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PG (NEW) CBCS
M.Sc. Semester-I Examination, 2019
CHEMISTRY
PAPER: CEM-101
(PHYSICAL CHEMISTRY-I)

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Full Marks: 40 **Time: 2 Hours**

Group- A

Answer any four questions of the following: **2×4=8**

1. What do you mean by accessible microstates of a system?
2. What are the conditions for a system of particles to obey Maxwell-Boltzmann statistics?
3. Using separation of variable technique, show how you can arrive at the time independent form of Schrodinger equation from time-dependent one.
4. What is meant by fugacity of a gas?
5. Show that kinetic energy operator $\hat{T} = \frac{p_x^2}{2m}$ is hermition.
6. Show that two commuting operators must have a complete common set of Eigen functions.
7. Why is it not possible for photons to undergo Bose- Einstein Condensation?
8. What is tunneling in quantum mechanics?

Group-B

Answer any four questions of the following: **4×4=16**

9. Entropy is additive, whereas probability is multiplicative- how does this lead to $S = k_B \ln\Omega$?
10. Start from $\sum_{i=0}^{k}(lng_i - lnN_i - \alpha - \beta Ei)\, dN_i = 0$, to get $N_i = g_i e^{-\alpha} e^{-\beta E_i}$. State the assumptions clearly.
11. State and prove the two important features of Hermitian operator.
12. What is meant by Gibb's paradox? How can you get rid of it?
13. Calculate the change in chemical potential of an ideal gas at 300K when its pressure is changed from 2 atm to 5atm.

(Turn Over)

14. Discuss the physical aspects of Born-Oppenheimer approximation.
15. Evaluate the commutator $[\hat{L}_+, \hat{L}_-]$.
16. Discuss the evenness or oddness of the Eigen functions of parity operator.

Group-C

Answer any <u>two</u> questions of the following: **8×2=16**

17. Explicitly stating the assumptions, deduce the Bose-Einstein distribution equation.
18. (a) Starting with the expression of energy of an anharmonic oscillator, arrive at the equation for equilibrium dissociation energy.

(b) Obtain the Sackur–Tetrode equation for the entropy of an ideal gas.

19. Using Schwartz inequality, show that for three operators $\hat{A}$, $\hat{B}$ and $\hat{C}$, $[\hat{A}, \hat{B}] = i\hat{C}$, $\Delta A \Delta B \geq \frac{1}{2}[\langle \hat{C} \rangle]$.
20. For HCl^{35} (g) the value of rotational constant is 10.445 cm^{-1}. Calculate the values of rotational temperature and molecular rotational partition function for HCl^{35} at 300k.

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