

MATHEMATICAL CHALLENGE 2022–2023

Entries must be the unaided efforts of individual pupils.

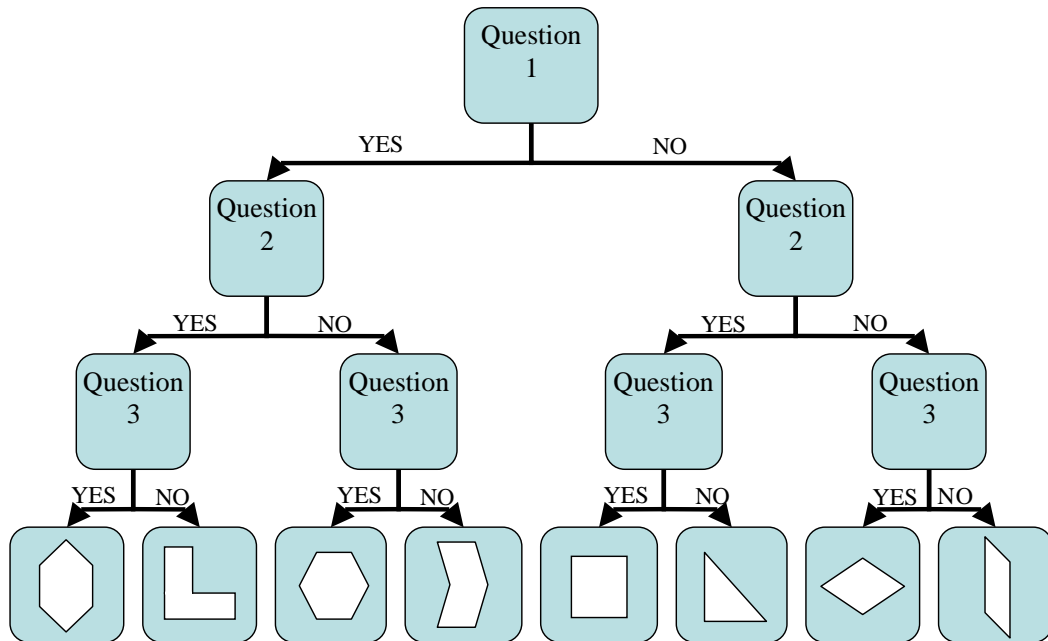
Solutions must include explanations and answers without explanation will be given no credit.

Do not feel that you must hand in answers to all the questions.

Junior Division: Problems 2

- J1.** Six straight lines have been drawn on a plane so that they are all distinct, none of them are parallel, and no three intersect at the same point. Into how many regions has this plane been subdivided?

J2.



The eight geometrical shapes shown in the boxes in the bottom row of the flowchart have been sorted by answering questions 1, 2 and 3 in turn. Your task is to find three questions to sort the shapes in the way shown.

For example, if Question 1 was “Are all the sides the same length?” the first shape would correctly follow the YES branch but the square would also follow the YES branch, which is not correct.

- J3.** In a particular exam, the ratio of the number of pupils who passed to the number of pupils who failed was 3:2.

If the pass mark had been lowered so that 12 more pupils passed then the ratio of passes to fails would have been 21:10.

How many pupils passed the exam?

- J4.** A man is walking his dog on the lead towards home at a constant speed of 3 m.p.h. When they are 1.5 miles from home, the man lets the dog off the lead. The dog immediately runs towards home at a constant speed of 5 m.p.h. When the dog reaches the house, it turns round and runs back to the man at the same speed. When it reaches the man, it turns back for the house. This is repeated until the man reaches the house and lets the dog in. How many miles does the dog run from being let off the lead to being let into the house?

- J5.** The nine points $P, Q, R, S, T, U, V, W, X$ lie equally spaced round the circumference of a circle, as shown in the diagram. Find the number of distinct triangles whose vertices belong to the set $\{P, Q, R, S, T, U, V, W, X\}$ so that the centre of the circle lies in the interior of each triangle.

