



Using technology to help with Ritangle

Here is an example problem where a spreadsheet can help:

Find a four-digit square number such that if you add the cubes of its digits you get another cube.

Technology can help with a problem like this simply because it can check lots of possible answers very quickly.

Let's think about how this approach might work. The steps might be as follows:

- 1) Find all the four digit square numbers
- 2) For each of these, find the sum of the cubes of its digits
- 3) For each value obtained in this way check whether it is a cube

A spreadsheet program can do all of the above. Parts 1) and 3) are the most straightforward:

- To find the square of the number in cell A1, use the formula `"=A1^2"`
- To check whether the value in cell A1 is a cube you could find its cube root using `"=A1^(1/3)"` and then check whether that is a whole number (you may need to be careful with rounding here and carry out a manual check of your answer too just to be sure).

For 2) above you need to be able to isolate the digits of a four digit number. This is a bit trickier:

The ROUNDDOWN function (in Excel, other spreadsheet programs are likely to have equivalents) is what is needed. The function does what you might expect - it rounds down:

- `"=ROUNDDOWN(4.7)"` returns the value 4
- `"=ROUNDDOWN(10.1)"` returns the value 10
- `"=ROUNDDOWN(0.999999999)"` returns the value 0.

Imagine that a four digit value is contained in cell A1 of a spreadsheet and you would like cell A2 to contain its first digit, cell A3 its second digit, cell A4 its third digit and cell A5 its final digit. Of course you want this to update if you were to change the value in cell A1 and so you must use formula.

Let's think about an example. Suppose cell A1 contains the value 3481.

Dividing a given four digit number n by 1000 gives a number which rounds down to the first digit of n . In this case:

$$\frac{3481}{1000} = 3.481 \text{ which rounds down to 3, the first digit of 3481.}$$

So the formula required for cell A2 is “=ROUNDDOWN(A1/1000)”.

To get the second digit you can use the same method once you have got rid of the first digit.

If you know that the first digit of n is a then $n - 1000a$ leaves a three digit number whose first digit is the second digit of n . Think carefully about this! In the example you've been considering this is just

$$3481 - (1000 \times 3) = 481$$

The first digit of a three digit number is found by dividing by 100 and rounding down:

$$\frac{481}{100} = 4.81 \text{ which rounds down to 4.}$$

So the formula required in cell A3 is “=ROUNDDOWN((A1 - 1000*A2)/100)”.

Continuing, the formula in cell A4 is “=ROUNDDOWN((A1 - 1000*A2 - 100*A3)/10)”

This Excel spreadsheet shows these calculations. Once you understand how each cell in the spreadsheet has been calculated you should be able to find the answer to the problem.

Here are some screenshots from the spreadsheet

	Square of value in column to left	First digit of value in column B	Second digit of value in column B	Third digit of value in column B	Fourth digit of value in column B	Sum of values in columns C, D, E and F	Cube root of value in column G
32	1024	1	0	2	4	73	4.179339196
33	1089	1	0	8	9	1242	10.74914361
34	1156	1	1	5	6	343	7
35	1225	1	2	2	5	142	5.217103446
36	1296	1	2	9	6	954	9.844253565
37	1369	1	3	6	9	973	9.909177627
38	1444	1	4	4	4	193	5.778996565
39	1521	1	5	2	1	135	5.12992784
40	1600	1	6	0	0	217	6.009245007
41	1681	1	6	8	1	730	9.004113346
42	1764	1	7	6	4	624	8.545317363
43	1849	1	8	4	9	1306	10.93069372

Formula view (view of fifth and sixth columns obscured):

