Problem A. Puzzle: X-Sums Sudoku

Input file:	*standard input*
Output file:	*standard output*
Time limit:	4 seconds
Memory limit:	256 mebibytes

An $n \times m$ sudoku puzzle is a grid consisting of $m \times n$ regions, and each region contains $n \times m$ cells. Hence an $n \times m$ sudoku puzzle contains $nm \times nm$ cells. Every integer from 1 to nm occurs exactly once in each row, each column, and each region of an $n \times m$ sudoku puzzle.

Listing the integers in a row or a column starting from some direction as a sequence of length nm, X is the first integer of the sequence, and X-sum is the sum of the first X integers of the sequence.

	1	6	11	20	22	32	34	36	
1	1	2	3	4	5	6	7	8	36
8	3	4	1	2	7	8	5	6	29
27	5	6	7	8	1	2	3	4	10
34	7	8	5	6	3	4	1	2	3
3	2	1	4	3	6	5	8	7	34
10	4	3	2	1	8	7	6	5	27
29	6	5	8	7	2	1	4	3	8
36	8	7	6	5	4	3	2	1	1
	36	34	32	22	20	11	6	1	

The above figure is a 4×2 sudoku puzzle with X-sums. The 7-th row listed from right to left is $[3, 4, 1, 2, 7, 8, 5, 6]$ and the first integer X is 3, so the X-sum of the 7-th row from the direction right is $8 = 3 + 4 + 1$.

Given two positive integers n and m, a direction d, and an index x, you need to find the X-sum of the x-th row or x-th column from the direction d in **the lexicographically smallest** $2^n \times 2^m$ sudoku.

Denoting $a_{i,j}$ as the i-th row and the j-th column of a sudoku puzzle a, a sudoku puzzle a is lexicographically smaller than a sudoku puzzle b of the same size if there exists i and j satisfying that $a_{i,j} < b_{i,j}$, that $a_{x,y} = b_{x,y}$ for all $x < i$, and that $a_{x,y} = b_{x,y}$ for all $x = i$ and $y < j$. You can find that the above is the lexicographically smallest 4×2 sudoku puzzle.

Input

There are multiple test cases. The first line of input contains an integer $T (1 \le T \le 10^5)$, the number of test cases.

For each test case:

The only line contains two integers n and m $(1 \le n, m \le 30)$, a string d, and an integer x $(1 \le x \le 2^{n+m})$. Here, $2^n \times 2^m$ is the size of the sudoku puzzle; d is the direction of X-sum, and it is one of "`left`", "`right`", "`top`", and "`bottom`"; x is the index of a row or a column.

Output

For each test case:

Output an integer: the X-sum of the x-th row or x-th column from the direction d in **the lexicographically smallest** $2^n \times 2^m$ sudoku.

Note that the answer may exceed $2^{64} - 1$. Consider using `__int128_t` in C++, `BigInteger` in Java or Kotlin, or `int` in Python.

Examples

standard input	standard output
4 2 1 top 1 2 1 bottom 2 2 1 left 3 2 1 right 4	1 34 27 3
4 11 19 top 1053766555 12 26 top 230781535210 14 10 right 8344647 7 30 right 70120568170	565741033271081135 31719572400444316026492 112693473538824 477453505821905419941