FUNCTIONS — SOLUTIONS

- Teams may try the functions in any order, and may come back to functions later.

- Where a 2D table is used, the first column represents the x-values and the first row represents the y-values.

F1. $f(x, y) = \binom{x}{y}$.

$x\backslash y$	2	3	4	5	6	7	8	9	10
2	1	0	0	0	0	0	0	0	0
3	3	1	0	0	0	0	0	0	0
4	6	4	1	0	0	0	0	0	0
5	10	10	5	1	0	0	0	0	0
6	15	20	15	6	1	0	0	0	0
7	21	35	35	21	7	1	0	0	0
8	28	56	70	56	28	8	1	0	0
9	36	84	126	126	84	36	9	1	0
10	45	120	210	252	210	120	45	10	1

F2. $f(x, y) = x^2 - xy + y^2$.

$x\backslash y$	2	3	4	5	6	7	8	9	10
2	4	7	12	19	28	39	52	67	84
3	7	9	13	19	27	37	49	63	79
4	12	13	16	21	28	37	48	61	76
5	19	19	21	25	31	39	49	61	75
6	28	27	28	31	36	43	52	63	76
7	39	37	37	39	43	49	57	67	79
8	52	49	48	49	52	57	64	73	84
9	67	63	61	61	63	67	73	81	91
10	84	79	76	75	76	79	84	91	100

F3. $f(x, y) = 2^x + y^3$.

$x\backslash y$	2	3	4	5	6	7	8	9	10
2	12	31	68	129	220	347	516	733	1004
3	16	35	72	133	224	351	520	737	1008
4	24	43	80	141	232	359	528	745	1016
5	40	59	96	157	248	375	544	761	1032
6	72	91	128	189	280	407	576	793	1064
7	136	155	192	253	344	471	640	857	1128
8	264	283	320	381	472	599	768	985	1256
9	520	539	576	637	728	855	1024	1241	1512
10	1032	1051	1088	1149	1240	1367	1536	1753	2024

F4. $f(x,y) = \frac{x}{y} + \frac{y}{x}$.

$x \backslash y$	2	3	4	5	6	7	8	9	10
2	2	2.167	2.5	2.9	3.333	3.786	4.25	4.722	5.2
3	2.167	2	2.083	2.267	2.5	2.762	3.042	3.333	3.633
4	2.5	2.083	2	2.05	2.167	2.321	2.5	2.694	2.9
5	2.9	2.267	2.05	2	2.033	2.114	2.225	2.356	2.5
6	3.333	2.5	2.167	2.033	2	2.024	2.083	2.167	2.267
7	3.786	2.762	2.321	2.114	2.024	2	2.018	2.063	2.129
8	4.25	3.042	2.5	2.225	2.083	2.018	2	2.014	2.05
9	4.722	3.333	2.694	2.356	2.167	2.063	2.014	2	2.011
10	5.2	3.633	2.9	2.5	2.267	2.129	2.05	2.011	2

F5. $f(n) = 2024 \pmod{n}$.

Read table by (first digit of n)\(last digit of n).

first\last	0	1	2	3	4	5	6	7	8	9
0	-	0	0	2	0	4	2	1	0	8
1	4	0	8	9	8	14	8	1	8	10
2	4	8	0	0	8	24	22	26	8	23
3	14	9	8	11	18	29	8	26	10	35
4	24	15	8	3	0	44	0	3	8	15
5	24	35	48	10	26	44	8	29	52	18
6	44	11	40	8	40	9	44	14	52	23
7	64	36	8	53	26	74	48	22	74	49
8	24	80	56	32	8	69	46	23	0	66
9	44	22	0	71	50	29	8	84	64	44

$n = 100$: answer $= 24$.

SHUTTLE — SOLUTIONS

- If an answer is incorrect, make sure the other pair is aware.

- Circle the corresponding number: 4 if correct on the first attempt, 3 if correct on the second attempt, and 0 otherwise.

- Record the time that the time finished. If the team finished in faster than 8 minutes, circle 2, if faster than 10 minutes circle 1, otherwise circle 0.

- Fill in the total number of points achieved.

A1. 25

A2. 405

A3. 305

A4. 22

B1. 1840

B2. 84

B3. 49

B4. 3

RELAY — SOLUTIONS

Team:

Referee:

(Circle the corresponding numbers and add them up at the end.)

R1	2022			4	3	0
R2	$3/(2\sqrt{7})$			4	3	0
R3	2			4	3	0
R4	$101 \cdot 302/12 = 15251/6$			4	3	0
R5	97			4	3	0
R6	$2^{1012} + 1012 \cdot 2^{506} - 1$			4	3	0
	Time			4	2	0

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CROSSNUMBER — SOLUTIONS

- The pairs are supposed to only attempt one square at a time. If many squares are filled in at once, stop marking at the first incorrect square and consult the pair.

- If the answer for a square is correct, tick the circle in the lower right.

- If the answer for a square is incorrect, cross it out and write the correct answer.

- The pairs are responsible for copying the correct answers onto their own grids.

- The two pairs are not allowed to communicate on any matters related to the questions themselves, but may encourage the other team to, for example, work on a specific clue.

- Teams are not allowed to communicate what values they think are possible for a square.

¹7	■	■	²6	7	³6	5
⁴1	0	⁵2	0	■	7	■
4	■	4	■	■	⁶2	7
■	■	⁷3	3	⁸3	3	■
⁹8	¹⁰4	1	■	1	■	■
■	6	■	■	¹¹1	1	¹²3
■	¹³8	0	6	4	■	0

Quizdle — Solutions

- Allow and fix minor spelling mistakes.

- If the answer is incorrect, don't give the correct answer, and the team is not allowed to attempt that word again, even using easier clues.

- Let your team fill in the crossword – your job is just to mark the Answer Sheet.

- The Across and Down clues of a particular difficulty must be given out at the same time.

Across
4. HARDY
5. TILE
9. SYMBOL
12. TAO (accept DAO but fix spelling)
13. ARABIC
14. QUADRATICRECIPROCITY
15. POSTULATE
16. REGULAR
18. MINOR
19. EIGHTYSIX

Down
1. HASH
2. SIXTYEIGHT
3. HYPERBOLA
6. ORIGAMI
7. RESONANCE
8. MOBIUS
10. MAGIC
11. NOETHER
15. PRIME
17. GENUS