	Square of value in column to left	First digit of value in column B	Second digit of value in column B	Third digit of value in column B	Fourth digit of value in column B	Sum of values in columns C, D, E and F	Cube root of value in column G
32	=A2^2	=ROUNDDOWN(B2/1000,0)	=ROUNDDOWN(B2/100,0)-10*C2	=ROUNDDOWN(B2/10,0)-100*C3	=ROUNDDOWN(B2/1,0)-1000*C4	=C2^3+D2^3+E2^3+F2^3	=G2^(1/3)
33	=A3^2	=ROUNDDOWN(B3/1000,0)	=ROUNDDOWN(B3/100,0)-10*C3	=ROUNDDOWN(B3/10,0)-100*C4	=ROUNDDOWN(B3/1,0)-1000*C5	=C3^3+D3^3+E3^3+F3^3	=G3^(1/3)
34	=A4^2	=ROUNDDOWN(B4/1000,0)	=ROUNDDOWN(B4/100,0)-10*C4	=ROUNDDOWN(B4/10,0)-100*C5	=ROUNDDOWN(B4/1,0)-1000*C6	=C4^3+D4^3+E4^3+F4^3	=G4^(1/3)
35	=A5^2	=ROUNDDOWN(B5/1000,0)	=ROUNDDOWN(B5/100,0)-10*C5	=ROUNDDOWN(B5/10,0)-100*C6	=ROUNDDOWN(B5/1,0)-1000*C7	=C5^3+D5^3+E5^3+F5^3	=G5^(1/3)
36	=A6^2	=ROUNDDOWN(B6/1000,0)	=ROUNDDOWN(B6/100,0)-10*C6	=ROUNDDOWN(B6/10,0)-100*C7	=ROUNDDOWN(B6/1,0)-1000*C8	=C6^3+D6^3+E6^3+F6^3	=G6^(1/3)
37	=A7^2	=ROUNDDOWN(B7/1000,0)	=ROUNDDOWN(B7/100,0)-10*C7	=ROUNDDOWN(B7/10,0)-100*C8	=ROUNDDOWN(B7/1,0)-1000*C9	=C7^3+D7^3+E7^3+F7^3	=G7^(1/3)
38	=A8^2	=ROUNDDOWN(B8/1000,0)	=ROUNDDOWN(B8/100,0)-10*C8	=ROUNDDOWN(B8/10,0)-100*C9	=ROUNDDOWN(B8/1,0)-1000*C10	=C8^3+D8^3+E8^3+F8^3	=G8^(1/3)
39	=A9^2	=ROUNDDOWN(B9/1000,0)	=ROUNDDOWN(B9/100,0)-10*C9	=ROUNDDOWN(B9/10,0)-100*C10	=ROUNDDOWN(B9/1,0)-1000*C11	=C9^3+D9^3+E9^3+F9^3	=G9^(1/3)
40	=A10^2	=ROUNDDOWN(B10/1000,0)	=ROUNDDOWN(B10/100,0)-10*C10	=ROUNDDOWN(B10/10,0)-100*C11	=ROUNDDOWN(B10/1,0)-1000*C12	=C10^3+D10^3+E10^3+F10^3	=G10^(1/3)
41	=A11^2	=ROUNDDOWN(B11/1000,0)	=ROUNDDOWN(B11/100,0)-10*C11	=ROUNDDOWN(B11/10,0)-100*C12	=ROUNDDOWN(B11/1,0)-1000*C13	=C11^3+D11^3+E11^3+F11^3	=G11^(1/3)
42	=A12^2	=ROUNDDOWN(B12/1000,0)	=ROUNDDOWN(B12/100,0)-10*C12	=ROUNDDOWN(B12/10,0)-100*C13	=ROUNDDOWN(B12/1,0)-1000*C14	=C12^3+D12^3+E12^3+F12^3	=G12^(1/3)
43	=A13^2	=ROUNDDOWN(B13/1000,0)	=ROUNDDOWN(B13/100,0)-10*C13	=ROUNDDOWN(B13/10,0)-100*C14	=ROUNDDOWN(B13/1,0)-1000*C15	=C13^3+D13^3+E13^3+F13^3	=G13^(1/3)