

Newcastle University

Senior Challenge '24

Year 10 or below

Illustrations by Kiera Wadeson & Will Ashworth

Rules

- 1) Senior 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:

Senior 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. Pegasus

Pegasus sets off from the Pegasus Crossing in Deeside, on the English-Welsh border, to fly to Pegasus Bridge, north of Caen, France, stopping off at the Uffington White Horse for a picnic.

It's 212.5km from Deeside to Uffington and 287.5km from there to Caen.

Pegasus always flies at a steady 200km per hour and nothing EVER gets in his way.

Given that the picnic lasts 20 minutes and begins at 1240, at what time did he leave Deeside, and when does he arrive in Caen (to the nearest minute in each case)?



2. Triangulum

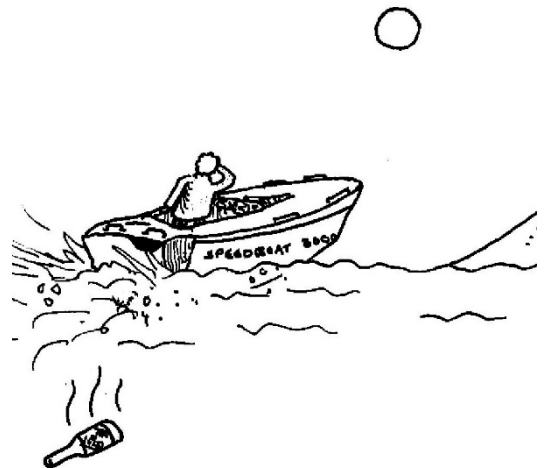
Maggie is playing with a bundle of straws. Some of the straws are of length 1cm, others 2cm, 3cm, and so on. There are lots of straws of each size. Eventually, she starts making triangles with the ends of the straws being at the corners of a triangle.

How many different triangles can she make if two of the straws used have lengths 4cm and 2cm respectively? (NB triangles with sides 4cm, 3cm & 2cm, and those with sides of 4cm, 2cm & 3cm must only be counted once.)

If the longest straw is 5cm long, what is the total number of different triangles that Maggie can make?

3. Eridanus

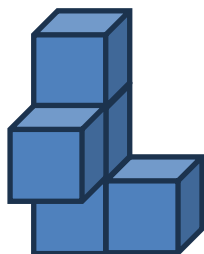
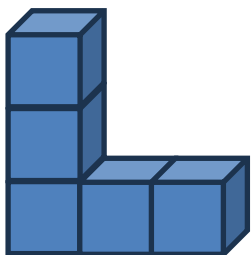
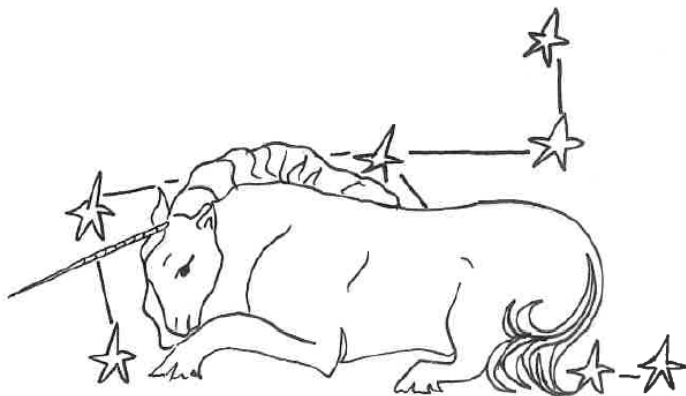
Lucie was travelling up a steadily flowing river in a small boat fitted with a constant speed outboard motor. Accidentally, a bottle dropped out of the boat into the water. Ten minutes later, she realised her loss, rapidly turned around and started back downstream. Lucie eventually caught up with the bottle after it had floated two miles. How fast was the river flowing?



4. Camelopardalis, Apus and Monoceros

Martin goes to the garden centre with £1000 to buy animal statues for his garden. Giraffes are 7.5m tall and cost £98, Unicorns are 2m tall and cost £42, and Birds of Paradise 25cm tall and cost £6. He buys at least one of each, 100 statues in all. He wants the total height of his statue collection to be the same as the height of his favourite tree, which is 50m tall.

How many of each statue does Martin buy?



5. Gemini

Toy space men of different shapes are each formed from five 1cm cubes, with adjacent cubes firmly welded together face-to-face.

How many such space men are there, each distinct from the other? How many pairs of twins are there, where twins are mirror images of each other?

6. Canis Major and Canis Minor

'Be good dogs,' said Pete as he left Major and Minor to guard his house while he was out.

When they were alone, the two dogs started to tear the living room carpet into pieces. When Major chose a piece, he tore it into four parts, and when Minor chose a piece, she tore it into seven parts. Being good dogs, they never chose the same piece at the same time. When Pete returned he found exactly 2024 pieces of carpet.

Were there any pieces missing?



7. Sagittarius

Sagittarius was striding purposefully through the woods with his trusty bow and arrow strapped to his shoulder when he spotted a mysterious spherical ball partially stuck in some mud.

After removing the ball, the hole in the mud was 60mm deep and 240mm wide. What was the radius of the ball?

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.