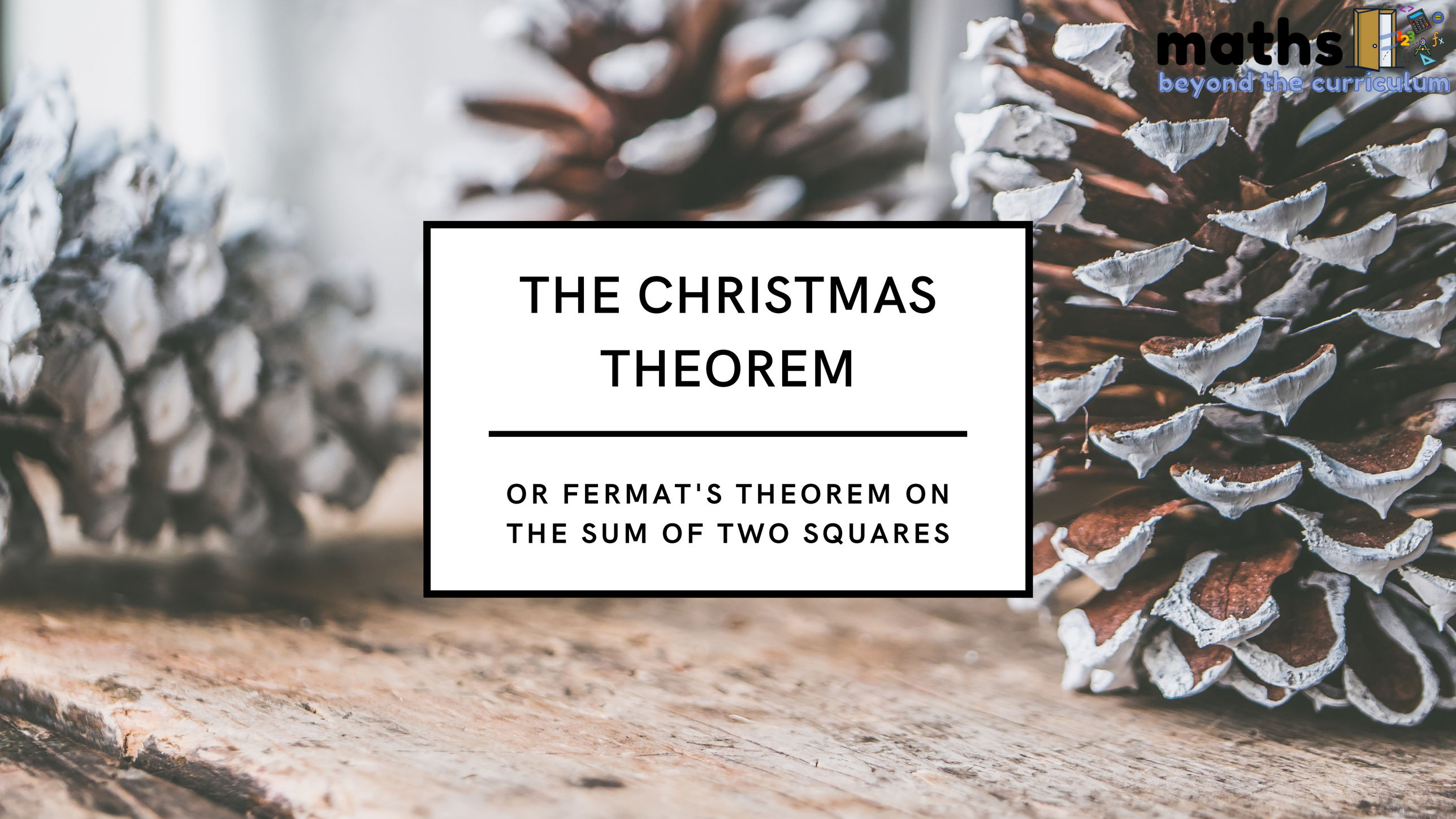

maths beyond the curriculum

THE CHRISTMAS THEOREM

OR FERMAT'S THEOREM ON THE SUM OF TWO SQUARES

THE CHRISTMAS THEOREM

CHOOSE TO START FROM THE NEXT SLIDE OR THIS SLIDE (SLIDE 13)

THE FIRST FEW SLIDES ARE FOR STUDENTS WHO ENJOY EXPLORING MATHS AND NEED VERY LITTLE GUIDANCE

5	17
31	41

13 can be written as the sum of two squares:

$$13 = 2^2 + 3^2$$

Here are four prime numbers - write them all as a sum of two squares

Tell me when you have ALL FOUR

5	17
31	41

5	17
31	41

$$5 = 2^2 + 1^2$$

5	17
31	41

$$5 = 2^2 + 1^2$$

5	17
31	41

$$5 = 2^2 + 1^2$$

$$17 = 4^2 + 1^2$$

5	17
31	41

$5 = 2^2 + 1^2$

$17 = 4^2 + 1^2$

5	17
31	41

$5 = 2^2 + 1^2$

$17 = 4^2 + 1^2$

$41 = 5^2 + 4^2$

5	17
31	41

$5 = 2^2 + 1^2$

$17 = 4^2 + 1^2$

$41 = 5^2 + 4^2$

WHY NOT 31?

