Binary 2022

Author

Jeffrey Tong

Solution

The computation is quick after observing that the expression is close to a power of 2.

2022 + (20 + 2 + 2) = 2046= 2¹¹ - 2 = 100,000,000,000₂ - 10₂ = 11,111,111,110₂

Flag MBMT{1111111110}

Amaze

Author

Jeffrey Tong

Solution

This is a maze (hence the title) whose entrance and exit can be inferred from the flag wrapper pieces MBMT $\{$ and $\}$, respectively. After finding the unique path that solves the maze, the flag can be read off along the path. Besides the flag wrapper, all letters are random.



Flag

MBMT {TKEYDOMSLVHJAOWVA}

Curious Crossword

Author

Elina Lee

Solution

The only two-digit factorial is $24 = 4! = 1 \cdot 2 \cdot 3 \cdot 4$. The two-digit Fibonacci numbers are 13, 21, 34, 55, and 89. The only two-digit perfect number is 28 = 1 + 2 + 4 + 7 + 14. The two-digit perfect squares are 16, 25, 36, 49, 64, and 81.

Due to the factorial and perfect number restrictions, and the fact that $B \le C$ because $AB \le AC$, the following can be filled:

2	4
8	D

D must be 9 to fulfill both the Fibonacci and perfect squares restrictions, resulting in:

2	4
8	9

Flag MBMT{2489}

Coordinate Crossword

Author

Jeffrey Tong

Solution

This crossword is a generalization of traditional crosswords where the starting points and orientations of each word are given by the starting and ending points of a line segment. The orientation of each word can be any multiple of 45°.

The grid should be interpreted as a Cartesian coordinate plane. In the diagram below, the color(s) in each circle correspond to the word(s) covering it.



#	Begin	End	Word
1	(-3, 3)	(4, -4)	FRACTION
2	(-4, 2)	(1, 2)	CIRCLE
3	(-4, 2)	(-4, -1)	CUBE
4	(-2, 2)	(-2, -2)	RIGHT
5*	(2, 2)	(2, -5)	QUOTIENT
6	(-1, 1)	(-1, -5)	ALGEBRA
7	(5, 1)	(2, 4)	BASE
8	(4, 0)	(4, 3)	MEAN
9	(4, -2)	(4, -1)	PI

10	(4, -2)	(0, -2)	PRIME

The flag is written along the path indicated by the bolded circles, which requires all the words.

Flag

MBMT {UCIRCALGEEMIRPIMEANS}

Secretive Seven

Author

Elina Lee

Solution

This is a word search with 18 words. The completed search is shown below.

М	U	L	Т	I	Ρ	L	Y	Ρ
А	R	В	Е	G	L	А	Т	Y
Т	R	W	Η	Y	S	S	Ι	R
Н	В	Ι	Х	А	F	R	L	А
Е	М	Ι	R	Ρ	А	Ι	Ι	М
М	U	S	А	D	0	L	В	Ι
А	Ν	Q	Y	F	S	М	А	D
Т	Е	U	Е	۷	Т	Ν	В	W
Ι	Ν	А	Е	Ν	G	т	0	0
С	Ι	R	С	L	Е	Н	R	Ν
S	L	Е	Е	Ν	Α	L	Ρ	Κ

The remaining letters spell WHYSSIXAFRAIDOFSEVEN.

It may be clear that this resembles the joke, "Why's six afraid of seven?"

Using the blanks provided, "_____ ____," we can complete the pun: "BECAUSE SEVEN ATE NINE".

Flag

MBMT{BECAUSE SEVEN ATE NINE}

Desolate Diagonal

Author

Elina Lee

Solution

The completed Sudoku is as follows.

