

Project Euler: Problem 1

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Find the sum of all multiples of 3 or 5 below 1000.

So $S = \sum_{0 \leq n < 1000} n[n \text{ is a multiple of 3 or 5}]$.

Using factorization and sets we can see:

$$S = 3(1 + 2 + \cdots + k) + 5(1 + 2 + \cdots + m) - 3 * 5(1 + 2 + \cdots + t) \text{ such that}$$

$$3k < 1000 \leq 3(k + 1)$$

$$5m < 1000 \leq 5(m + 1)$$

$$3 * 5t < 1000 \leq 3 * 5(t + 1)$$

so thus $S = 3 \frac{k(k+1)}{2} + 5 \frac{m(m+1)}{2} + 3 * 5 \frac{t(t+1)}{2}$ with $k = 333, m = 199, t = 66$
so the solution is $S = 233168$