

University of Liverpool Maths Club

Some Mathematical Puzzles

1. Choose a digit from 1 to 9 e.g. 4
Repeat twice more 4 4 4
Add these $4+4+4=12$
Multiply by 37 $12 \times 37 = 444$
What do you notice? Why does this always work?
2. Take a 2-digit number e.g. 73
Subtract the separate digits from 9 26
Put the two numbers together 7326
Divide by 11 666
Subtract 9 657
Divide by 9
What do you notice? Why does this always work?
3. A retailer buys an item for a certain cost price, adds 20% markup, then adds $17\frac{1}{2}\%$ VAT and finally discounts the item by 10%. What is a quick way of finding the final price from the cost price?
4. Fred needs to type a manuscript at the rate of 15 pages per day in order to meet a deadline. So he types the first half at 10 pages per day and the second half at 20 pages per day. "After all" said Fred, "15 is the average of 10 and 20". Did Fred finish on time?
5. Julia drove 1 mile to the top of a hill at the rate of 30 miles per hour. How fast must she drive down the other side to average 50 miles per hour the whole distance?
6. Which is larger, 2^{3000} or 7^{1000} ? How about 2^{5978} and 7^{2135} ?
7. Before his last test in a course, Adam worked out that he would have to score 97 in the last test in order to average 90 in all the tests. Also if he scored 73 in the last test he would average 87 overall. How many tests were there altogether?

The next puzzles are based on the following amazing fact:

Any number and the sum of its digits leave the same remainder when divided by 9.

For example, $247 \div 9 = 27$ remainder 4; $2 + 4 + 7 = 13$ and $13 \div 9 = 1$ remainder 4.

8. Take any whole number e.g. 362
Multiply by 10 3620
Subtract the original number 3258
Cross out any digit other than zero 3258
From the other digits 3 5 8
You can deduce the one crossed out 2
How? And why doesn't it work if you cross out a 0?

9. Take any whole number	e.g. 13428
Add the digits	18
Subtract from the original number	13410
Add 31	13441
Cross out any digit other than zero	13441
From the other digits	1 3 4 1
You can deduce the one crossed out	4

How? And why doesn't it work if you cross out a 0?
 What has 31 got to do with it?

10. What is the missing digit?

$$35! = 35 \times 34 \times 33 \times \dots \times 4 \times 3 \times 2 \times 1 =$$

$$10333147966386144929?66651337523200000000$$