



Mathematics

**Maths
Mysteries**

For ages 10 and up.

In each case solutions
are on following page.

The Missing 8

Without 8

$$\begin{aligned}12\ 345\ 679 \times 9 &= 111\ 111\ 111 \\12\ 345\ 679 \times 18 &= 222\ 222\ 222 \\12\ 345\ 679 \times 27 &= 333\ 333\ 333 \\12\ 345\ 679 \times 36 &= 444\ 444\ 444\end{aligned}$$

and notice...

$$\begin{aligned}12\ 345\ 679 \times 999\ 999\ 999 &= \\12\ 345\ 678\ 987\ 654\ 321 &\end{aligned}$$

With the 8

$$\begin{aligned}123\ 456\ 789 \times 9 &= 1\ 111\ 111\ 101 \\123\ 456\ 789 \times 18 &= 2\ 222\ 222\ 202 \\123\ 456\ 789 \times 27 &= 3\ 333\ 333\ 303 \\123\ 456\ 789 \times 36 &= 4\ 444\ 444\ 404\end{aligned}$$

and notice...

$$\begin{aligned}123\ 456\ 789 \times 999\ 999\ 999 &= \\123\ 456\ 788\ 876\ 543\ 211 &\end{aligned}$$

Challenge:

Complete these...

Without the 8.

- 1) $12\ 345\ 679 \times 45 =$
- 2) $12\ 345\ 679 \times 54 =$
- 3) $12\ 345\ 679 \times 63 =$
- 4) $12\ 345\ 679 \times 72 =$
- 5) $12\ 345\ 679 \times 81 =$

With the 8.

- 6) $123\ 456\ 789 \times 45 =$
- 7) $123\ 456\ 789 \times 54 =$
- 8) $123\ 456\ 789 \times 63 =$
- 9) $123\ 456\ 789 \times 72 =$
- 10) $123\ 456\ 789 \times 81 =$

The 'without 8' pattern continues below:

$$\begin{aligned}12\ 345\ 679 \times 90 &= 1\ 111\ 111\ 110 \\12\ 345\ 679 \times 99 &= 1\ 222\ 222\ 221 \\12\ 345\ 679 \times 108 &= 1\ 333\ 333\ 332\end{aligned}$$

Fill in the answers to these:

- 11) $12\ 345\ 679 \times 117 =$
- 12) $12\ 345\ 679 \times 126 =$
- 13) $12\ 345\ 679 \times 135 =$
- 14) $12\ 345\ 679 \times 144 =$
- 15) $12\ 345\ 679 \times 153 =$
- 16) $12\ 345\ 679 \times 162 =$

The 'with the 8' pattern continues below:

$$\begin{aligned}123\ 456\ 789 \times 90 &= 11\ 111\ 111\ 010 \\123\ 456\ 789 \times 99 &= 12\ 222\ 222\ 111 \\123\ 456\ 789 \times 108 &= 13\ 333\ 333\ 212\end{aligned}$$

Now fill in the answers to these:

- 17) $123\ 456\ 789 \times 117 =$
- 18) $123\ 456\ 789 \times 126 =$
- 19) $123\ 456\ 789 \times 135 =$
- 20) $123\ 456\ 789 \times 144 =$
- 21) $123\ 456\ 789 \times 153 =$
- 22) $123\ 456\ 789 \times 162 =$



Solutions to The Missing 8

1. 555 555 555
2. 666 666 666
3. 777 777 777
4. 888 888 888
5. 999 999 999
6. 5 555 555 505
7. 6 666 666 606
8. 7 777 777 707
9. 8 888 888 808
10. 9 999 999 909
11. 1 444 444 443
12. 1 555 555 554
13. 1 666 666 665
14. 1 777 777 776
15. 1 888 888 887
16. 1 999 999 998
17. 14 444 444 313
18. 15 555 555 414
19. 16 666 666 515
20. 17 777 777 616
21. 18 888 888 717
22. 19 999 999 818

Multiples of 9

$$987\ 654\ 321 \times 9 = 8\ 888\ 888\ 889$$

$$987\ 654\ 321 \times 18 = 17\ 777\ 777\ 778$$

$$987\ 654\ 321 \times 27 = 26\ 666\ 666\ 667$$

$$987\ 654\ 321 \times 36 = 35\ 555\ 555\ 556$$

$$987\ 654\ 321 \times 45 = 44\ 444\ 444\ 445$$

Challenge:

1. What do you notice about the first and last digits of the product?

Complete these:

2. $987\ 654\ 321 \times 54 =$

3. $987\ 654\ 321 \times 63 =$

4. $987\ 654\ 321 \times 72 =$

5. $987\ 654\ 321 \times 81 =$



Solutions to Multiples of 9

1. Same as the multiplier.

2. 53 333 333 334

3. 62 222 222 223

4. 71 111 111 112

5. 80 000 000 001

Amazing Number 2 520

The number 2 520 can be divided by 1 and 2 and 3 and 4 and 5 and 6 and 7 and 8 and 9 and 10.

Challenge:

- 1) Write down the first ten factors of 2 520.
- 2) 7 and 8 are factors of 2 520; does that mean that 56 is a factor of 2 520?
- 3) 28, 35, 42. Which of these are **not** factors of 2 520?
- 4) 11, 12, 14, 15, 16, 18, 20, 21, 22, 24. Seven of these ten numbers are also factors of 2 520. Which ones are they?
- 5) Can 5 040 be divided by 1 and 2 and 3 and 4 and 5 and 6 and 7 and 8 and 9 and 10?
- 6) 2 520 divided by 2 equals 1 260. Which of the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 are **not** factors of 1 260?



Solutions to Amazing Number 2 520

1) *1, 2, 3, 4, 5, 6, 7, 8, 9 and 10*

2) *yes*

3) *None of them. They all divide evenly into 2 520.*

4) *12, 14, 15, 18, 20, 21, 24*

5) *yes*

6) *8*

Mysterious Primes

Every prime number except for 2 and 3 is evenly divisible by 6 if you either subtract 1 from it or add 1 to it.

Example 1: $13-1=12$ and 12 is divisible by 6.

Example 2: $17+1=18$ and 18 is divisible by 6.

Challenge:

1. Does the rule work for the prime 37? Test it.
2. Does the rule work for the prime 41? Test it.
3. Does the rule work for the prime 43? Test it.
4. Does the rule work for the prime 47? Test it.
5. Does the rule work for the prime 59? Test it.
6. What prime number gives a quotient of 4 after 1 is added to it and the result is divided by 6?
7. What prime number gives a quotient of 5 after 1 is subtracted from it and the result is divided by 6?
8. What prime number gives a quotient of 2 after 1 is added to it and the result is divided by 6?
9. What prime number gives a quotient of 3 after 1 is subtracted from it and the result is divided by 6?
10. What prime number gives a quotient of 9 after 1 is added to it and the result is divided by 6?



Solutions to Mysterious Primes

1. *yes*

2. *yes*

3. *yes*

4. *yes*

5. *yes*

6. *23*

7. *31*

8. *11*

9. *19*

10. *53*