B. Sc. Part – II Semester-III

PHYSICS Paper-V

DSC-C1 THERMAL PHYSICS AND STATISTICAL MECHANICS – I

Unit I: Kinetic Theory of Gases and thermometry

Correct answer is shown in Red color

1. The r.m.s. velocity of a molecule of gas at absolute temperature T is proportional to ----------

(A)1/T (B) $\sqrt{T}$ (C) T (D) T^2

2. The energy of an ideal gas molecule depends only on its...

(A)volume (B) pressure (C) density (D) temperature

3. The average kinetic energy of a gas molecule at absolute temperature T is proportional to .....

(A) 1/T (B) $\sqrt{T}$ (C) T (D) T^2

4. Average kinetic energy of translation of a molecule of perfect gas is .....

(A) $\frac{1}{2}kT$ (B) $\frac{3}{2}kT$ (C)kT (D) $\frac{5}{2}kT$

5. The average kinetic energy of a molecule in each degree of freedom is .....

(A) $\frac{1}{2}kT$ (B) $\frac{3}{2}kT$ (C)kT (D) $\frac{5}{2}kT$

6. For monoatomic gas the number of degree of freedom is .....

(A) 1 (B) 2 (C) 3 (D) 4

(B) For diatomic gas, the number of degrees of freedom of .....

(A) 1 (B) 3 (C) 5 (D) 6

(B) Boltzmann constant k= .....

(A)R/N (B)RN (C) N/R (D)1/RN

9. For monoatomic gas, ratio Cp/Cy =- ----------

(A) 4/3 (B)7/5 (C)5/3 (D)2/3

10. For diataomic gas, ratio Cp/Cy=...

(A) 5/3 (B)7/5 (C)4/3 (D)1/2

11. For triataomic gas, ratio Cp/Cy=...

(A) 5/3 (B)7/5 (C)4/3 (D)1/2

12. For monoatomic gas, ratio Cp/Cy =- ----------

(A) 1.4 (B)7/5 (C)1.67 (D)1.33 (D) 1.1

13. For diataomic gas, ratio Cp/Cy=...

(A) 1.4 (B)7/5 (C)1.67 (D)1.33 (D) 1.1

14. For triataomic gas, ratio Cp/Cy=...

(A) 1.4 (B)7/5 (C)1.67 (D)1.33

15. The temperature interval between the ice point and steam point is .....

(A) range of thermometer (B) fundamental interval

(C) basic interval (D) normal interval

16. Mean free path of a gas molecule is .....

(A) $\frac{1}{\pi\sigma^2 n}$ $(B)\frac{n}{\pi\sigma^2}$ $(C)\pi\sigma^2 n$ $(d)\frac{\sigma^2}{\pi.n}$

13. Clausius formula for mean free path of a gas molecule is.....

(A) $\frac{3}{4}\frac{1}{\pi\sigma^2 n}$ $(B)\frac{2}{4}\frac{1}{\pi\sigma^2 n}$ $(C)\frac{1}{\pi\sigma^2 n}$ $(D)\frac{n}{\pi\sigma^2}$

14. Maxwell's formula for mean free path of a gas molecule is .....

(A) $\frac{1}{\sqrt{2}}\frac{1}{\pi\sigma^2 n}$ $(B)\frac{2}{4}\frac{1}{\pi\sigma^2 n}$ $(C)\frac{1}{\pi\sigma^2 n}$ $(D)\frac{n}{\pi\sigma^2}$

15. Coefficient of viscosity of gas corresponds to transfer of --------. of gas.

(A) momentum (B) energy (C) mass (D) entropy

16. Thermal conductivity of gas is due to transfer of .....

(A) momentum (B) energy (C) mass (D) volume

17. Coefficient of diffusion of gas corresponds to transfer of ---------.of gas.

(A) momentum (B) energy (C) mass (D) temperature

18. The coefficient of viscosity of gas λ = ...

$(A)\rho\bar{c}\lambda$ $(B)\frac{1}{2}\rho\bar{c}\lambda$ $(C)\frac{1}{3}\rho\bar{c}\lambda$ $(D)3\rho\bar{c}\lambda$

19. The coefficient of viscosity of gas at absolute temperature T is proportional to .....

(A) 1/T (B) $\sqrt{T}$ (C) T (D) T^2

20 The thermal conductivity (K) of gas is related to its coefficient of viscosity (η) by equation .....

$(A)K=\frac{\eta}{C_v}$ (B) $K=\eta C_v$ $(C)K=\frac{1}{\eta C_v}$ $(D)K=\frac{C_v}{\eta_v}$

