

GOVERNMENT ZIRTIRI RESIDENTIAL SCIENCE COLLEGE

Subject : PHYSICS
Paper Name : Thermal and Statistical Physics
Paper No. : PHY/VI/CC/18
Semester : VI

A. Multiple Choice Questions:

1. The mean free path of gas at pressure p and temperature T is

- a) $\frac{kT}{(\sqrt{2})\sigma^2\pi p}$
- b) $\frac{p}{(\sqrt{2})\sigma^2\pi kT}$
- c) $\frac{\sqrt{kT}}{\sigma^2\pi p}$
- d) $\frac{1}{\sigma} \sqrt{\frac{kT}{2\pi p}}$

2. According to Perrin's experiment the value of Avogadro's No is equal to

- a) 62.2×10^{22}
- b) 64.2×10^{22}
- c) 66.2×10^{22}
- d) 68.2×10^{22}

3. The formula for the most probable speed of the molecules

- a) $C_m = \sqrt{\frac{3kT}{m}}$
- b) $C_m = \sqrt{\frac{m}{2kT}}$
- c) $C_m = \sqrt{\frac{2kT}{m}}$
- d) $C_m = \sqrt{\frac{m}{2kT}}$

4. The root mean square speed of molecules of mass ' m ' at temperature T is:

- a) $\sqrt{\frac{2kT}{m}}$
- b) $\sqrt{\frac{3kT}{\pi m}}$
- c) $\sqrt{\frac{3kT}{m}}$
- d) $\sqrt{\frac{8kT}{m}}$

5. The most probable speed of molecules varies with temperature T as $v_{mp} \propto T^n$ the value of n is:

- a) 0
- b) $1/2$

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- c) 2
d) 1/3
6. In diffusion, the transport of the following occurs:
a) Momentum
b) Energy
c) Mass
d) none of these
7. At very low temperatures, the coefficient of viscosity of a gas
a) decreases with decrease of pressure.
b) increases with increase of pressure.
c) is independent of pressure.
d) is equal to pressure.
8. Four thermodynamic potentials are:
a) Pressure, volume, temperature and internal energy function.
b) Pressure, volume, internal energy and Helmholtz function.
c) Internal energy function, Helmholtz function, enthalpy and Gibbs function.
d) None of these.
9. From Maxwell's thermodynamic relations $E_S/E_T = ?$
a) $1/2$
b) $\frac{1}{\gamma}$
c) γ
d) 2
10. Helmholtz free energy function is defined by:
a) $F=U+TS$
b) $F=U-TS$
c) $F=U + PV$
d) $F=U + PV-TS$
11. Constraints imposed on a system:
a) increase number of inaccessible microstates.
b) decrease the number of inaccessible microstates.
c) have no effect
d) none of these
12. The probability of occurrence of two independent events is equal to their:
a) Sum
b) Difference
c) Product
d) ratio

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13. Choose the correct answer for extensive variables
- Mass, volume, internal energy, entropy, temperature
 - Mass, volume, Pressure, entropy, heat capacity
 - Mass, volume, internal energy, entropy, heat capacity
 - Mass, volume, internal energy, density, heat capacity
14. According to Boltzmann canonical distribution law, the number of molecules per cell
- increases linearly with energy associated with the cell,
 - increases exponentially with energy associated with the cell,
 - decreases linearly with energy associated with the cell,
 - decreases exponentially with energy associated with the cell.
15. In the equilibrium state;
- probability is maximum,
 - β parameters of two systems are equal,
 - both (a) and (b),
 - number of particles is maximum.
16. Out of n particles in a gas, the number of particles having exactly the most probable velocity
- Zero
 - n
 - $n/2$
 - 1
17. Microcanonical ensemble is a collection of essentially independent systems having
- Same temperature, volume and no of identical particles.
 - Same energy, volume and no of particles
 - Same temperature, volume and chemical potential
 - None of these
18. In grand-canonical ensemble the expression for probability distribution is
- $\rho(E) = e^{\left[\frac{\Omega+n\mu-E}{kT}\right]}$
 - $\rho(E) = e^{\left[\frac{\Omega+n-\mu E}{kT}\right]}$
 - $\rho(E) = e^{\left[\frac{\Omega+n-E}{\mu kT}\right]}$
 - $\rho(E) = e^{\left[\frac{\Omega\mu+n-E}{kT}\right]}$
19. The number of meaningful ways 4 Fermions can be arranged in 5 compartments:
- 1
 - 4
 - 5
 - 9

