

Newcastle University

Challenge '24

Year 8 or below

Illustrations by Kiera Wadson

Rules

- 1) Challenge '24 should be attempted at home during February half term.
- 2) Your entry must be your own work, though of course you may ask for help on how to get started or for the meanings of unfamiliar words.
- 3) Entries without any working out at all or written on this sheet **will not be marked**.
- 4) It is possible to win a prize or certificate even if you have not completed all of the questions, so hand in your entry even if it is not quite finished.
- 5) Please make sure that you staple your pages together and you must write **your name and school neatly on every page**.

Either you or your maths teacher needs to return your entry by 8th March to this address:

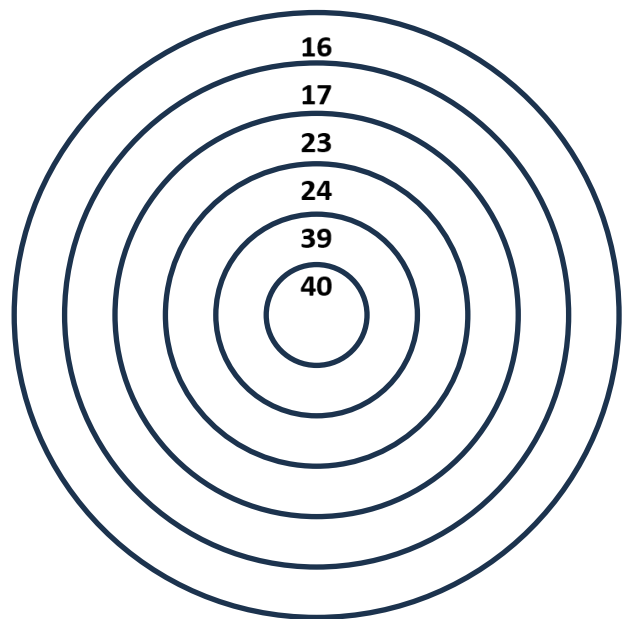
Challenge '24 Entries,
School of Mathematics, Statistics, & Physics
Newcastle University,
Newcastle upon Tyne
NE1 7RU.

A Prize-Giving Evening will be held at Newcastle University on 8th May.

We hope that you enjoy the questions.

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?



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?

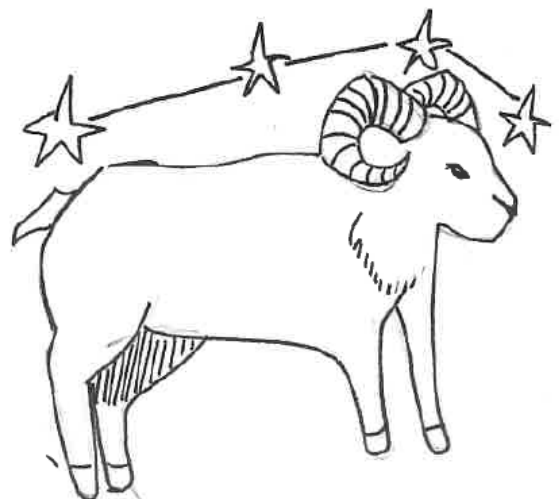
3. Aries

A farmer has 41 sheep and lives in a house surrounded by 8 fields, 3 of which can be seen from each window. There is one window on each side of the house.

One day, he notices that he can see exactly 15 sheep through each window and that each field had one or other of two particular numbers of sheep in it.

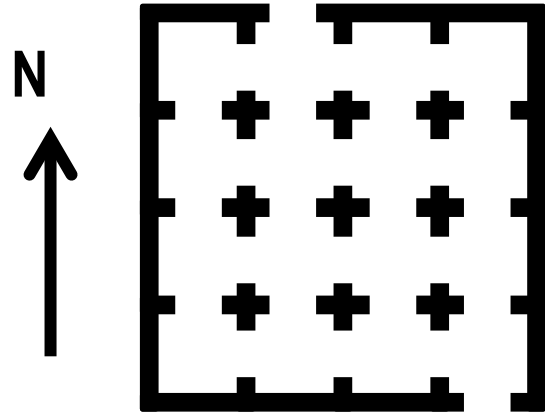
How many sheep were in each field?

Draw a diagram to show how the sheep are arranged by field.



4. Taurus

A bull is running through the above maze. He only visits each cell once, entering through the entrance door on the South side of the maze and leaving through the exit door on the North side. How many different routes are there where he visits all of the cells only once?



5. Canis Minor, Lepus and Lacerta

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?



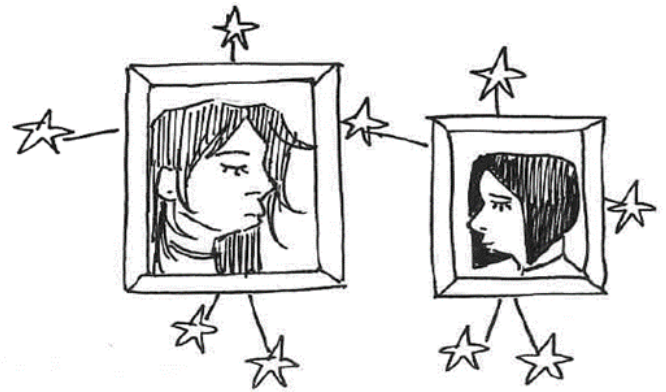
6. Gemini

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 particular 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 18cm diameter and 30cm in height. 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?

The Challenge is organised by:-

School of Mathematics, Statistics & Physics
Newcastle University
Newcastle upon Tyne
NE1 7RU

For more information or if you have any questions, visit:-

<https://www.ncl.ac.uk/maths-physics/engagement/outreach/maths-challenge/>

Please note that entries will not be returned, though solutions will be available ASAP after the scripts are marked and ideally not later than 30th April.

The School of Mathematics, Statistics and Physics would like to acknowledge the University of Liverpool and Mathematical Education on Merseyside for developing the Challenge questions.