21. Thermal conductivity (K) of gas at absolute temperature T is proportional to .....

(A) T (B) 1/T (C) $\sqrt{T}$ (D) $1/\sqrt{T}$

22. Coefficient of diffusion (D) of gas is .....

$(A)D=\eta\rho$ (B) $D=\frac{\eta}{\rho}$ $(C)D=\frac{\rho}{\eta}$ $(D)D=\frac{1}{\rho\eta}$

22. Which of the following thermometer is easily accessible?

(A) mercury thermometer (B) platinum-resistance thermometer

(C) thermo-electric thermometer (D) gas thermometer

23.On Fahrenheit scale, fundamental interval is divided into------ equal parts.

(A) 180 (B) 100 (C) 80 (D) 200

24. On Reaumer scale, fundamental interval is divided into---- equal parts.

(A) 180 (B) 100 (C) 80 (D) 50

25.On Rankine's scale, fundamental interval is divided into ------- equal parts.

(A) 80 (B) 100 (C) 180 (D) 120

26 On Fahrenheit scale, ice point is marked at .....

(a) 0°F (B) 32° F (C) 492°F (D) 273° F

27. On Fahrenheit scale, steam point is marked at .....

(A) 0°F (B) 32° (C) 212° F (D) 273° F

27. On Rankine scale, steam point is marked at .....

(A) 492o Ra (B) 672^{o} Ra (C) 32° Ra (D) 212° Ra

28. The conversion formula from centigrade to Fahrenheit scale is .....

(A) $F = \frac{9}{5}C + 32$ $(B)F = \frac{9}{5}C - 32$ $(C)F = C + 273$ $(D)F = \frac{C}{100}$

29. ..... thermometer works on the principle of increase of resistance with increase in temperature.

(A) mercury (B) platinum-resistance (C) thermo-electric (D) gas

30. Thermocouple thermometer or thermo-electric-thermometer works on principle of .....

(A) increase of resistance of metal with temperature

(B) Seebeck effect

(C) change in pressure of gas at constant volume

(D) change in volume with temperature

30. The temperature of hot junction at which thermo e.m.f. becomes maximum is .....

(A) neutral temperature (B) inversion temperature

(C) curie temperature (D) critical temperature

31.The temperature of hot junction at which thermo e.m.f. beyond neutral temperature again becomes zere is ..... temperature.

(A) neutral (B) inversion (C) critical (D) curie

32. Neutral temperature for Cu-Fe thermocouple is .....

(A) 270°C (B) 540°C (C) 200°C (D) 3000°C

33. If θn is neutral temperature and θι is inversion temperature for a thermocouple then .....

(A) θn = θι (B) θn = 2.θι (C) θi = 2θn (D) θn = 3θι

34. Thermo e.m.f. produced in a thermocouple is of the order of .....

(A) microvolt (B) millivolt (C) volt (D) kilovolt

35 In thermistor ---------- changes with temperature.

(A) resistance (B) emf (C) volume (D) area

36 For measurement of temperature --------- temperature coefficient thermistors are used.

(A) positive (B) negative (C) maximum (D) zero

- ***Short answer questions 5 mark***

1. Explain the term free path and mean free path with suitable diagram
2. Define mean free path and obtain expression for mean free path using mutual collision cross section method.
3. Explain the Claussius and Maxwell corrections to approximate formula of mean free path Explain experiment verifying Maxwell's law of distribution of velocities.
4. State law of equipartition of energy (qualitative) and explain its applications to specific heat of monoatomic and diatomic gases.
5. State properties of mercury suitable for its use in thermometer.
6. State advantages and disadvantages of thermoelectric thermometer.
7. Explain how temperature is measured using sensitive galvanometer in thermoelectric thermometer.
8. Sate advantages and disadvantages of mercury thermometer.
9. Sate advantages and disadvantages of platinum resistance thermometer.
10. Explain use of thermister as thermometer.
11. Solved examples

- ***Long Answer questions 10 marks***

1. Explain transport of momentum in gases. Obtain expression for coefficient of viscosity of the gas.
2. Explain transport of thermal energy in gases. Obtain an expression for thermal conductivity of the gas.
3. Explain transport of mass in gases. Obtain expression for coefficient of diffusion of the gas.
4. Explain construction of thermoelectric thermometer. Also explain how temperature is measured using a potentiometer.
5. Explain construction and working of platinum resistance thermometer.
6. Explain construction and working of mercury thermometer.

