King Edward VI Camp Hill School for Girls

Maths Department Newsletter

8th February 2021

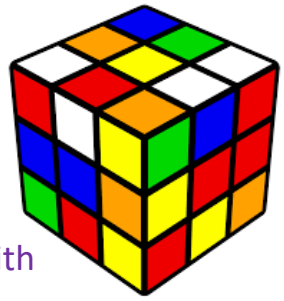
$82 = 3^3 + 3^3 + 3^3 + 1^3$

News

The theme for this week's newsletter is cubes. This is because it was recently announced in the news that scientists think they have worked out why wombats poo cubes. Wombats are animals that live in Australia.[1] If you didn't know that wombats did cube-shaped poos, have a look at the picture that I've helpfully placed just below this sentence. Apparently, the cube shape is formed within the intestines, and not at the 'point of exit'[2], as was previously thought. To get to the bottom[3] of this problem, scientists "tested the tensile strings of the intestine while physicists in the US based at the Georgia Institute of Technology created mathematical models to simulate the production of cubes." The team found that rhythmical contractions of the muscles in the intestines helped to form the sharp corners of the cubes. One theory about why wombats might have evolved this way is that, with their strong sense of smell, they communicate with each other using their poo, and the cube shape helps prevent the poos from rolling away. Researchers found that cube-shaped poos on an eight-degree slope rolled far less than spherical-shaped models. So, you see, you never know what you might end up using maths for!

Maths Word

A **cube** is a symmetrical three-dimensional shape, either solid or hollow, contained by six equal squares. Here are some fun facts about them.



11 different nets can be made by folding out the 6 square faces.

A cube has the largest volume of all cuboids with a given surface area.

Cubes are one of the five Platonic solids. These are the only solid shapes you can make where every face is the same regular polygon.[4]

A cube is sometimes called a hexahedron.

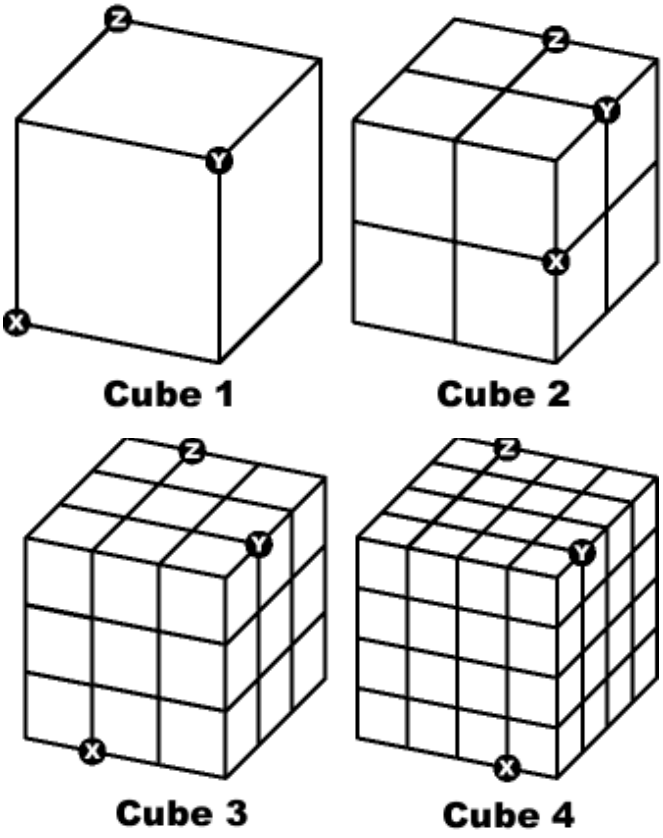
There are 43 quintillion, 252 quadrillion, 3 trillion, 274 billion, 489 million, and 856 thousand[5] possible configurations of a Rubik's Cube, and yet from any one of those starting positions, it can always be solved in at most 20 moves!

Joke

1. Also, they're loads bigger than you think they're going to be. Google it!
2. Apparently, that's the technical term for it.
3. Sorry.
4. The Platonic solids are interesting. Watch this video about them (just click on the words 'this video').
5. Do you know how to write that number out using digits?

Tricky Cubes Puzzle

Can you work out the size of the angle ***XYZ*** in each of these diagrams if each cube has a side length of 1cm?[6]

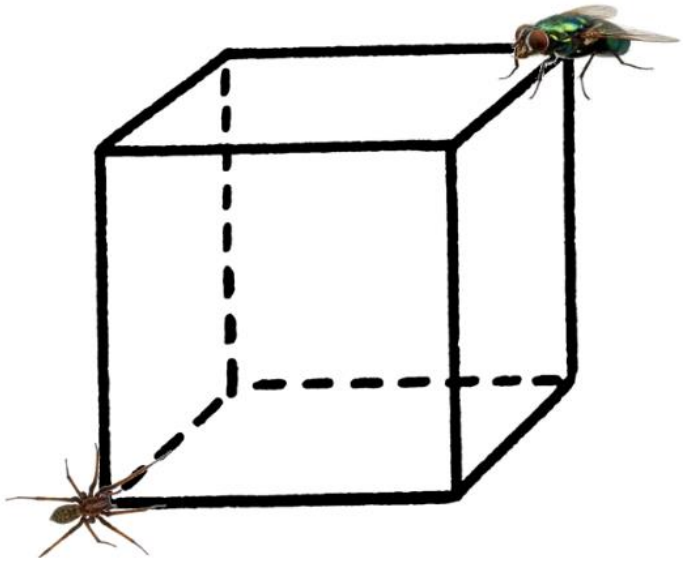


Waring's Problem

At any time in history, there are always lots of famous unsolved maths problems, and most famous mathematicians become famous because they solve one or more of them! If you want to become a famous mathematician, here's a question we don't know the answer to. We **do** know that every positive integer can be made by adding together at most 4 square numbers[7], or 9 cube numbers, or 19 fourth powers. We do not know whether we can say something similar for every power. The question of whether we can is called Waring's Problem, and the mathematician who finally solves it will probably become quite famous. Could it be you?

Spider and Fly Puzzle

Here is a famous puzzle. A spider and a fly are sitting on opposite corners of a cube. What is the shortest path along which the spider could walk in order to reach the fly?[8]



Algebra

You may have come across the idea of 'the difference of two squares' in algebra. This is the neat factorisation that says that

$$a^2 - b^2 = (a+b)(a-b)$$

You may also know that $a^2 + b^2$ does not factorise.[9] What you might not know is that both the difference and the sum of two cubes factorise in the following ways:

$$a^3 - b^3 = (a-b)(a^2 + ab + b^2)$$

$$a^3 + b^3 = (a+b)(a^2 - ab + b^2)$$

Why not learn these factorisations?

Anyway, that's all we have space for in this newsletter. Don't forget to join virtual maths club if you haven't already! Hope you have a good half-term holiday and let me know if you solve the puzzles 😊.

6. The length of the side is irrelevant. I just thought it might confuse some people if I didn't say it was something.
7. This is called Lagrange's Four-Square Theorem (follow the hyperlink!).
8. Assume the fly doesn't move. It's stupid… or asleep or something.
9. It actually does, but you have to use complex numbers! Look this up!