CLASS INVESTIGATION:

Fermat, a famous french mathematician, believed that some, but not all, primes can be written as a sum of two squares - and he said he could work out which ones just by looking at them - but he didn't show his working out!
Can you figure out how he knew?

(for example he could tell if 999999937 could be done, in just a few seconds)

PIERRE DE FERMAT

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$$13 = 2^2 + 3^2$$

PIERRE DE FERMAT

3.	5.
7.	11.
13.	17.
19.	23.
29.	31.
37.	41.
43.	47.
53.	59.
61.	67.
71.	73.
79.	83.
89.	97.

3.

5. ✓

7.

11.

13. ✓

17. ✓

19.

23.

29. ✓

31.

37. ✓

41. ✓

43.

47.

53. ✓

59.

61. ✓

67.

71.

73. ✓

79.

83.

89. ✓

97. ✓

What do all these have in common?

Clue - just write out the list of the ones that worked

3.

5. ✓

7.

11.

13. ✓

17. ✓

19.

23.

29. ✓

31.

37. ✓

41. ✓

43.

47.

53. ✓

59.

61. ✓

67.

71.

73. ✓

79.

83.

89. ✓

97. ✓

What do all these have in common?

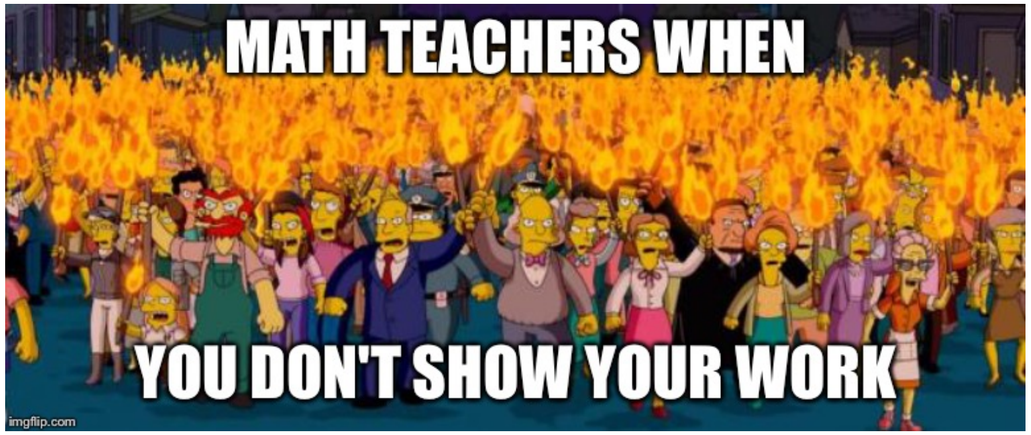
Clue 2 -write out the multiples of four too.

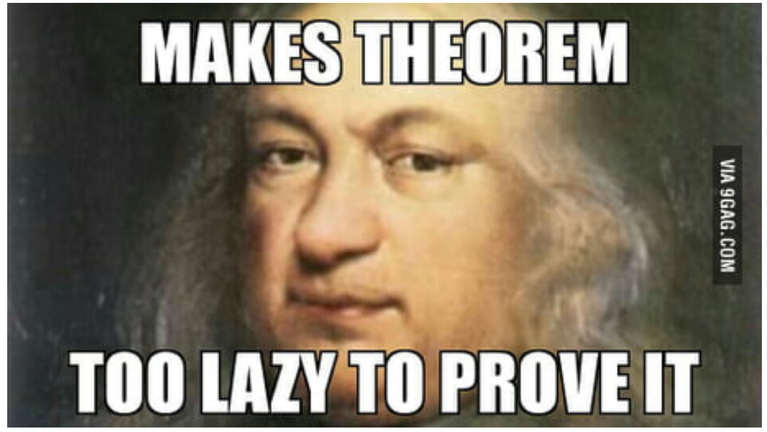
THE CHRISTMAS THEOREM

Fermat wrote to his his friend on the 25th December saying he had found a proof that all odd primes that were **1 more than a multiple of four** could be calculated as a sum of two squares.

He never actually wrote down his proof, and since then many famous mathematicians (Lagrange, Pascal, Gauss) have tried to prove his theorem based on this letter.

PIERRE DE FERMAT





Final Summary

Explain what Fermat's idea was in less than 25 words

Then explain how you know if 999999937 works for Fermat's Christmas Theorem