11521

Reg. No.

V Semester B.Sc. (CBCS) Degree Examination, March/April - 2022

PHYSICS

Statistical Physics, Quantum mechanics - I

Atmospheric Physics & Nano Materials

(CBCS Scheme Freshers and Repeaters 2018-19 & Onwards)

Paper : V

Time : 3 Hours **Maximum Marks : 70**

Instructions to Candidates:

1. Answer any **Five** questions from each part.
2. Use Non - programmable scientific calculators are permitted.

PART - A

Answer any **five** questions. Each question carries Eight marks. **(5×8=40)**

1. a. What are fermions and bosons?
   b. Derive an expression for the distribution function of particles obeying Fermi - Dirac statistics. **(2+6)**
2. a. What is Phase Space?
   b. Distinguish between Maxwell - Boltzmann statistics, Bose - Einstein statistics and Fermi - Dirac statistics. **(2+6)**
3. Discuss briefly the failure of classical mechanics to explain :
   a. Atomic spectra.
   b. Black Body radiation. **(4+4)**
4. a. What are matter waves? Mention any two of its characteristics.
   b. Deduce an expression for the de-Broglie wavelength and express it in terms of energy and temperature. **(3+5)**
5. a. State and explain Heisenberg's uncertainty principle.
   b. Describe gamma - ray microscope experiment to illustrate the uncertainty principle. **(3+5)**
6. a. What is meant by Hydrostatic balance?
   b. Derive Beer's law for the absorption of solar radiation by the earth's atmosphere. **(2+6)**
7. a. What are fixed gases and variable gases of the earth's atmosphere?
   b. Derive an expression for variation of atmospheric pressure with altitude and give its graphical representation. **(2+6)**

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8. a. Mention the methods of synthesis of nano - materials.
   b. What are zero, one and two dimensional nano systems? Give one example each. (2+6)

PART - B

Answer any **five** questions. Each question carries **four** marks. (5×4=20)

9. A system contains 2 particles A & B and there are three quantum states or cells. With the help of a diagram show the number of arrangements according to
   i. Maxwell - Boltzmann.
   ii. Bose - Einstein statistics.
10. Calculate the Fermi energy of Lithium at T = 0K. Given, the number of conduction electrons per unit volume in Lithium is 2.06×10^{27} m^{-3}. Given h = 6.625×10^{-34} Js, me = 9.1×10^{-31} kg.
11. Calculate the maximum velocity of photoelectrons, when ultraviolet radiation of 260nm is incident on a metal whose threshold wavelength is 380nm. Given $h = 6.625\times10^{-34}\,Js$, $m_e = 9.1\times10^{-31}\,kg$, $c = 3\times10^{8}\,ms^{-1}$.
12. An electron has a de-Broglie wavelength of 1Å. Calculate the group velocity and phase velocity. Given $h = 6.625\times10^{-34}\,Js$ $m_e = 9.1\times10^{-31}\,kg$.
13. In Davisson Germer experiment, electrons accelerated through a potential difference of 54V showed a maximum reflection at 50° (first order). Calculate the wavelength of the electrons. Given d = 2.15 Å.
14. Calculate the pressure gradient force per unit mass between two isobars of pressure 103.9kPa and 100.3 kPa which are separated by 79 km from each other. Given density of air = 1.2 kgm^{-3}.
15. A mass weighing 0.9 kg is thrown from a point 30°N towards north (in the northern hemisphere) with a velocity of 0.6kms^{-1}. Find the magnitude and direction of the Coriolis force acting on the mass. Given, $\omega=7.27\times10^{-5}rad\text{-}s^{-1}$.
16. Calculate the total mass of the earth's atmosphere. Given the pressure at sea level is equal to 1.013×10^{5}Pa, Radius of the earth = 6400 km and g = 9.8 ms^{-2}.

PART - C

Answer any **five** questions. Each question carries **two** marks. (5×2=10)

17. a. Why do bosons and Fermions have different distribution function?
    b. He^4 shows Bose - Einstein condensation, while He^3 does not. Explain.
    c. Can we use M-B statistics to explain the properties of photon gas? Explain.
    d. Are de-Broglie waves observed in case of macroscopic objects? Explain.
    e. Is water vapor a green house gas? Explain.
    f. Can optical microscope be used to observe nano - particles? Explain.
    g. Graphene is the strongest material. Justify.
    h. The properties of materials are different at nano level. Why?
