King Edward VI Camp Hill School for Girls
Maths Department Newsletter
7th November 2023
101, 103, 107 and 109 are all prime numbers

## The Number 101



Between 2004 and 2009, the tallest building in the world was Taipei 101, in Taiwan, an island off the coast of China. It is called Taipei 101 because it has 101 floors. This number was chosen for symbolic reasons. Since the number 100 traditionally
 represents perfection, the number 101 came to represent something that is even better than perfect. This idea of attaching meaning to different numbers is called numerology. ${ }^{1}$ The main tower features a series of eight segments of eight floors each. In Chinese speaking cultures the number eight is associated with abundance, prosperity and good fortune. The number 101 has always been popular though. Can you work out what the surrounding pictures have to do
 with the number 101?


## Halloween Venn Diagrams

Can you work out what each of these Venn diagrams mean?


1. If you learned about numerology in America, it would probably be on a course called Numerology 101.

## The View From Room I

A little project I have been working on this year with a few members of my form is trying to work out what all the tall buildings are that you can see out of the window in room 1. It's going quite well, but there are a few buildings that we can't work out. Can you help? ${ }^{2}$

What is this red building?!
And what are these two?


## Lagrange's Four Square Theorem (part 4)

In the last newsletter we started to think about how sometimes in maths it is useful to look at something in two different ways. Algebra is a useful tool for doing this. You may have already come across the idea of the difference of two squares. If you haven't, then you definitely need to learn it because it crops up all over the place in maths questions. The difference of two squares is an example of a factorisation and it looks like this:

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

There are lots of other useful factorisations in maths, such as the difference of two cubes

$$
a^{3}-b^{3}=(a-b)\left(a^{2}+a b+b^{2}\right)
$$

and the sum of two cubes

$$
a^{3}+b^{3}=(a+b)\left(a^{2}-a b+b^{2}\right)
$$

You can't factorise the sum of two squares using only real numbers, but you can if you use complex numbers ${ }^{3}$

$$
a^{2}+b^{2}=(a+b i)(a-b i)
$$

Some factorisations are named after people, like this one which is called Sophie Germain's Identity

$$
a^{4}+4 b^{4}=\left(a^{2}+2 b^{2}-2 a b\right)\left(a^{2}+2 b^{2}+2 a b\right)
$$

An identity in maths is basically an algebraic statement that tells you that two expressions are the same as each other, even though they look different. They are just two different ways of looking at the same thing. You don't need to provide complicated mathematical proofs for these because you can check them by just multiplying out the brackets. The proof of Lagrange's Four Square Theorem uses an identity discovered by the famous mathematician Leonhard Euler and we will look at that in the next newsletter. Meanwhile, why not learn the factorisations and identities that I've just mentioned? Also, see if you can find any others. Let me know if you do and l'll put them in a future newsletter.

[^0]
[^0]:    2. House points will definitely be awarded to anyone who works out what any of these buildings are.
    3. You may need to read up on complex numbers for this one to make sense.
