that the outermost circle has radius $r = 1$, how many circles in the Gasket will have a radius $r \geq 0.001$?



4B. Billy picks an angle to strike a red ball from on the billiards table shown below. Each bounce reflects the ball's trajectory against the line of the table, and after 2026 bounces the ball goes into one of the six holes. How many angles could Billy have picked? *[Below is an example of the ball going into a hole after one bounce.]*



4C. How many digits does the 2026th Fibonacci number have? *[The Fibonacci numbers are defined by $F_1 = 1$, $F_2 = 1$, and $F_{n+2} = F_{n+1} + F_n$.]*