

Newcastle University

Challenge '21

Year 8 or below

Illustrations by Theo Chaddock

Rules

- 1) Challenge '21 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 5th March to this address:

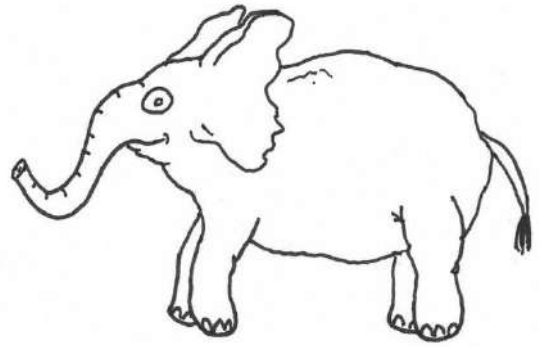
Maths Challenge Entries,
School of Mathematics, Statistics, & Physics
Newcastle University,
Newcastle upon Tyne
NE1 7RU.

We hope that you enjoy the questions.

1. The Elephants in the Zoo

A zoo has an equal number of African elephants and Asian elephants. The African elephants cost £11 per day to feed and the Asian elephants cost £9 per day to feed. The total daily bill for feeding all of the zoo's elephants is £1000.

How many elephants does the zoo have?



2. Twitching Points

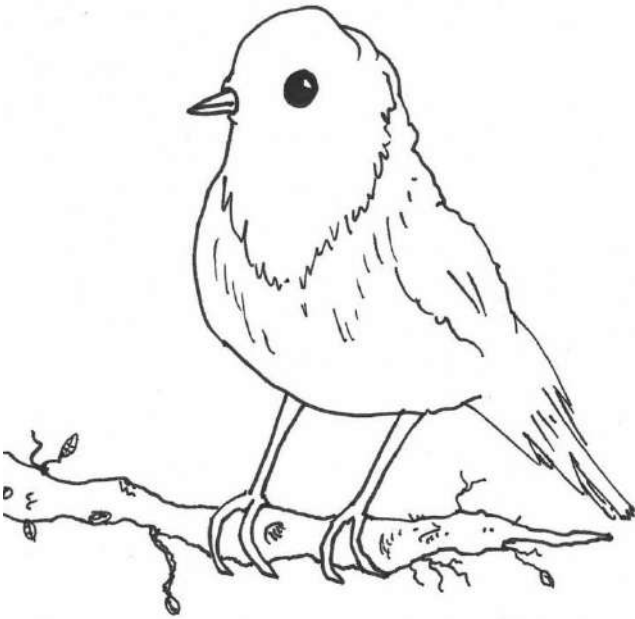
John, Sarah and Michael go birdwatching. They make it a competition by allocating a different number of points for each type of bird they spot. A sparrow is worth 1 point, a robin is worth 2 points and a wren 4. After the birdwatching, this is what they say:

John - "I saw 2 sparrows and at least one of every bird. In total, I got 16 points."

Sarah - "I saw no sparrows and the same number of robins as John."

Michael - "I got 20 points, the same number of wrens as John, double his number of sparrows and double his number of robins."

Find the minimum number of wrens Sarah would need to see to win the competition and the maximum number she could see but still come third in the competition.



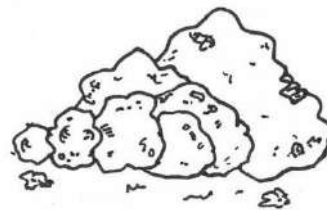
3. Going Up

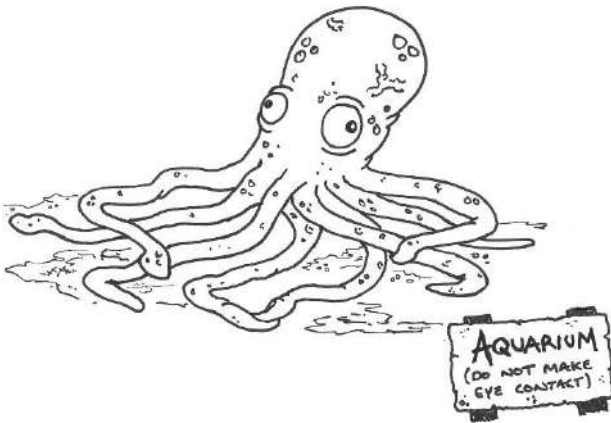
Ginoni the goat is at the bottom of a series of 7 boulders, each higher than the last. She wants to reach the top, where there is a huge patch of grass that she'd like to graze. Being an athletic goat, she sometimes bounds up two boulders at a time; otherwise, she just jumps up one.

Ginoni can use both one-boulder and two-boulder leaps within an ascent.

Starting at the bottom, in how many ways could she reach the grass at the top?

Investigate what happens for different numbers of boulders and explain the pattern of how many different ways she can ascend.





4. Aquarium Query.

Barney Akles runs an aquarium. In his collection, he has cyclops starfish (T) (one eye, five legs), blue octopuses (C) (2 eyes, 8 legs) and red lobsters (L) (2 eyes, 10 legs). (For the purpose of this question, we are using 'legs' to cover all limbs, arms, tentacles, etc.)

In each of 3 tanks, there are a prime number of animals with some or none of each species. Work out how many starfish, lobsters and octopuses could be in each tank:

Botany Bay Tank – 175 legs and 41 eyes

Sargasso Sea Tank – 92 legs and 22 eyes

La Manche Tank – 46 legs and 10 eyes

5. Felines on the Farm

There are 8 mice on a farm at dawn on 1st March. The population of mice doubles at 1am on the 1st of each month.

