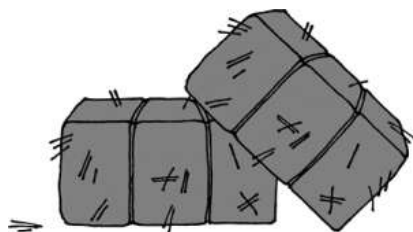


## 6. A WAY TO WEIGH HAY

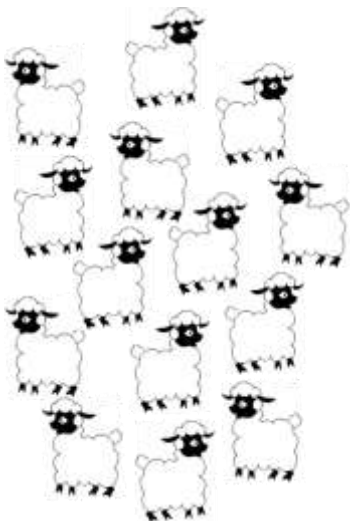
Mr Chen sells hay and needed to know the individual weights of five bales of hay before delivering them to a customer.

However his scale could only weigh items over 100lb. His workmate Jin weighed them two at a time in all possible ways, and informed Mr Chen that the weights in pounds were 110, 112, 113, 114, 115, 116, 117, 118, 120, and 121.



Mr Chen was at a loss as to what each one weighed but Jin quickly worked out the individual weights. Can you find the weight of each of the five bales?

## 7. FAIR SHARES



Farmer Giles gives some of his sheep to his four children Adam, Beth, Carol and David who decide to sell them at market. Each sheep fetches as many pounds as there are animals in the flock. They share the money in the following way. First Adam takes £10, then Beth takes £10, then Carol takes £10, then David takes £10, then Adam again and so on. Eventually, when it's David's turn, there is less than £10 remaining. David takes this then each of Adam, Beth and Carol gives a sum of money (in exact pounds) to David so that the four of them finally have equal shares of the sale money. How much does each give?

(INCORPORATING THE LIVERPOOL BRANCH OF THE MA AND THE ATM)

# Open Challenge '21 For Year 13 or below

## Rules

- 1) It should be attempted at home during February half term.
  - 2) Your entry must be your own work.
  - 3) For individual entries only. You should attempt all questions.
  - 4) Entries without any working out at all or written on this sheet will not be marked.
  - 5) It is possible to win a prize even if you have not completed all of the questions, so please submit your entry even if it is not quite finished.
  - 6) **You must PRINT your name, date of birth and school address plus postcode in neat, legible writing on the front sheet.**
  - 7) Pupils under 15 years of age should only attempt this in exceptional circumstances.
- Either you or your maths teacher needs to return your entry by ~~5 March~~ to this address:  
**\*\*\*\*\*Due to COVID restrictions the deadline has been extended to 19 March\*\*\*\*\***

Pupils may submit their individual entries directly, preferably by post, to  
**Open Challenge '21 Entries,**  
**Mrs A. Carter, Danes Court, Mudhouse Lane, Burton, Neston CH64 5TS.**

or, where this is not possible, by email with a pdf attachment to  
**[newstead@liverpool.ac.uk](mailto:newstead@liverpool.ac.uk)**

All of the prizes and certificates **will be posted** to schools and colleges. Solutions will be posted on [www.maths.liv.ac.uk/lms.html](http://www.maths.liv.ac.uk/lms.html) shortly afterwards.  
We hope that you enjoy the questions.

There will be no Open Challenge prizegiving evening in the University of Liverpool this year. We are planning to organise an evening of online activities to replace this.

## 1. WET NELLIE



An old lady taking her elephant for a walk beside the river was dismayed to see it falling over the steep, slippery bank towards the water. Luckily it was harnessed to a strong rope, and the lady managed to take several complete turns of the rope around a tree and hold on tightly enough to keep it from the waiting crocodiles.

Each turn of the rope around the tree reduced the pull by 70%. Given that the old lady, who is really quite strong, can support a weight of at most 50kg, while her elephant weighs 1 tonne, find the smallest number of complete turns which the old lady could have used.

If she had used half a turn less could she still have held the elephant?

## 2. SOME SUNNY DAY

For many years, Basil and Rosemary have spent long weekends (4 days) at the resort of Wetsun.

They have observed that two sunny days in three are followed by another sunny day, while half of all the wet days are followed by another wet day.

Assuming days are either wet or sunny, estimate how many days have been wet in their last ten visits.

On the second day of their most recent holiday they sent me a card “Weather fine, do you wish you were here?”

How likely is it that a card sent the previous day would also have described the weather as fine?



### 3. HOT ICE



Roughly  $3 \times 10^{19}$  kg of the earth's water is bound as ice. Assuming the earth is a smooth sphere estimate the depth of water this ice would produce if it melted.

In days of yore some people thought the earth was a flat disc. Assuming the area of this disc to be the same as the surface area of the sphere what depth of water would the same quantity of ice produce?

### 4. DIPPY SHEILA

Farmer Giles has 85 sheep, all of which have to be dipped. The last sheep in the queue, Sheila, remembers how long this took last time and decides to do a bit of queue jumping. Each time Farmer Giles dips a sheep, she manages to pass three other sheep in the queue.



How many sheep are dipped before Sheila?

The next year, Farmer Giles has the help of his new farmhand Bill and they can dip two sheep at a time. Sheila, at the back again, is able to pass three sheep each time as before. If twice as many sheep are dipped before Sheila as last year, how many sheep does Farmer Giles have this year?

### 5. END OF HIS TETHER



Mrs Rashid owns a goat which grazes in a field in the shape of an equilateral triangle, with a wall along one edge and hedges along the other two. She tethers her goat in it by a rope attached to a post, so that the goat cannot eat either hedge. The post is normally placed in the centre of the field, but her daughter Aditi tells her there is another position which allows the goat more grass to eat. Find such a position.