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20. Partition function is
- a) $z = \sum_i e^{-\beta E_i}$
 - b) $z = \sum_i e^{-2\beta E_i}$
 - c) $z = \sum_i e^{-2\beta/E_i}$
 - d) None of these
21. Boson particles obey Pauli's exclusion principle:
- a) True
 - b) False
 - c) Can't say
 - d) Sometimes true sometimes false.
22. Fermions have spin value :
- a) $\frac{1}{2}$
 - b) 1
 - c) 0
 - d) Any one.
23. Boson have spin value :
- a) 0
 - b) 1
 - c) $\frac{1}{2}$
 - d) 0 or 1
24. The spin of photon is :
- a) Zero
 - b) $\frac{1}{2} \hbar$
 - c) \hbar
 - d) $\frac{3}{2} \hbar$
25. Average energy of a Planck's oscillator is :
- a) $E = h\nu$
 - b) $E = nh\nu$
 - c) $E = \frac{h\nu}{(e^{h\nu/kT} - 1)}$
 - d) $E = mc^2$

B. Fill up the blanks:

1. Viscosity of a gas is due to transport of _____
2. The molecular density in a gas is n and the diameter of its molecule is d then the mean free path of molecule is _____

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3. Statistical methods give greater accuracy when the number of observations is _____
4. The value of probability of an event cannot be _____
5. The macrostates which are allowed under a constrain are called _____
6. The thermodynamic probability of a system in equilibrium is _____
7. RMS speed of an ideal gas is inversely proportional to the square-root of its _____
8. The particles obeying Maxwell-Boltzmann statistics are _____
9. _____ remains constant in isothermal- isobaric process.
10. Intensive variables of a substance is independent of _____ of the system.
11. Photons obey the _____ statistics.
12. Deduction of Planck's law is possible on the basis of _____
13. Pauli's exclusion principle applies to _____
14. The ratio of most probable speed and average speed of a gas enclosed in a vessel is _____
15. The number of most probable macrostates for a system having odd number of particles is _____

Key Answers

A. Multiple Choice Questions:

1. a) $\frac{kT}{(\sqrt{2})\sigma^2\pi p}$
2. d) 68.2×10^{22}
3. c) $C_m = \sqrt{\frac{2kT}{m}}$
4. b) $\sqrt{\frac{3kT}{\pi m}}$
5. b) 1/2
6. a) Momentum
7. c) is independent of pressure.
8. c) Internal energy function, Helmholtz function, enthalpy and Gibbs function.
9. c) γ
10. b) $F=U-TS$
11. a) increase number of inaccessible microstates.
12. c) Product
13. c) Mass, volume, internal energy, entropy, heat capacity

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14. d) decreases exponentially with energy associated with the cell.
15. c) both (a) and (b),
16. a) Zero
17. b) Same energy, volume and no of particles
18. a) $\rho(E) = e^{\left[\frac{\Omega+n\mu-E}{kT}\right]}$
19. c) 5
20. a) $z = \sum_i e^{-\beta E_i}$
21. b) False
22. a) $\frac{1}{2}$
23. d) 0 or 1
24. c) \hbar
25. c) $E = \frac{hv}{(e^{hv/kT}-1)}$

B. Fill up the blanks:

- | | | |
|----------------------------|----------------------------------|-------------------------------------|
| 1. Momentum | 2. $\frac{1}{\sqrt{2\pi n d^2}}$ | 3. very large |
| 4. negative | 5. Accessible macrostates | 6. Maximum |
| 7. Mass | 8. distinguishable | 9. Gibb's free energy |
| 10. Mass Or size | 11. Bose-Einstein (B-E) | 12. Bose-Einstein (B-E) statistics. |
| 13. Fermi Dirac Statistics | 14. $(\sqrt{\pi})/2$ | 15. 2 |