2	8	3	6	9	7	5	1	4
4	9	5	8	1	2	3	7	6
6	1	7	4	5	3	8	2	9
3	2	4	9	6	5	7	8	1
9	5	1	7	4	8	6	3	2
8	7	6	3	2	1	9	4	5
7	6	9	1	3	4	2	5	8
1	3	2	5	8	6	4	9	7
5	4	8	2	7	9	1	6	3

Flag MBMT{297941293}

Minesweeper Prophet

Author

Jeffrey Tong

Solution

Given only the visible digits, we can only locate 13 of the flags and open some of the tiles.



However, given that the grid was generated with 14 flags, we deduce that there is one more flag neighboring the 3, 1, and 2 on the right.



This enables completing the entire grid, and the flag is read off along the right side.



Flag MBMT{12X11110}

Caesar

Author

Jeffrey Tong

Solution

As suggested by the puzzle title "Caesar" and the curly brackets, this is an example of a Caesar cipher. By noting that shifting ZOZG 13 places produces MBMT, we deduce that this is a <u>ROT13 cipher</u>.

For this puzzle, all five words inside the braces in the encrypted text were specifically chosen to produce new words when decrypted. A full list of word pairs with this property is available at <u>https://www.furrfu.org/rot13words.html</u>. The decrypted words aren't intended to have any meaning together.

Flag
MBMT{ENVY_FLAP_OR_BAR_NAG}

Curvy Crossword

Author

Jeffrey Tong

Solution

This crossword is a further generalization of Coordinate Crossword where the paths traced by each word are given parametrically by vectors and can be even more diverse.

We can first standardize the parametrics into a form $\mathbf{r}(t) = (x(t), y(t))$ that is easy to compute mentally. Otherwise, the same solution from Coordinate Crossword applies. The vocabulary here is overall more advanced.



#	Coordinates	Word
1	(1, 5 - <i>t</i>)	EUCLID
2	(4 - 2t, 2 - t)	LINE
3	(2t - 4, 3 - t - 2)	AXIOM
4*	(3, t – 1)	RADIAN
5	(t + 3, t - 1)	RAY
6	(t - 2, t ² - 2)	НАТ
7	(t, -2)	ARCSIN
8	(t - 4, -3)	QUADRATIC

9	(3t - 1, 3t - 4)	SET
10	(5, t - 4)	CONIC

* Note that for #4, the answer could also be DEGREE until #5 is filled in.

The flag again uses all the words.

Flag

MBMT{TLOILTYCINIC}

Obstacle

Author

Jeffrey Tong

Solution

The line segment directly connecting the two landmarks is very long and gets interrupted by two pillars. Thus, direct measurement is infeasible.

However, assuming that the tiles of the sidewalk are identical, we can model the part of the sidewalk enclosing the segment as a coordinate grid. Then, since both landmarks lie almost exactly on lattice points in our grid, the only direct measurements needed are the side lengths of an arbitrary tile.

Establishing the coordinate system below, one landmark is interpreted as (0, 0) while the other is (6, 3).



Looking closer, however, each tile is a rectangle, so 1 unit in the *x* direction is longer than 1 unit in the *y* direction. Using the meter stick, we find that although dimensions vary slightly between tiles, the difference is within 1 cm in almost all cases.

Using the meter stick, we obtained the dimensions by measuring to the nearest millimeter and taking the median over 5 randomly selected tiles, although you likely won't need as much precision.

Trial #	<i>l</i> (m)	<i>w</i> (m)
1	1.793	1.528
2	1.788	1.523
3	1.789	1.522
4	1.790	1.525
5	1.797	1.531

The medians are length $l \approx 1.790$ m and width $w \approx 1.525$ m. From these data, the final distance is

$$d\approx \sqrt{\left(6l\right)^2+\left(3w\right)^2}\approx 11.67~{\rm m}.$$

If you only used one of the individual trials listed in the table, you'll still reach the same answer. If your dimension data differ by within 1 cm in either direction, your answer when rounded to the nearest tenth may differ by 0.1 m. Still, through a few guesses, you'll likely find the correct answer.

Flag

MBMT{11.7}