Baltzmann Distribution

$$P_r = \frac{\exp(-\beta E_r)}{\sum_r \exp(-E_r\beta)}$$

There are Three distribution mainly

1. maxwell Baltzmann Distribution $\rightarrow [Q_1]^n$
2. Bose - Einstein Distribution (particle are indistinguishable) $\rightarrow \frac{[Q_1]^N}{n!}$
3. fermi - Dirac distribution. (particle are indistinguishable & two particle should not occupy same state)

① Simple harmonic oscillator

$$H = \frac{1}{2}Kx^2 + \frac{1}{2}mv^2$$

$$H = \frac{p^2}{2m} + \frac{1}{2}m\omega^2 x^2$$

$$\therefore Z_1 = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} e^{-\beta\left(\frac{p^2}{2m} + \frac{1}{2}m\omega^2 q^2\right)} \frac{dp\,dq}{h}$$

$\rightarrow$ for one particle in phase space.

② plank oscillator

$$\varepsilon = n\hbar\omega$$

$$F = NKT \ln\left(1 - e^{-\hbar\omega/KT}\right)$$

③ Quantum harmonic oscillator

$$\varepsilon = (n + \tfrac{1}{2})\hbar\omega$$

$$F = N\left(\tfrac{1}{2}\hbar\omega + KT\ln(1 - e^{-\hbar\omega/KT}\right)$$

particle is Distinguishable Q (partition function) $= [Q_1]^n$
(Bose - Einstein)

Particle is indistinguishable Q (partition function) $= \frac{[Q_1]^N}{N!}$

Ensemble :-

1. micro Canonical ensemble (ENV)
2. Canonical ensemble (T, N, V)
3. Grand Canonical ensemble (T, μ, V)