Math Diversion Problem 587

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The YouTube video is found at:

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Source: https://www.youtube.com/watch?v=agOetV8b87U
Title: Is there creativity in Maths? The History
    of Mathematics with Luc de Brabandere
 Presenter: What Makes It Tick?
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1 The Problem

Consider the following 12 numbers.

51	36	3	15
9	17	63	6
53	42	33	72

Figure 1. A subset of these twelve numbers add to 100. Can you find them?

2 The Solution

One can always use a systematic exhaustive search for these numbers, but there's a trick to this problem that greatly simplifies the search, and it has to do with the nature of the numbers themselves. If you can find the trick, you can shorten the search and reduce the amount of calculation required. If you want a hint, go to the next page.

Okay, here's the hint: All but two of these numbers are divisible by 3.

So, what are these two numbers? They are 17 and 53. So, what are the implications? First, since 100 is not divisible by 3, then at least one of 17 and 53 must be part of the sum. Let's look closer at this. What if we only tried to use numbers that are divisible by three. Each of those numbers can be written as $3m$ for some positive number m. If we take any sum of such numbers we get (for ℓ such numbers)

$$3 \cdot m_1 + 3 \cdot m_2 + \cdots + 3 \cdot m_\ell = 3 \cdot (m_1 + m_2 + \cdots + m_\ell) = 3N\,, \tag{1}$$

for some N. Then what about

$$3 \cdot N = 100\,? \tag{2}$$

This won't work because 3 does not divide 100. So, to cut to the chase, which of the following numbers is divisible by 3:

$$100 - 17 = 83\,, \quad 100 - 53 = 47\,, \quad 100 - (53 + 17) = 30\,? \tag{3}$$

The answer is: Only the last one. So, the solution requires both 17 and 53 in the sum, leaving 30 left over. We can account for 30 by the numbers 15, 9, 6.

Therefore, the answer is:

$$53 + 17 + 15 + 9 + 6 = 100\,. \tag{4}$$

3 Aftermath

This trick was presented as a way to 'be clever' or 'creative' when doing mathematics, by which the presenter meant to be more efficient than merely applying brute force calculation or exhaustive search. By the way, I didn't get the trick until it was revealed to me by the presenter.

So what's the upshot of this message? Solving brain teasers can teach us the tricks of the mathematical trade that might make us more efficient (being more creative) in the long run.