Challenges

1). Tom divides his birthday cake with his two friends by cutting it into four quarters and then one of the quarters into quarters. Each gets one of the two equal pieces. What fraction is left over. What would that be for 4, 6, 8 friends etc. each time dividing the smallest piece into four with each getting a section of all the sizes..

2). A sequence is: 2, 5, 8, 14, 17, 20 etc.

What is the sequence and what would the 103 term be.

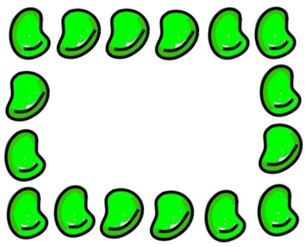
This is of the form aN+c so what about a sequence of type

aN^2 + bN +c and of the form

aN^m + bN^(m-1) + cN^(m-2)……cN^r….

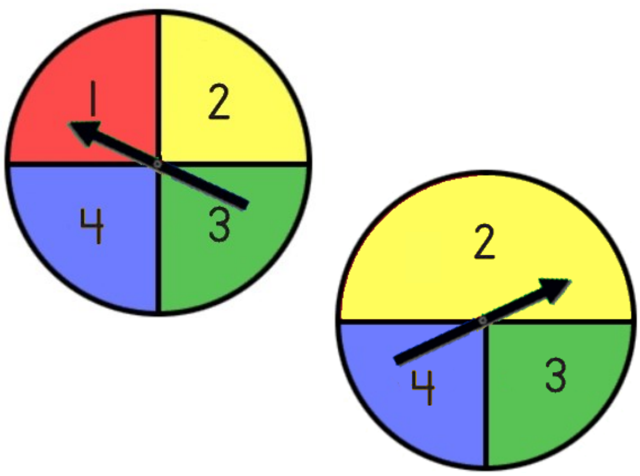
3). Put these 5 sets of numbers in order, smallest first

1/5,	0.5	5%
1/3,	0.3	34%
2/17	0.111	2%
19/43	0.442	44%
4701/5007	0.95	94%



4). 16 beans are arranged as shown how many beams are need for 12x5 rectangular shape.

How many beans for an N x M shape



5). Which spinner will give the highest score for 10 spins. What about a 1000 spins each.

Is there a relationship of the scores for 10 and 1000 spins.

6). A clock chimes every 7 minutes it chimes at 1p.m. when does it next chime exactly on the hour

7). Is 1/50 nearer to 1/10 or 1/100

8). Bill dawdles to school at 25 m/min. His sister leaves home, after Bill has gone 150m, walking 75m/min, how long before she catches him up.

9). Which is strongest a glass of orange juice made with 8 parts of juice with 3 parts of water or 9 parts of juice with 4 parts of water

10). Gertrude was born on February 29, 1924 how many birthdays have fallen on February 29 since.

11). A blue triangle has a yellow triangle in it, a further yellow triangle placed above it. More and more yellow triangles are added getting smaller and smaller. What is the sum of the areas of the yellow triangles as a ratio/fraction/percentage of the blue triangles.

OK it's obvious but write a programme to show how the answer approaches the obvious.

12). Some numbers are in columns ⟶ and rows. ↓

What number is in row 78 and column 5

13). A distraught shopkeeper is trying to sell Scratch Kat toys.

He reduces the price each day by 7%, how long before the toys are selling at a quarter, or less, of their original price

14). 5! Called factorial 5! is calculated as 5 x 4 x 3 x 2 x 1

Which is bigger 5! or (5 x2)!

15). Which sequence gets to 1000 first

1, 6, 16, 31, 51….

