2's complement

HackerRank

Understanding *2's complement* representation is fundamental to learning about Computer Science. It allows us to write negative numbers in binary. The leftmost digit is used as a sign bit. If it is 1, we have a negative number and it is represented as the two's complement of its absolute value. Let's say you wrote down the 2's complement representation for each 32-bit integer in the inclusive range from a to b. How many 1's would you write down in all?

For example, using an 8-bit byte rather than 32 bit integer, the two's complement of a number can be found by reversing all its bits and adding 1. The two's complement representations for a few numbers are shown below:

```
       |Number|            Representation in
Number   Binary     Inverse     Two's Complement
-3      00000011   11111100    11111101
-2      00000010   11111101    11111110
-1      00000001   11111110    11111111
 0      00000000           00000000
 1      00000001           00000001
 2      00000010           00000010
 3      00000011           00000011
```

To write down that range of numbers' two's complements in 8 bits, we wrote 26 1's. Remember to use 32 bits rather than 8 in your solution. The logic is the same, so the 8 bit representation was chosen to reduce apparent complexity in the example.

Input Format

The first line contains an integer T, the number of test cases.

Each of the next T lines contains two space-separated integers, a and b.

Constraints

- $T \leq 1000$
- $-2^{31} \leq a \leq b \leq 2^{31} - 1$

Output Format

For each test case, print the number of 1's in the 32-bit 2's complement representation for integers in the inclusive range from a to b on a new line.

Sample Input 0

```
3
-2 0
-3 4
-1 4
```

Sample Output 0

```
63
99
37
```

Explanation 0

Test Case 0:
-2 contains 31 ones followed by a zero.
-1 contains 32 ones.

$\mathbf{0}$ contains $\mathbf{0}$ ones.
$\mathbf{31 + 32 + 0 = 63}$

Test Case 1:
$\mathbf{31 + 31 + 32 + 0 + 1 + 1 + 2 + 1 = 99}$

Test Case 2:
$\mathbf{32 + 0 + 1 + 1 + 2 + 1 = 37}$