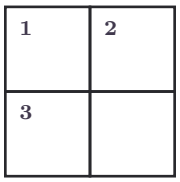
Cross Number

Mr. Merrick · Logic Puzzles

How to solve: Fill the grid so that every listed Across and Down clue is satisfied. These clues are intended to work together, so crossings matter. All clues are mathematical.

Puzzle 1 — 2×2



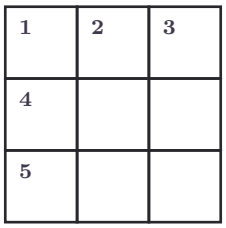
Across

1. A two-digit triangular number.
3. A two-digit multiple of 9.

Down

1. A two-digit prime.
2. A two-digit square.

Puzzle 2 — 3×3



Across

1. A three-digit triangular number.
4. A three-digit cube.
5. A three-digit number whose digits are consecutive in increasing order.

Down

1. A three-digit prime whose digits sum to 17.
2. A three-digit palindrome.
3. A three-digit square.

Cross Number

Solutions and Reasoning

Puzzle 1

[1] 2	[2] 1
[3] 3	6

Reasoning

1. 2 Down is a two-digit square: 16, 25, 36, 49, 64, 81.
2. 1 Across is a two-digit triangular number: 10, 15, 21, 28, 36, 45, 55, 66, 78, 91.
3. 3 Across is a two-digit multiple of 9: 18, 27, 36, 45, 54, 63, 72, 81, 90, 99.
4. If 2 Down were 25, 36, 49, 64, or 81, then the top row would end in 2, 3, 4, 6, or 8 respectively. The only triangular numbers with those endings are:

   $$36, 66 \quad \text{(ending in 6)}, \quad 28, 78 \quad \text{(ending in 8)}.$$

   Check each case:

   - 36: bottom row must end in 6, so possibilities are 36 or 96. This gives left columns 33 or 39, neither prime.
   - 66: bottom row must end in 6, giving left columns 63, 66, or 69, none prime.
   - 28: bottom row must end in 5, so the only option is 45, giving left column 24, not prime.
   - 78: bottom row must end in 1, so the only option is 81, giving left column 78, not prime.

   All cases fail.
5. Therefore 2 Down must be 16. Then 1 Across must end in 1, and the only triangular possibility is 21.
6. Now 1 Down is 23, which is prime, and 3 Across is 36, a multiple of 9.

Puzzle 2

[1]9	[2]4	[3]6
[4]5	1	2
[5]3	4	5

Reasoning

1. 4 Across is a three-digit cube: 125, 216, 343, 512, 729.
2. 5 Across has consecutive increasing digits: 123, 234, 345, 456, 567, 678, 789.
3. 2 Down is a palindrome, so its first and last digits are equal. Therefore the middle digit of 1 Across must equal the middle digit of 5 Across.
4. 3 Down is a square. Its tens digit is the last digit of 4 Across, and its units digit is the last digit of 5 Across.
5. If 4 Across is 125, then 3 Down has tens digit 5. The only three-digit squares with tens digit 5 are 256, 529, and 576, so 5 Across must end in 6 or 9. The only possibilities are 456 or 789.

   If 5 Across is 456, then 1 Across must have middle digit 5 and end in 2 or 6, giving candidates such as 152 or 456, none of which are triangular.

   If 5 Across is 789, then 1 Across must have middle digit 8 and end in 9, but no three-digit triangular number fits this pattern. So this case is impossible.
6. If 4 Across is 216, then 3 Down has tens digit 6. The only such squares are 169 and 961, so 5 Across must end in 9, giving 789.

   Then 1 Across must have middle digit 8 and end in 1 or 9. No three-digit triangular number fits these constraints, so this case fails.
7. If 4 Across is 343, then 3 Down has tens digit 3. The only matching square is 324, so 5 Across would have to end in 4, which is impossible for consecutive increasing digits.
8. If 4 Across is 729, then 3 Down has tens digit 9. The only matching square is 196, so 5 Across must be 456.

   This forces 1 Across to have middle digit 5 and last digit 1, so the only triangular candidate is 351. But then 1 Down is 374, which is not prime. So this case fails.
9. Therefore 4 Across must be 512. Then 3 Down has tens digit 2, and the only compatible square is 625, so 5 Across is 345.
10. Now 2 Down is 414, a palindrome, and 1 Down is 953, which is prime.
11. The top row is a triangular number with middle digit 4 and last digit 6. The only possibility is 946.