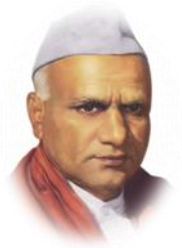

"ज्ञान, विज्ञान आणि सुसंस्कार यासाठी शिक्षण प्रसार"

शिक्षणमहर्षी- डॉ बापूजी साळुंखे .

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DEPARTMENT OF PHYSICS

QUESTION BANK

B.Sc. Part-II, Semester-IV, PHYSICS Paper-VII

DSC-D1 THERMAL PHYSICS AND STATISTICAL MECHANICS – II

❖ Multiple Choice Questions

1. ---------- in Joule-Thomson effect, remains constant during throttling process.

a) Pressure b) Temperature c) Volume d) Enthalpy

2. The temperature of inversion for hydrogen at about 100 atm. pressure is ------

a) 80 K b) 193 K c) 35 K d) 100 K

3. The temperature of inversion for Helium is ------

a) 80 K b) 193 K c) 35 K d) 100 K

4. For perfectly black body coefficient of absorption is ------

a) zero b) one c) 0.5 d) infinite

5. In a black body radiation spectrum, as temperature increases, maximum energy shiftstowards

b) longer wavelength side b) shorter wavelength side

c) first shifts towards shorter wavelength side and then shifts towards longer wavelengthside

d) first shifts towards longer wavelength side and then shifts towards shorter wavelength side

6. Wein's distribution law explains the black body radiation spectrum in ------- wavelength region

a) shorter b) Longer c) entire d) middle

7. According to Stefan's law, the energy radiated per second per unit area by a perfectly

blackbody at temperature T ^{0}K is proportional to -------

a) T b) T^2 c) T^3 d) T^4

8. S.I. unit of Stefan's constant σ is ……

a) $W\ m^{-2}\ K^4$ b) m K c) $W\ m^{-2}\ K^{-4}$ d) $W\ m^2\ K^4$

9. S.I. unit of Wien's constant is ……

a) $W\ \ K^4$ b) m / K c) $W\ m^{-2}$ d) $m\ K$

10. The ratio of rates of emission of heat by black body at 527 °C and at 127 °C will be -------

a) 4:1 b) 1:1 c) 16:1 d) 2:1

11. The Stirling formula is ----------

c) ln n! = n ln n- n b) *ln n! = n ln n* c) *ln n! = n ln n+ n* d) *ln n! = n-n ln n*

12. If, W, M *and* G are respective total probability, thermodynamic probability and a prioryprobability of any thermodynamic distribution then--------

a) $W = M + G$ b) $W = M \times G$ c) $W = M/G$ d) $W = G/M$

13. Bose-Einstein statistics is applicable to --------

a) Gas molecules b) photons c) electrons d) protons

14. Fermi-Dirac statistics is applicable to ---------

a) Gas molecules b) photons c) electrons d) helium atoms

15. Bose-Einstein statistics is applicable to --------

a) distinguishable particles b) indistinguishable particles having integral spin

c) indistinguishable particles having half spin d) distinguishable particles of any spin

16. Fermi-Dirac statistics is applicable to --------

a) distinguishable particles

b) indistinguishable particles having integral spin

c) indistinguishable particles having half spin

d) distinguishable particles of any spin

13. The energy distribution in black body radiation spectrum can be explained by------

a) M-B statistics b) F-D statistics c) B-E statistics d) F-E statistics

14. Bosons are particles with ---------- spin

a) half b) zero or integral c) any d) negative

15. Electrons are ------

a) Bosons b) Fermions c) Photons d) phonons

16. In how many distinct ways 2 distinguishable particles will be arranged in 3 different shells?

a) 4 b) 6 c) 9 d) 3

17. In how many distinct ways 2 indistinguishable particles obeying exclusion principle, will be arranged in 3 different shells?

a) 4 b) 6 c) 9 d) 3

18. Thermodynamic probability of arrangement of 4 distinguishable particles in 2 different shells is----

a) 4 b) 6 c) 16 d) 20

19. Consider a distribution of 4 distinguishable particles in 2 different shells. The number of microstates corresponding to macrostate (2, 2) will be ------

a) 1 b) 4 c) 6 d) 8

20. The phase space is combination of……space.

a) Position and momentum b) position and moment

c) moment and velocity d) moment and momentum

21. The volume of a cell in phase space is ----------

d) $\hbar$ b) $\hbar^2$ c) $\hbar^3$ d) $\hbar^4$

❖ Long Answer Questions

1. Derive Maxwell's thermodynamic relations.
2. What is Joule-Thomson effect? Derive an expression for change in temperature of gasduring throttling process.
3. Using thermo dynamical relations, prove that for ideal gas $Cp - Cv = R$.
4. What is black body radiation? Explain black body radiation spectrum.
5. Derive an expression for energy density of radiation inside the closed enclosure.
6. Derive Planck's radiation law in terms of frequency.
7. What is phase space? Explain microstates and macrostates with example.
8. Derive Maxwell- Boltzmann distribution law.
9. Using Maxwell- Boltzmann law of distribution of velocities, obtain expressions for most probable speed and r.m.s. speed of gas molecules.
10. Using Maxwell- Boltzmann law of distribution of velocities, obtain expressions for most probable speed and average speed of gas molecules.

11. Obtain an expression for Bose-Einstein distribution law.

12. Derive Fermi-Dirac distribution law.

13. Give distinguishing points between Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics.

❖ Short Answer Questions

1. State and explain thermodynamic potentials, 1. Internal energy and 2. Enthalpy.
2. State and explain thermodynamic potentials, 1. Helmholtz function and 2. Gibb's function.
3. What is the temperature of inversion? Why hydrogen and helium shows heating effect at NTP?
4. Derive Clausius- Clapeyron's equation from Maxwell's thermodynamical relations.
5. Using Maxwell's thermodynamic relations obtain an expression for ratio of specific heat.
6. Derive first and second TdS equations.
7. Derive Maxwell's thermodynamic relations using thermodynamic potentials i) internal energy U and b) Enthalpy H.
8. What is a black body? Give its importance.
9. Explain Ferry's black body.
10. What is Joule-Thomson effect? Show that enthalpy remains constant during throttling process
11. Obtain an expression for the energy density of radiation inside the close enclosure.
12. Derive Wien's displacement law from Plank's radiation law.
13. Derive Rayleigh- Jean's law from Plank's radiation law.
14. Derive Wien's distribution law from Plank's radiation law.
15. Derive Stefan - Boltzmann law from Planck's radiation law.
16. Explain black body radiation spectrum.
17. Write a note on Phase Space
18. Explain with example macrostates and microstates.
19. Explain a priori probability and thermodynamic probability.
20. Write a note on ‘Most probable distribution’
21. Using Maxwell-Boltzmann distribution law, obtain an expression for most probable speed of gas molecules.
22. Using Maxwell-Boltzmann distribution law, obtain an expression for average speed of gas molecules.
23. Using Maxwell-Boltzmann distribution law, obtain an expression for r.m.s. speed of gas molecules.

24. Show that entropy (S) of a system is given by S = k ln W, where W is probability of a state of the system.
25. Derive an expression for Bose-Einstein distribution law.
26. Derive an expression for Fermi-Dirac distribution law.
27. Distinguish between MB, BE statistics.
28. Distinguish between MB, FD statistics.
29. Derive an expression for Planck's radiation law.
30. Calculate the most probable speed, average speed, and rms speed of oxygen at room temperature (m = 2×16×1.67×10-27 gm, k=1.38×10-23 J/k, T=27o C).
31. Explain the terms macrostates, microstates and accessible microstates.