

MATHEMATICAL EDUCATION ON MERSEYSIDE

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Senior Challenge '26

Year 10 or below

Illustrations by Charles Peterson

Rules

- 1) Senior Challenge '26 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**.

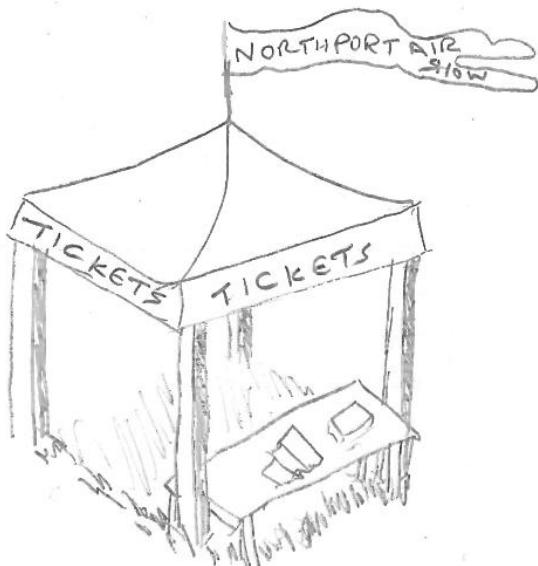
Either you or your maths teacher needs to return your entry by 6th March to this address:

Senior Challenge '26 Entries,
Chris Marchant,
Department of Mathematical Sciences,
University of Liverpool,
Peach Street,
Liverpool,
L69 7ZL

A Prize-Giving Evening will be held at the University of Liverpool on Wednesday 6th May.
We hope that you enjoy the questions.

1. Phyllis' Flight Number

When asked what her flight number was, Phyllis answered, somewhat cryptically: "It's an odd number with 3 digits. All the digits are different, and they add up to 12. The difference between the 1st and 2nd digits is the same as the difference between the 2nd and 3rd digits. The 1st digit is greater than the sum of the other two digits." What was her flight number?



2. Trip Tickets

Chris takes his Troop of 24 Scouts and 4 Adult Leaders to the Northport Air Show. He pays the group rate. This is a 10% discount on standard price for each child and for every 10 children, he gets 1 adult free. The remaining adults are paid for at full price. His total bill was £153.60.

Jo and Beth bring a party of 6 pensioners from their church, paying the pensioner rate. 2 of the pensioners need wheelchairs, so they get free tickets for 2 carers and Jo and Beth pay full price. Their total bill was £72.

Michael and Katie bring their twin 10-year-olds, Jacob and Liam, and Katie's mum, Nerys, to celebrate Nerys' 65th birthday. Their total bill comes to £44.

How much does it cost for one pensioner, one adult and one child at full price?

3. Shuffling Seats

Anouk, Ethan, Polly and Maks board a flight to Dublin from Liverpool. They have booked for seats A, B, C and D in row 6 respectively.

If they each sit in one of those seats randomly, in how many possible orders could they be sat?

After take-off, they realise that none of them are sat in the correct seat. In how many possible ways could they be sat now?

4. Clean Up on Aisle...

Ann is looking to buy a new robot vacuum cleaner to help clean four planes between flights.

She has quotes from 3 suppliers:

Robbie the Robot will clean 87% of the crumbs from a plane in 15 minutes, and costs £1,299;

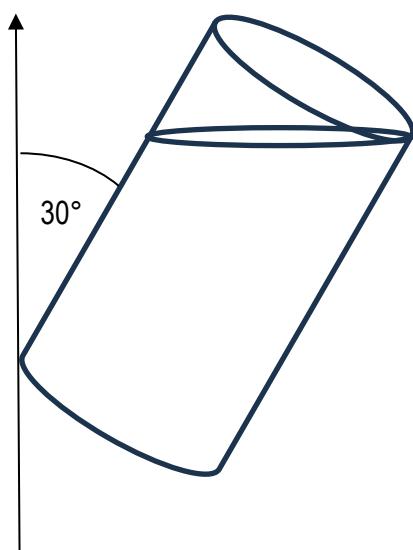
Vinnie the Vacuum will clean 94% of the crumbs from a plane in 30 minutes, and costs £1,649;

Callum the Cleaner will clean 99% of the crumbs from a plane in 2 hours, and costs £1,999.

