

Senior Challenge '24

Year 10 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. Pegasus

Pegasus sets off from the Pegasus Crossing in Deeside, on the English-Welsh border, to fly to the Southampton Commons, stopping off midway at the Uffington White Horse for a picnic.

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

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 12:40, at what time did he leave Deeside, and when does he arrive in Southampton (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 many straws of each size. Eventually, she starts making triangles with the ends of the straws being at the corners of a triangle.

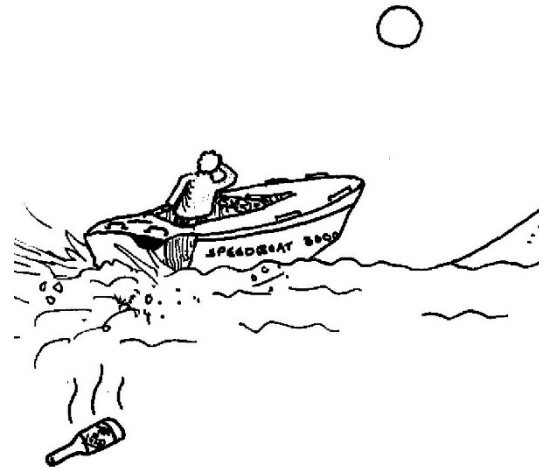
How many different triangles can she make using, for each triangle, a 4cm straw, a 2cm straw and one additional straw of any length?

(Note: for example, triangles with sides of 4cm, 3cm & 2cm and those with sides of 4cm, 2cm & 3cm are equivalent, and should be counted once.)

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

3. Eridanus

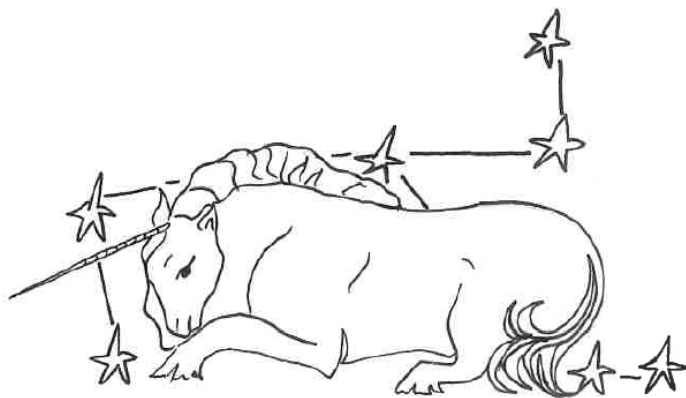
Lucie was travelling up a steadily flowing river in a small boat fitted with a constant speed outboard motor. Accidentally, a bottle dropped out of the boat into the water. Ten minutes later, she realised her loss, rapidly turned around and started back downstream. Lucie eventually caught up with the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

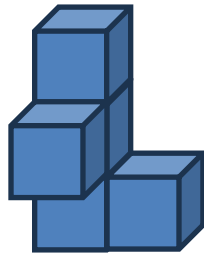
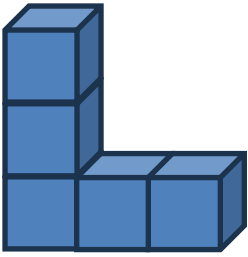


4. Camelopardalis, Apus and Monoceros

Martin goes to the garden centre and spends exactly £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? Explain your reasoning.



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, less than half-way in.

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