



USACO 2022 FEBRUARY CONTEST, GOLD PROBLEM 2. COW CAMP

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English (en) ▾

To qualify for cow camp, Bessie needs to earn a good score on the last problem of the USACOW Open contest. This problem has T distinct test cases ($2 \leq T \leq 10^3$) weighted equally, with the first test case being the sample case. Her final score will equal the number of test cases that her last submission passes.

Unfortunately, Bessie is way too tired to think about the problem, but since the answer to each test case is either "yes" or "no," she has a plan! Precisely, she decides to repeatedly submit the following nondeterministic solution:

```
if input == sample_input:
    print sample_output
else:
    print "yes" or "no" each with probability 1/2, independently for each test case
```

Note that for all test cases besides the sample, this program may produce a different output when resubmitted, so the number of test cases that it passes will vary.

Bessie knows that she cannot submit more than K ($1 \leq K \leq 10^9$) times in total because then she will certainly be disqualified. What is the maximum possible expected value of Bessie's final score, assuming that she follows the optimal strategy?

INPUT FORMAT (input arrives from the terminal / stdin):

The only line of input contains two space-separated integers T and K .

OUTPUT FORMAT (print output to the terminal / stdout):

The answer as a decimal that differs by at most 10^{-6} absolute or relative error from the actual answer.

SAMPLE INPUT:

```
2 3
```

SAMPLE OUTPUT:

```
1.875
```

In this example, Bessie should keep resubmitting until she has reached 3 submissions or she receives full credit. Bessie will receive full credit with probability $\frac{7}{8}$ and half credit with probability $\frac{1}{8}$, so the expected value of Bessie's final score under this strategy is $\frac{7}{8} \cdot 2 + \frac{1}{8} \cdot 1 = \frac{15}{8} = 1.875$. As we see from this formula, the expected value of Bessie's score can be calculated by taking the sum over x of $p(x) \cdot x$, where $p(x)$ is the probability of receiving a score of x .

SAMPLE INPUT:

```
4 2
```

SAMPLE OUTPUT:

```
2.87500000000000000000
```

Here, Bessie should only submit twice if she passes fewer than 3 test cases on her first try.

SCORING

- Test cases 3-6 satisfy $T \leq 25$ and $K \leq 100$.
- Test cases 7-9 satisfy $K < 10^6$.

- Test cases 10-17 satisfy no additional constraints.

Problem credits: Benjamin Qi

Contest has ended. No further submissions allowed.
