

Ramanujan's Number

By [At Right Angles](#) | Sep 23, 2013

They say that each number has its own special property, unique and peculiar to it. It is not always easy to find such a property; sometimes, by luck, or by hard work, one stumbles upon it.

Mathematicians such as John E Littlewood and Godfrey H Hardy who worked closely with the great mathematician Srinivasa Ramanujan (1887–1920) would say of him that he seemed to know the positive integers as friends. He the individual peculiarities of each number!

Here is a well known property that Ramanujan noted about the number 1729:

he said to Hardy one day:

It is the smallest positive integer that can be written as the sum of two positive cubes in more than one way

'Cubes' are numbers like 1, 8, 27, 64, 125, 216,.... Ramanujan obviously had in mind the following identity: $1729 = 10^3 + 9^3 = 12^3 + 1^3$.

The identity is easy to check. But how could he know that 1729 is the *smallest* positive integer that can be written in two such ways? Only if he had looked at lots and lots of integers before that

Ramanujan is said to have made this observation to Hardy who happened to be visiting him while he was recovering in a sanatorium in England, in the year 1918; on entering Ramanujan's room, Hardy apparently said (perhaps just to start a conversation), "I came in a taxi whose number was 1729. I could not see anything interesting about that number" — thereby inviting the response quoted above.¹



We shall call a number with such a property a *Ramanujan number*. Thus, 1729 is the least Ramanujan number.

Here is our challenge to you: *Find the next Ramanujan number after 1729.*

Probably you will need to use a computer to make a systematic search for such numbers.

And some extensions ...

1. *Which is the smallest positive integer that can be written as the sum of two squares in more than one way?*

2. *Which is the smallest positive integer that can be written as the sum of two triangular numbers in more than one way? (The 'triangular numbers' are the numbers 1, 1+2, 1+2+3, 1+2+3+4, ...; i.e., the numbers 1, 3, 6, 10, 15, 21, ...)*


3. Which is the smallest positive integer that can be written as the sum of two fourth powers in more than one way? (You will certainly need to use a computer to solve this.)

We will discuss the answers in the next issue, and at the same time make some general comments about such problems.

1. Editor's note: Ramanujan had gone to England four years earlier, in 1914, at the invitation and insistence of Hardy. We shall have more to say about Ramanujan in future issues of this magazine.

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