

Junior Challenge '24

Year 8 or below

Illustrations by Kiera Wadeson

Rules

- 1) The challenge should be attempted in your own time. Your entry must be **your own work**, though you may ask for help for the meanings of unfamiliar words. It is possible to win a prize or certificate even if you have not completed all the questions.
- 2) Present your worked solutions **separately on A4 size papers**. Lined papers are recommended, but blank or graph paper are accepted – as long as they are neatly presented. Do not write directly on this question sheet.
- 3) Write **your name and school on every page neatly**.
- 4) When you have completed, please scan your pages and save as a **single PDF file**. Make sure the scan is clear and legible.

Submission instructions

All submissions are done online this year. When you are ready to submit, please ask your teacher¹ to upload your entry by filling in this form:

<https://forms.office.com/e/hqeQ59zev1>

All entries should be submitted by **15th March 2024**. A Prize-Giving Evening will be held at the University of Southampton on 5th June 2024.

We hope that you enjoy the questions!

Optional diversity monitoring questionnaire

Completing this questionnaire is **optional** and is **not a requirement** for participating in the Challenge. The questionnaire is meant to be completed by a parent or guardian of the participating student. This data is being collected for the purpose of assessing the diversity of participants in the Maths Challenge. The data will be stored and used in accordance with the University of Southampton's published Data Privacy Notice and Data Protection Policy.

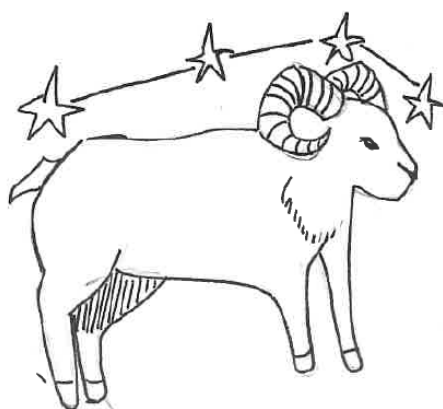
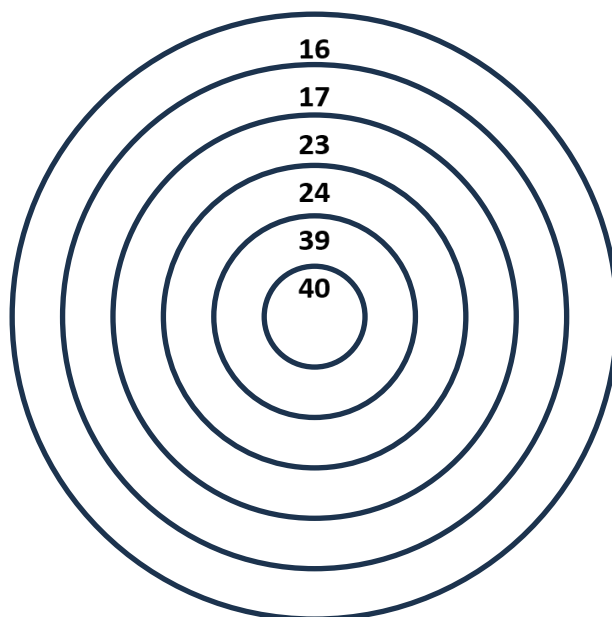


<https://forms.office.com/e/36ksGL5RVM>

¹ If you are not affiliated with a school, you may also ask your parents to fill in the form and submit for you.

1. Sagittarius

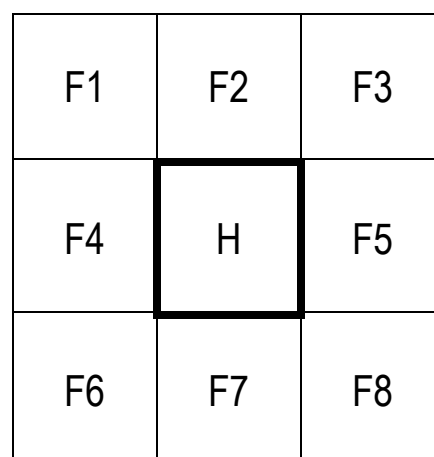
Edmond, Nicholas and James are practising their archery on this unusual target. Each of them has fired 6 arrows and the scores are 120, 110 and 100 respectively. Every arrow hit and the bullseye was only hit once. What were the six hits for each archer?



3. Aries

A farmer has 41 sheep and lives in a square house with 4 windows, surrounded by 8 fields. 3 of the fields can be seen from each window (e.g., in the diagram, F1, F2 and F3 can be seen from the top window).

One particular day, she can see exactly 15 sheep through each window, and either m sheep or n sheep in each field. Determine the numbers m and n . Draw and label the diagram to show one way the sheep could be arranged in the fields.