The limitations on how well they can clean the plane is due to the size of the robot vacuum cleaner, so using one twice will not improve the amount cleaned!

Ann will have to pay Joel the Operator £16 per hour and earns £60 for each clean percentage point.

Which machine should she buy?



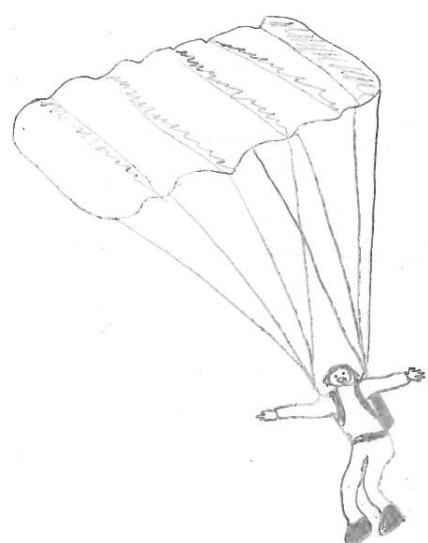
5. Sue Sips Serendipitously

Relaxing on the plane to her latest skiing holiday, Sue ordered a 330ml can of lemonade, which the flight attendant served her in a completely filled cylindrical glass of radius 3cm. She drank some of it immediately before the plane hits turbulence, resulting in the plane and thus the glass to become tilted at an angle of 30° to the vertical. None of the lemonade was spilt, but only just!

How much lemonade has Sue drunk, to the nearest ml?

6. Parachute Plummet

Fred the paratrooper jumped out of a plane at 40,000 feet above sea level. His landing point is 40 feet above sea level. It takes 5 seconds for him to reach terminal velocity (176ft/s). In that time, he has fallen 480ft. After freefalling for a further 3 minutes and 28 seconds, he deploys his parachute. The parachute takes 5.5 seconds to deploy, during which time you can assume he continues at 176ft/s. Once fully deployed, the parachute decelerates him at a rate of 8ft/s². How fast is he falling when he hits the ground?



7. Devious Davina

Davina is taking a flight into Liverpool

John Lennon Airport.

Her friends Ellie and Amy have agreed to pick her up; however, Davina has decided to set them a maths problem instead of just telling them when the flight lands!

Davina tells Ellie the hour of her plane's arrival and she tells Amy at which minute it arrives. She also tells them both that the plane arrives between 1000 and 1400.

They check the website and find that there are flights arriving at the following times:

1032, 1043, 1050;

1117, 1146;

1219, 1232;

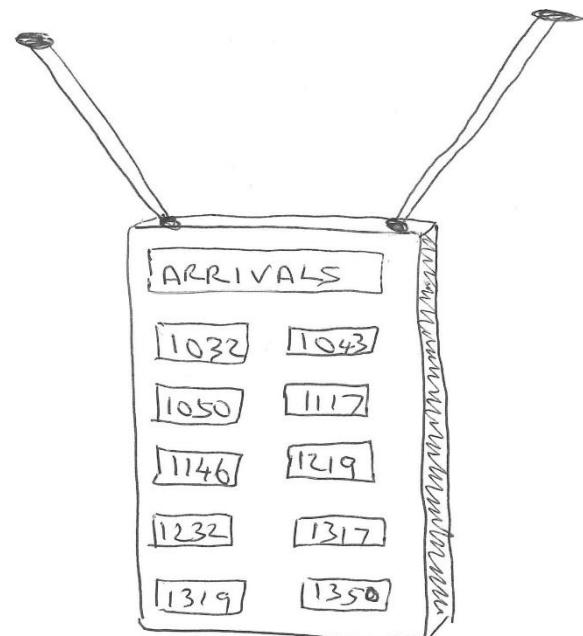
1317, 1319, 1350.

Ellie then says, 'I don't know when Davina's plane arrives, but I'm sure that neither does Amy.'

Amy replies, 'I didn't know her arrival time, but now I do.'

Ellie responds, 'Now I do as well!'

When does Davina's plane land and how do you know?



The competition is promoted by

Mathematical Education on Merseyside (MEM)
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Department of Mathematical Sciences,
University of Liverpool,
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