

## Quiz 3

Consider an collection of  $N$  many indistinguishable one dimensional quantum harmonic oscillators. Each individual particle has an energy  $E_n = (n + \frac{1}{2})\hbar\omega$ ,  $n = 1, 2, 3, \dots$

You may find the following expression to be of use:

$$\sum_{n=0}^N r^n = \frac{1 - r^{N+1}}{1 - r}$$

1. What is the partition function of this system?
2. What is the average energy  $U$ ?
3. What is the heat capacity  $C_V$ ?