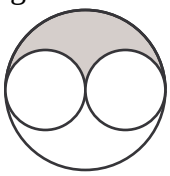
1. The product of three consecutive positive integers is equal to 4080. What is the sum of the three integers? 1. ____

2. In the picture below, the two smaller circles are equal in size, go through the center of the larger circle, and are tangent to each other and to the larger circle. If the area of each smaller circle is 17 square units, what is the area, in square units, of the shaded region? 2. ____



3. How many integers n are there such that $1 \leq n \leq 64$ and n^n is a perfect square? 3. ____

4. For any whole number n, the number $n!$ is defined by 4. ____

$$n! = (1)(2)(3)(4)\cdots(n-1)(n).$$

For example $4! = (1)(2)(3)(4) = 24$.

What is the the remainder when $2! + 3! + 4! + \cdots + 89! + 90!$ is divided by 90?

5. How many zeros are there in the decimal representation of

$$1000000^{1000000}$$

(one million to the power one million)?

5. ☐

6. What is the remainder when 222,222,222 is divided by 99?

6. ☐

7. How many ways are there to express 105 as a sum of two or more consecutive positive whole numbers? One of the ways is

$$105 = 34 + 35 + 36.$$

7. ☐

8. How many ordered pairs (x, y) are there such that x and y are integers, with $x \leq y$ and

$$(3x - 16)(3y - 16) = 256?$$

Note that the integers are 0, 1, -1, 2, -2, 3, -3, and so on.

8. ☐

9. How many ways are there to express 22 as a sum of six (not necessarily different) positive odd integers? (The order of summation does not matter, so for example the expression $1 + 1 + 1 + 3 + 3 + 13$ is to be considered the "same" as $1 + 3 + 1 + 13 + 1 + 3$.)

9. ☐

10. One of the factors of 10^{20} is chosen at random. What is the probability that this factor is actually a factor of 10^{10}? Express your answer as a common fraction.

10. ☐