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V Semester B.Sc. Examination, December - 2019
(CBCS) (F+R) (2018-19 and Onwards)

PHYSICS - V

Statistical Physics, Quantum Mechanics-I, Atmospheric Physics And Nano-material

Time : 3 Hours Max. Marks : 70

Instruction : *Answer **any five** questions from **each** Part.*

PART - A

Answer **any five** of the following. Each question carries **8** marks. **5x8=40**

Note : Non-programmable scientific calculators are permitted.

1. (a) Define the terms microstate and phase-space for a thermodynamic system. **2+6**

(b) Derive the Maxwell-Boltzmann distribution law $n_i = g_i e - (\alpha + \beta^{Ei})$.

2. What are bosons ? Derive Bose-Einstein's distribution law. **1+7**

3. Give an account of the failure of classical physics to explain : **4+4**

(a) Photoelectric effect and

(b) Atomic spectra

4. (a) From Planck's law of radiation, arrive at Rayleigh-Jean's law for energy distribution in the blackbody spectrum. **3+5**

(b) Derive expression for the de Broglie wavelength in terms of energy of a non-relativistic particle.

5. Explain the construction and theory of Thomson's experiment, with a neat diagram. What is the significance of the result ? **7+1**

6. (a) Define the terms group velocity and phase velocity. Derive relation between them. **5+3**

(b) Give any two mathematical forms of the Heisenberg's uncertainty principle. What is the physical significance of the principle ?

P.T.O.

7. Based on the vertical distribution of temperature, explain the formation of different layers in earth's atmosphere.

8. (a) What is "greenhouse effect" ? Mention any two greenhouse gases.
   (b) Write a short note on Carbon nano-tube and Graphene.

PART - B

Answer **any five** of the following. Each question carries **4** marks. **5x4=20**

Common data :
$h = 6.625 \times 10^{-34}$ Js, $C = 3 \times 10^{8}$ ms^{-1}, $m_e = 9.1 \times 10^{-31}$ kg, $m_n = 1.67 \times 10^{-27}$ kg, $m_p = 1.67 \times 10^{-27}$ kg

9. A system has two particles 'x' and 'y'. Using appropriate diagram, show how they can be arranged in three quantum states according to : **2+2**
   (a) M B distribution and
   (b) F D distribution

10. The free electron density of silver and aluminium are 5.85×10^{28} m^{-3} and 1.8×10^{29} m^{-3}, respectively. Find the Fermi energy of silver, given fermi energy of aluminium is 11.63 eV.

11. Five bosons have to be distributed in two compartments having 3 and 4 cells respectively. Find the thermodynamic probability for the macro state (4, 1) and (5, 0). **2+2**

12. UV radiation has wavelength 234 nm. Find its frequency and energy (eV). **2+2**

13. For proton and electron to have same de Broglie wavelength, compare their speeds.

14. Calculate the earth's atmospheric pressure at an altitude of 1 km. Given $R = 8.31$ Jmol^{-1}K^{-1}, $g = 9.8$ ms^{-2}, $t = 12°C$, Mean molar mass of air $= \mu = 29$ g/mol and 1 atm pressure $= 1.013 \times 10^{5}$ Pa.

15. A layer in the earth's atmosphere has thickness 225 m, density 0.15 kg m^{-3} on which radiation is incident at angle 65°. Calculate the absorbance and the optical thickness of the layer.

16. Find the total mass of air present in the earth's atmosphere. Assume pressure of air at mean sea level $= 1.013 \times 10^{15}$ Pa, $g = 9.8$ ms^{-2} and the radius of earth $= 6400$ km.

PART - C

Answer **any five** of the following. Each question carries **2** marks. **5x2=10**

17. (a) The isotopes $_2He^3$ and $_2He^4$ obey which distribution law at low temperature ?

(b) In metals, what is the occupation index :

(i) Below Fermi energy and

(ii) Above Fermi energy.

(c) Can we use M-B statistics to explain the properties of photon gas ?

(d) Two particles have same mass and speed, with one of them charged and the other neutral. Can they have same de Broglie wavelength ? Justify your answer.

(e) Wave nature of matter is not observed in bulk bodies. Why ?

(f) 'Quantum dot is zero dimensional'. Justify.

(g) Electrically and thermally, what is remarkable about Graphene ?

(h) Is nano gold yellow in colour ? Justify.

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