King Edward VI Camp Hill School for Girls

Maths Department Newsletter

4th January 2021

79 is the smallest number that cannot be represented as a sum of fewer than 19 fourth powers

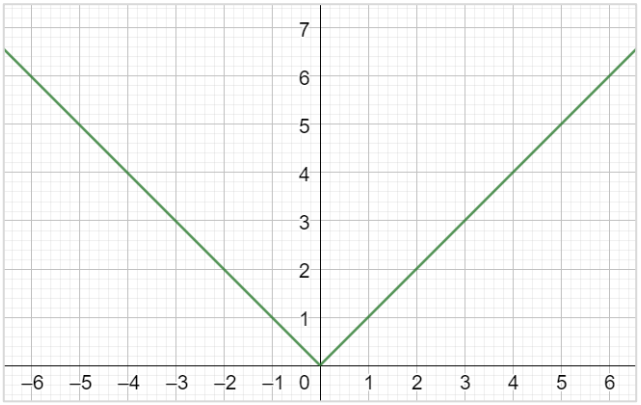
News

Happy New Year! I've been trying to work out the probability that this year will be better than last year and I've come to the conclusion that I think it's quite high, based on the fact that it would be hard for this year to be any worse than last year. After all, maths is an optimistic subject, isn't it? When a number falls halfway between two other numbers, we round up, not down. Isn't that an example of optimism? And we're more likely to write $a + b$ than $-(-a - b)$ because instinctively we try to minimise the amount of negativity in our lives.[1]

2021 is also a better number than 2020 because it has the interesting property that the square of its reverse is the reverse of its square. You may have come across this idea before when you first learned that $12^2 = 144$ but $21^2 = 441$. This also works with 13, as $13^2 = 169$ and $31^2 = 961$. You may not have known that $2021^2 = 4084441$ but $1202^2 = 1444804$ but now you do. There are an infinite number of pairs of numbers that have this property. They are called **skinny numbers** and are the numbers where there are no carries when they are squared using long multiplication. You can read more about them by following the footnotes…[2]

Maths Words

The **modulus function**, written $y = |x|$, is a function that just turns anything you put inside it into the positive version of itself. Its graph looks like this:



It is often used when you just want to know the positive difference between two numbers. This is because $|a - b|$ is the same as $|b - a|$. If this fact isn't obvious, just think about it for a moment or two. It is why if you want to work out, for example, 3 – 17 in your head, it is easier to work out 17 – 3 and then change the sign.[3]

Joke

1. I think I've proved my point. There is even a function called the modulus function, whose only purpose is to make everything positive!
2. Read this https://t.co/8MNT7YRzm9?amp=1 first, and then this https://oeis.org/A061909.
3. Can you work out why the modulus of zero is funny?

The Scales Puzzle

I've accidentally turned the calibration dial on my bathroom scales, so its readings are wrong by a constant amount.[4] Apart from that, they work fine.

When I stand on the scales, they read 72 kg, and when my wife stands on them they read 59 kg. When we stand on them together, they read 125 kg.

By how many kg should I adjust them?

Algebra Puzzle

Can you find three numbers, *A*, *B* and *C*, such that

$$\frac{ABC}{A\times B\times C} = A+B+C$$

The number on the top of the fraction is not the product of A, B and C, but the number you get by joining the digits together as if it were a word.

The 2021 Puzzle

Can you put signs between each of the numbers from 10 down to 1 so that the calculation works?

10 9 8 7 6 5 4 3 2 1 = 2021

Virtual Maths Club

Don't forget that if you want to join our Camp Hill Girls' Virtual Maths Club (to get even more maths!), just go into Google Classroom and enter the code **uoks6uw**.

What's the Answer?

First, notice that

$$(\sqrt{2}-1)^0 = \sqrt{1}-\sqrt{0}$$

$$(\sqrt{2}-1)^1 = \sqrt{2}-\sqrt{1}$$

$$(\sqrt{2}-1)^2 = \sqrt{9}-\sqrt{8}$$

$$(\sqrt{2}-1)^3 = \sqrt{50}-\sqrt{49}$$

I'm wondering if every integer power of $(\sqrt{2}-1)$ is the difference between the square roots of consecutive integers?

Making the Year

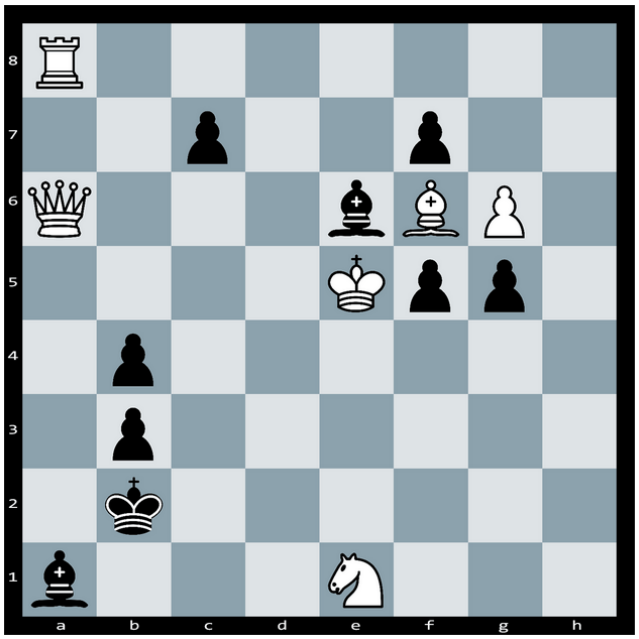
You can make the number 2021 using just ten 1s in the following way:

$$(1+1)^{11} - (1+1+1)^{(1+1+1)} = 2021$$

Can you make 2021 using less than ten of a different digit?[5]

Chess Puzzle

Checkmate in one move. White to play.[6]



4. This puzzle, the algebra puzzle, and the 'What's the Answer?' puzzle are all from Chris Smith.
5. For example, using six 2s or eight 4s or something. All the digits must be the same, but you can put them together to make numbers (like using two 1s to make 11), and you can use powers and roots if you like.
6. I've included a chess puzzle, because I had lots of responses to the one in newsletter 77. Let me know if you like them, and I'll find some more difficult ones. This one is a bit easy.