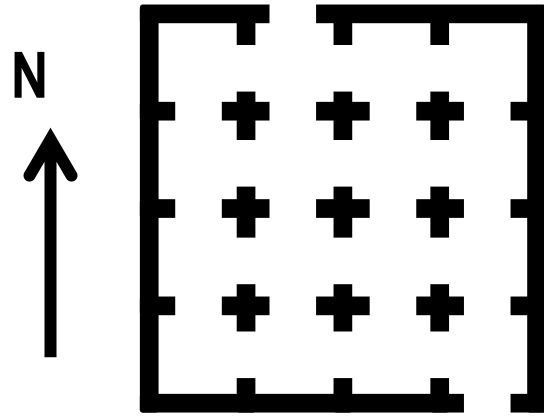


2. Auriga and Centaurus

A particular racetrack consists of 3 equal sections. Auriga goes at a constant speed for the whole course. Centaurus does the first section at twice Auriga's speed, the second at the same speed as him, and the 3rd at half Auriga's speed. Who wins and by how far?

4. Taurus

A bull is running through the maze on the right. He visits each cell exactly once, entering through the entrance door on the South side of the maze and leaving through the exit door on the North side. Count and display all the different routes the bull can take.



5. Canis Minor, Lepus and Lacerta

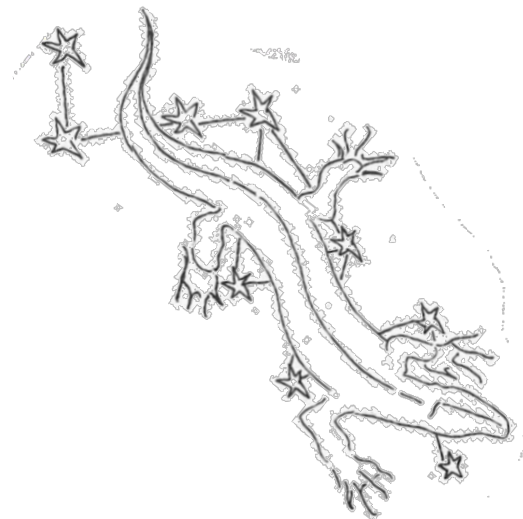
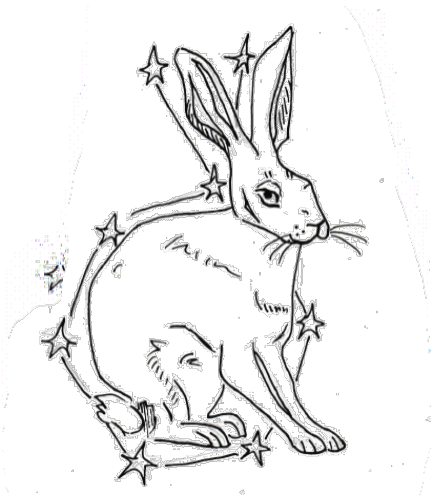
The students of Year 11 decided to carry out a pet survey in Moore Street.

In the 32 families living in the street, there were 25 lizards, 19 small dogs and 10 hares. All the families who owned pets had 1, 2 or 3 children.

The survey also found that no family owned more than 2 pets, and none had 2 pets of the same kind.

Furthermore, 5 of the families had no children.

How many families in the street had more than 3 children and how many hares had to share the family's affection with a small dog?



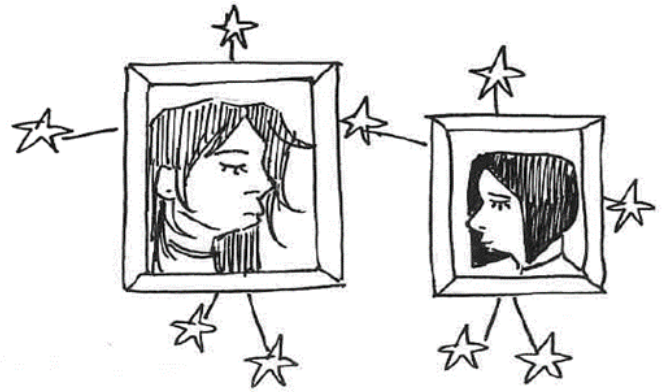
6. Gemini

Castor has a square photograph of himself and a square photograph of his brother, Pollux (which is slightly smaller in size) hanging upon his wall.

Pollux has the same two images, also as square photographs. Being a more narcissistic character, however, the image of himself that hangs upon his wall is much larger than his photograph of Castor.

Amazingly, the combined area of Castor's two photographs is 1865cm^2 and this is also true of Pollux's two photographs!

Given that all the photographs are a whole number of cm along each edge, what is the edge length of each individual photograph?



7. Aquarius

Aquarius is trying to fill a cylindrical barrel to at least the $\frac{3}{4}$ mark. The barrel has a diameter of 50cm and a height of 1m. He is using a cylindrical bucket with a diameter of 18cm and a height of 30cm.

Unfortunately, the bucket leaks, and loses 1% of its original volume every second. It takes 10 seconds to get from the tap to the barrel, neither of which can be moved.

How many times will Aquarius need to fill the bucket?