3.14159265358979323846264338327950288419716939937510582097494459230781640628620899862803482534211706798214808651328230664709384460955058223172535940812848111745028410270193852110555964462294895493038196442881097566593344612847564823378678316527120190914564856692346034861045432664821339360726024914127372458700660631558817488152092096282925409171536436789259036001133053054882046652138414695194151160943305727036575959195309218611738193261179310511854807446237996274956735188575272489122793818301194912983367336244065664308602139494639522473719070217986094370277053921717629317675238467481846766940513200056812714526356082778577134275778960917363717872146844090122

King Edward VI Camp Hill School for Girls
Maths Department Newsletter

14th March 2016

A ball made of pentagons and hexagons will always have 12 pentagons

Happy Pi Day

March 14th is always pi day but this year it's pi to 4 decimal places day[1], as it's 3/14/16. You might think that using the American way of writing dates just to make the date look like a number is a bit of an irrational thing to do, but isn't that what you'd expect from the most famous irrational number there is?
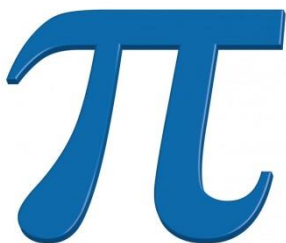
Maths Word

Before we go any further it would probably be a good idea to mention that pi is the name we give to the number you get if you divide the circumference of any circle by its diameter.[2]

What's so good about pi?

You might be wondering, if that's all pi is, why do people make such a fuss about it? One of the reasons pi is popular is because it appears in other, often unexpected places, such as Euler's famous identity

$$e^{i\pi} + 1 = 0$$

It also sounds like the name of a food and so it's easy to make silly jokes about it.[3] It also appears in Einstein's equation:

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = 8\pi GT_{\mu\nu}$$

Why not find out what this means?

1. or 5 significant figures if you prefer.
2. We thought we'd better say this, just in case.
3. A pie – see today's joke for an example.

Albert Einstein

Speaking of Einstein, you may or may not be aware that he was born on pi day in 1879. The 8 digits that make up his birthday '14031879' first appear together like that in pi, beginning at the 74434701th decimal place. The American version '03141879' occurs at the 60203039th decimal place. If you would like to search the first 200 million decimal places of pi to find your birthday, you can do this at http://www.angio.net/pi/
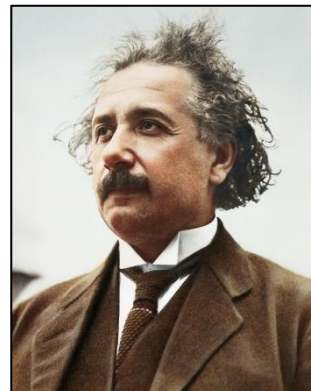
Maths Quote

"The beauty of pi is that it puts infinity within reach. The digits never end and never show a pattern. They go on forever, seemingly at random - except that they can't be random, because they embody the order inherent in a perfect circle. This tension between order and randomness is one of the most tantalising aspects of pi."
Steven Strogatz

If, however, some of the work you've been doing in class seems even more random and mysterious than pi, why not come along to maths workshop?

Joke

$$\sqrt{-1} \quad 2^3 \quad \Sigma \quad \pi$$

and it was delicious!

Extreme BIDMAS

Following on from the last newsletter, Anna and Xinzy in year 13 came up with a very neat way of making 2016 using eleven nines:

99× (9+9+9) − (9×9×9) + (9×9) − 9 = 2016

We also found this, using nine sixes:

(6×6×6) − (6×6) − (6+6) × (6+6) = 2016

and this, with alternating ones and twos:

(12 × 12 + 12 + 12) × 12 = 2016

So far, we haven't found a way of making 2016 using fewer than 16 ones.

(11 × (1+1) −1) ×
((11×11) − (11 × (1+1)) − (1+1+1)) = 2016

Let us know if you can do better.

How can we calculate pi?

So you know what pi is, and why it's interesting, so how can we calculate it? There are lots of really neat formulas for calculating pi. Here are a few of them. In 1655, John Wallis discovered that:

$$\frac{\pi}{2} = \frac{2}{1} \times \frac{2}{3} \times \frac{4}{3} \times \frac{4}{5} \times \frac{6}{5} \times \frac{6}{7} \times \frac{8}{7} \times \ \dots$$

Around 1675, James Gregory and Gottfried Leibniz both discovered:

$$\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \frac{1}{11} + \frac{1}{13} - \dots$$

Then, along came Euler, and gave us:

$$\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \frac{1}{5^2} + \frac{1}{6^2} + \dots$$

which is the solution to the famous Riemann Zeta Function[4] when zeta = 2. Then, in the early 1900s, the Indian mathematician Ramanujan[5] gave us:

$$\frac{1}{\pi} = \frac{\sqrt{8}}{9801} \sum_{n=0}^{\infty} \frac{(4n)!}{(n!)^4} \times \frac{26390n + 1103}{396^{4n}}$$

William Jones

William Jones was a friend of Sir Isaac Newton who taught maths on naval battleships and in coffeehouses in London[6]. He wasn't famous but maybe he should be slightly more well-known than he is. In a 'maths for beginners' guide he published in 1706, he decided to use the Greek letter pi to represent the number we now call pi, rather than just a letter 'p', which had previously been used, to stand for 'periphery'. Nobody would have taken any notice though, if the famous Euler hadn't decided to use Jones's notation in his own work about 30 years later.

The Food Factor

Hopefully, you now know a bit more about pi than you did before. Here at the maths newsletter, we like to think that pi day is not just for people who love maths. Pi day should be for everyone, so why not celebrate by baking a pi day pie? If it's a circular pie, then the number pi will be an intrinsic property of the structure of the pie, so when somebody eats a piece of the pie, they will actually be eating a bit of pi too. They will actually be eating a mathematical idea, possibly without even knowing it. And if a child eats some pi, 52 days after their 3rd birthday, they will also be pi years old (3.14 years). The possibilities are endless![7] Have fun ☺

4. The Riemann Hypothesis is the most famous unsolved problem in mathematics (ask Dr Ridha about it).
5. Most formulas I've seen by Ramanujan look a bit like this.
6. We have no idea why he was teaching maths in these places.
7. Just like pi!