IISER Mohali

[Session 2018-19, Even Semester]

PHY 304 (Statistical Mechanics)

Quiz # 3

Instructor: Ambresh Shivaji (**email**: ashivaji)

TA: Subhadip Ghosh (**email**: subhadipg)

Name:

Reg. No.:

Max. Marks: 10

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1. Select true and false statements and provide explanation.
   - A. In the context of the statistical distribution of N identical particles in single particle quantum states, a fixed configuration $\{n_1, n_2, n_3, ..\}$ does not specify a unique microstate if particles are distinguishable.
   - B. Bose-Einstein distribution is not well defined if chemical potential is larger than the energy of any of the quantum states.
   - C. For a system of N identical particles in Grand Canonical ensemble, the mean occupation number in a given quantum state depends only on T.
   - D. In an ideal gas, the quantum effects are manifested only at low temperature and/or high number density.

2. Which set of quantities correctly represents microcanonical, canonical and grand canonical ensembles respectively ?
   - A. $\Omega(S, N, V), Z(T, N, V), Z_G(T, \mu, V)$
   - B. $\Omega(E, N, V), Z(T, N, V), Z_G(T, \mu, V)$
   - C. $\Omega(E, N, V), Z(T, \mu, V), Z_G(T, N, V)$
   - D. $\Omega(S, N, V), Z(T, \mu, V), Z_G(T, N, V)$

3. The number of photons in equilibrium at temperature T in a 3D black body cavity follows,

   A. $e^{-x/T}$ B. T^3 C. T^4 D. no dependence on T

4. Explain the factors of $1/N!$ and h^3 in the derivation of partition function for a classical ideal gas of N identical particles.

Useful expressions:

1. Thermal de Broglie wavelength

$$\lambda = \sqrt{\frac{2\pi\hbar^2}{mk_BT}}$$

2. Mean occupation number in FD and BE statistics

$$\langle n_i \rangle = \frac{1}{e^{\beta(\epsilon_i - \mu)} \pm 1}$$