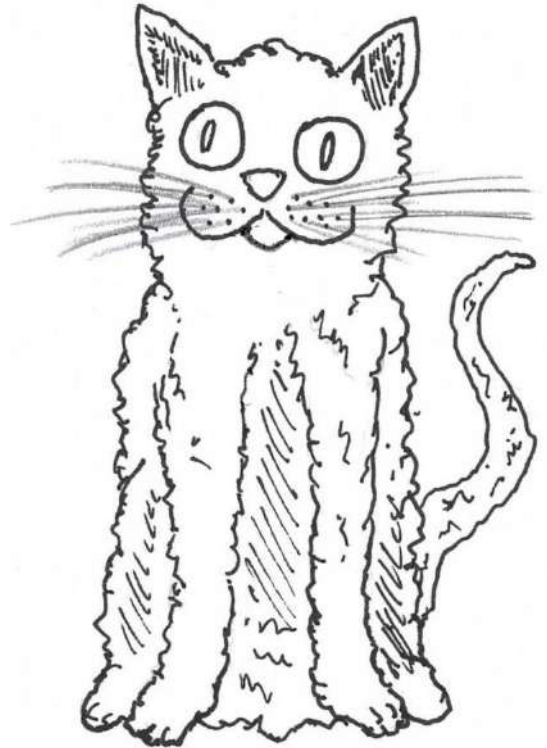
On the morning of 1st August, Linda and Richard, the farmers, each buy a cat.

For the first 2 months, Linda's cat catches 3 mice at noon each day; this then drops to 2 mice at noon each day until there are no mice left.

At sunset on the last day of each month, Richard's cat catches a third of the population of mice (to the nearest mouse).

Calculate the population of mice at dawn on the 1st of each month.

On which date does Linda's cat catch the final mouse?



6. Combine Harvesters

Margaret is looking to buy a new combine harvester. She has quotes from 3 companies:

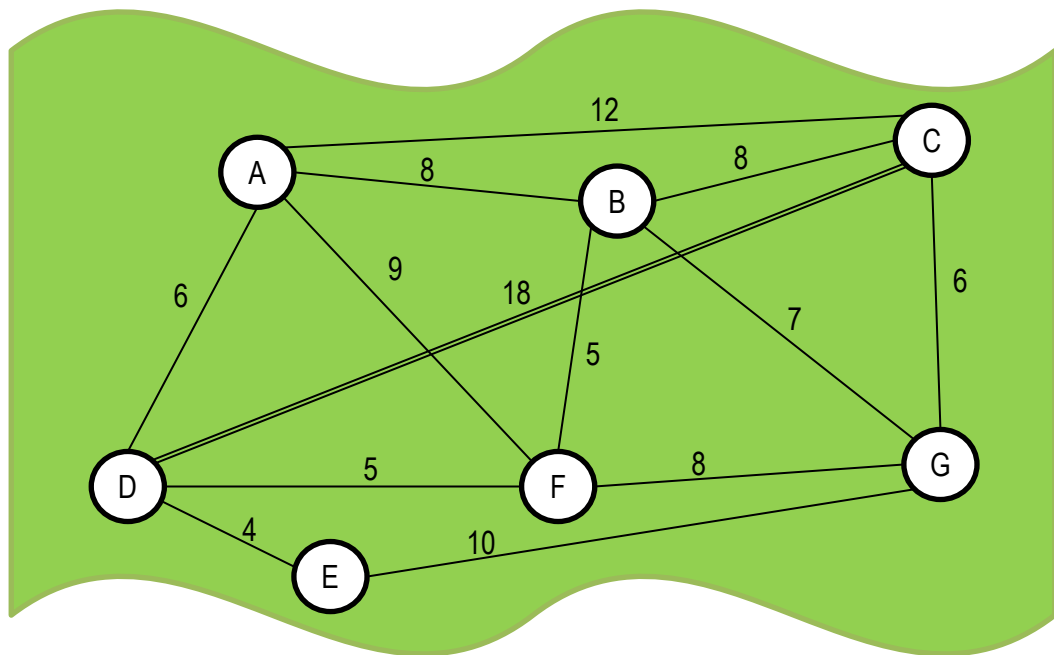
- Kate's Kwik Kombine will collect 85% of a crop in one day, and costs £15,000;
- Elijah's Easy-Crop will collect 94% of a crop in 3 days, and costs £17,000;
- Abi's All-Clear will collect 99% of a crop in 7 days, and costs £18,000.

Margaret will have to pay Keith the driver £150 per day and can sell each percentage point of a crop for £300.

Which machine should she buy?

Explain your answer.

7. Oakdale Woods



Above is a map of Oakdale Woods. Each of the seven clearings in the woods is shown, along with the time in minutes that it takes to walk along each of the woodland paths. The path between Don's Dell (D) and Cedar Clearing (C) is a disused railway track. The paths which cross it do so on bridges, so you cannot go from one path to another except in a clearing.

The Jones family arrive at Grenville Grove (G) for a walk around the woods. What is the quickest route they can follow to visit each of the clearings exactly once, before returning to Grenville Grove?

Rajit the Ranger is given the task of litter picking along all of the paths. The rangers are based at Bert's Bunker (B). He starts at 9am. Litter picking takes twice as long as just walking the paths.

Describe a route which means he only has to walk along each path once. At what time will he get back to Bert's Bunker?

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:-

<http://www.ncl.ac.uk/maths/outreach/teachers/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