

Zonal Informatics Olympiad, 2023

Solutions

1. Number of distinct scores the participant could obtain in the exam

(a) $N = 7, X = 4$

Answer : 30

(b) $N = 15, X = 18$

Answer : 136

(c) $N = 30, X = 20$

Answer : 441

From the problem statement, any final score is possible. However, some contestants assumed that the final score should be non-negative. This interpretation was also considered correct. For this interpretation of the question, the correct answers are as follows:

(a) $N = 7, X = 4$

Answer : 23

(b) $N = 15, X = 18$

Answer : 121

(c) $N = 30, X = 20$

Answer : 411

2. Number of subsets with exactly K distinct badge numbers

(a) $N = 12, M = 4, K = 1, A = [1, 2, 1, 2, 1, 3, 2, 2, 3, 3, 1, 1]$

Answer: 53

(b) $N = 20, M = 5, K = 3, A = [2, 2, 5, 5, 3, 3, 1, 1, 2, 2, 3, 3, 4, 4, 5, 5, 1, 1, 4, 4]$

Answer: 33750

(c) $N = 25, M = 10, K = 6, A = [10, 8, 4, 1, 4, 10, 9, 3, 9, 2, 1, 7, 7, 1, 8, 6, 8, 10, 8, 4, 7, 10, 9, 5, 8]$

Answer: 5437218

3. Number of valid permutations for the given table

(a) $N = 4$

		r			
		1	2	3	4
l	1	1	2	3	3
	2		2	3	3
	3			3	3
	4				4

Answer: 3

(b) $N = 8$

		r							
		1	2	3	4	5	6	7	8
l	1	1	1	1	1	5	5	5	5
	2		2	2	2	5	5	5	5
	3			3	3	5	5	5	5
	4				4	5	5	5	5
	5					5	5	5	5
	6						6	7	7
	7							7	7
	8								8

Answer: 70

(c) $N = 15$

		r														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
l	1	1	2	2	4	4	4	4	4	4	4	4	4	4	14	14
	2		2	2	4	4	4	4	4	4	4	4	4	4	14	14
	3			3	4	4	4	4	4	4	4	4	4	4	14	14
	4				4	4	4	4	4	4	4	4	4	4	14	14
	5					5	5	5	8	9	10	10	10	10	14	14
	6						6	7	8	9	10	10	10	10	14	14
	7							7	8	9	10	10	10	10	14	14
	8								8	9	10	10	10	10	14	14
	9									9	10	10	10	10	14	14
	10										10	10	10	10	14	14
	11											11	11	13	14	14
	12												12	13	14	14
	13													13	14	14
	14														14	14
	15															15

Answer: 344960

4. Sum of weights of stones over all steps.

(a) $N = 10, M = 6,$

$A = [6, 5, 1, 2, 3, 3],$

$B = [2, 9, 10, 5, 2, 8],$

$X = [5, 4, 4, 1, 4, 2]$

Answer: 181

(b) $N = 23, M = 22,$

$A = [11, 20, 12, 8, 20, 21, 5, 14, 7, 14, 21, 20, 23, 23, 23, 16, 11, 15, 11, 17, 11, 18],$

$B = [20, 12, 8, 13, 21, 5, 14, 7, 4, 19, 2, 23, 3, 9, 16, 1, 15, 10, 17, 6, 18, 22],$

$X = [16, 15, 16, 14, 13, 24, 18, 8, 17, 18, 12, 25, 21, 21, 12, 10, 23, 21, 3, 4, 12, 13]$

Answer: 12599

(c) $N = 30, M = 32$

$A = [18, 28, 27, 2, 21, 20, 12, 7, 13, 11, 30, 10, 2, 16, 7, 21, 16, 20, 6, 11, 16, 20, 15, 18, 11, 6, 27, 1, 2, 28, 2, 4]$

$B = [5, 3, 18, 1, 22, 29, 25, 9, 5, 8, 29, 12, 17, 19, 13, 26, 1, 10, 10, 14, 23, 29, 12, 21, 24, 3, 15, 8, 3, 12, 5, 3]$

$X = [2, 5, 5, 2, 2, 5, 5, 2, 1, 1, 5, 5, 3, 5, 1, 2, 4, 4, 4, 3, 2, 5, 1, 5, 4, 3, 13, 2, 5, 11, 4, 2]$

Answer: 4388

Marking

The question paper carries 80 marks, broken up into four questions of 20 marks each. Each question has three parts. *If you solve all three parts correctly, you get 20 marks for that question.* Otherwise, you get 5 marks for each part that you solve correctly.

Qualifying cutoff

- Std 12: 40
- Std 11: 35
- Std 10: 30
- Std 9: 25
- Std 8 and below: 20

The cutoff score is relaxed by 5 marks for female students in each category.

Score distribution

Score	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0
Number at or below this score	0	0	1	4	8	14	26	44	66	90	107	144	172	193	244	343	449