MATHEMAGICAL

Can you explore interesting patterns with numbers and use mathematical reasoning to explain them?

NOT ALL MATH PUNS ARE AWFUL. JUST SUM.

In this number puzzle you will use arithmetic to complete calculations, logical thinking to spot patterns and use your reasoning and problem-solving skills to prove your findings.

Do you have what it takes to think, reason and write like an expert to secure those house points?

Beware: your explanations will be judged as well as the maths.

Good Luck!

For this challenge you will need:

- **Pen**
- **Paper**
- **Calculator (optional)**

Follow the steps in the red box. Either type up your findings onto a Word Document, PowerPoint or copy up neatly on to a piece of paper.

Can you then take this a step further and prove your findings? Answer the questions in the blue and green boxes to help achieve this.

Step 1:
Write down any three **different** digits.
a) Make all the possible 2-digit numbers using combinations of your three digits (you cannot use a digit twice in a number e.g. 22, 33 etc..)
b) Sum these 2-digit numbers.
c) Divide your answer by 2.
d) Write down your answer.

Step 2
Now return to the original three digits that you wrote down at the start. Add these three digits together.

What do you notice?
Try this out a few more times using different digits and see if you can spot a relationship between your answers from Step 1 and Step 2.

Step 3
Put into words what you have found. Try to write in full sentences using mathematical language and correct terminology.

Why does this result occur? Can you prove why this always happens? (Hint: could you use some algebra?)

Congratulations! During this challenge you have reasoned, problem solved and (potentially) proved some exciting Mathematics! To be in with a chance of winning points for your house, please email your findings to your maths teacher.

Extension
Suppose we started with four different digits and this time made all possible 3-digit numbers and proceeded as before, how will you need to change step 1c) to make the puzzle 'work'?

What about using n-digit numbers from m digits?