1, 2, 4, 8, 16………

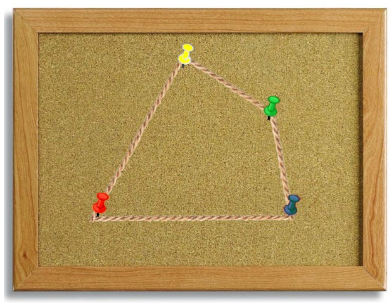
16). Albert’s race bike has a milometer which shows ❷❽❹

When will the milometer next show the same digits of 2, 4 & 8

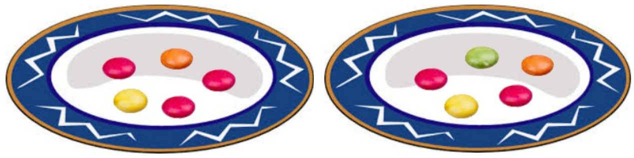
In any order.

17). The yellow pin is moved but the area of the space enclosed by the string remains the same.

Show the possible positions of the yellow pin.



18). Janet takes a smartie at random from one of the plates and puts it on the other plate. She then randomly takes a smartie from that plate and eats it.



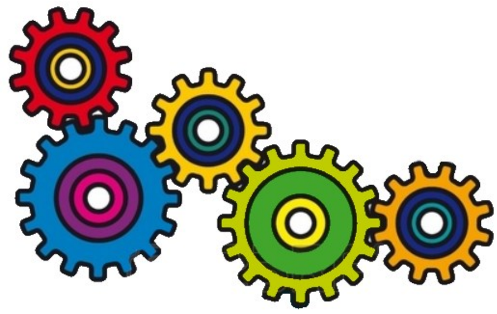
Which plate should she choose to start with if she prefers red smarties.

19). Adnan and Jill race to some trees and back. Adnan goes at 15 mph to the trees and back at 5 mph. Jill goes 10 mph in both directions.

Who wins.

20). Is 1/7 nearer to 1/6 or 1/8

21). The red, yellow and orange gears have 12 teeth and the blue and green gears 16.



When the red gear turns complete clockwise how far will the orange gear turn and in which way will it turn.

22). Three phone companies prices are:

A. Free phone then 3.5p per minute.

B. Phone for £20 then first 10hrs free then 2.8p per minute each month

C. Phone £15 the first 5hrs at 1p per minute and then 7.3p per minute each month.

The contract last a year. Which phone is the best buy according to the amount of use. Illustrate with a graph.

23). Somebody has left a jam biscuit on top of a box. An ant crawls up the box to feast on the jam. What is its shortest route. The box has the same dimensions in each direction.

If solving by a programme have the biscuit randomly placed on the top surface and the ant on either of the vertical faces. The ant each time must take the shortest route and draw his path.

This can be done at least two way:

A. The ant knows before starting where the biscuit is and immediately knows the quickest route.

B. It can not see the biscuit until it gets to the top of the box but will make repeated visits. Having a limited memory the ant at each visit does not remember where the biscuit is. However it does remember how far it travelled each time and the starting angle. If it starts off at a random angle to the top of the box could it gradually find the shortest route. Could it take a more systematic approach for its starting angle, and if so how would it know when it has the shortest route.

Challenge Notes

All these challenges can be done by paper and pencil—in some cases far easier and faster then writing a programme to do it. But that's the point choosing when to use programming over paper and pencil is part of mathematical understanding. Then of course to know whether the programme is correct in it's solution, use of the paper and pencil result might be the only way to do it.

Some can be done by kludging - say challenge 16 just start at the number 284 and increment it by one until the numbers 2, 4 & 8 are used. But how does the programme know that? What some of these challenges show, I hope, that a computer programme may come to a solution with a different approach then a paper and pencil. Hopeful some lend themselves to heuristics and/or Monte Carlo methods.

Some challenges made need another questioned answered, such as challenge 11.

Several challenges can be done in a line or two such as 4, 7, & 20. Some done quicker by paper and pencil but once done by programming give multiple solutions with different data inputs such as 2 & 3.

Challenge 2 may tax most K2s and some K3s with the last part of, the form aN^m + bN^(m-1) + cN^(m-2) ......cN^r.... requires some challenging coding. Could it be used to introduce calculus?