Unit II: Laws of Thermodynamics

1. Which of the following shows inter-conversion between heat energy and other form of energy

A) Thermostatic B) Thermople C) Thermodynamic D) Thermal

2. ---------- is a part of universe where thermodynamic change occur

A) System B) surrounding C) Process D) none of these

3. ---------- is a part of universe outside the Thermodynamics system.

A) System B) surrounding C) Process D) none of these

4.The equation of state of ideal gas are----------

A) PV = nRT B) PV=n *8.314* T C) P = nRT/V D) All Of these

5. Which of the following is not type of thermodynamic equilibrium----------

A) Mechanical B) Thermal C) Physical D) Chemical

6. ---------- law shows definition of Temprature.

A) First B) Zeroth C) Second D) Forth

7. The internal energy of free gas molecule is analogous to ----------energy of gas

A) Kinetic B) Potential C) Total D) Total kinetic

8. For cyclic process internal energy of system is----

A) Low B) High C) Zero D) constant

9. The first law of thermodynamics shows Eqivalence Between ------

A) Heat & Energy B)Heat & Mechanical work

C) Work & Energy D) Heat & system

10. According to Joules law----------

A) Z=W/Q B) J*Q =W C)W/ z = Q D) All of these

11. The unit Of molar specific heat is--------

A) Cal./(gm-mole ^{o}C) B) Cal./(gm ^{o}C)

C) erg(gm-mole ^{o}C) D) Both A & C

12. The relation Between Cp & Cv are

(Cp – specific heat at const pressure Cv- specific heat at const volume)

A) Cp > Cv B) Cp < Cv C) Cp = Cv D) None of These

13. ----------Process the Temperature of system remains Constant

A) Isothermal B) Adiabatic C) Isostatic D) Irreversible

14. change in entropy in adiabatic Process is----------

` A) High B) Low C) Zero D) None of these

15. Which of the Following True for Adiabatic Process

A) PV = constant B) $P^{\gamma-1}/T^{\gamma}$ = constant

C) TV^{γ} = constant D) All of these

16. Find the value of γ When Cp= 7 & Cv= 5

A) 1.2 B) 1.4 C) 1 D) 2

17. All natural Process are--------

A) Reversible B) Isolated C)Irreversble D) Adiabatic

18. First law of Thermodynamics obeys-----

A) Conservation of charge B) Conservation of Energy

C) Conservation of Work D) Conservation of System

19. Carnot's Cycle is divided in how many process

A) Two B) Three C) Four D) One

20. The Efficiency of Carnot's Heat engine is

A) 100 % B) 70 % C) 101 % D) 50%

21. Equation of state for one mole of ideal gas is----------

A) PV =RT B) PV = nRT

C) $(P + a/V^2) (V -b) = RT$ D) $(P + a/V^2) = RT$

22. Equation of state for one mole of real gas is----------

A) PV =RT B) PV = nRT

C) $(P + a/V^2) (V -b) = RT$ D) $(P + a/V^2) = RT$

23. Zeroth law of thermondynamics leads to defination of the term----------

A) Temperature B) Pressure C) Volume D) entropy

24. The system is said to be in thermodynamics equilibrium when it is in------

A) Mechanical equilibrium B) Thermal equilibrium

C) chemical equilibrium D) All of these

25. The real gas possess----------

A) internal kinetic energy only B) internal potential energy only

C) both internal kinetic energy & internal potential energy

D) None of the above

26. The Mechanical equilibrium of thermodynamics system implies that uniformity of ---------

A) Pressure B) Temperature C) Volume D) Density

- ***Short Answer Questions for 5 Marks***

1. Explain thermodynamic equilibriums of system.
2. Explain Zeroth law of thermodynamics.
3. State and explain third law of thermodynamics.
4. Obtain an expression for work done in an isothermal process.
5. Obtain an expression for work done in an adiabatic process.
6. Define isothermal, adiabatic, isobaric and isochoric processes.
7. Explain the reversible and irreversible processes.
8. Give physical significance of entropy.
9. Obtain expression for work done during an adiabatic change.
10. Give statement of third law of thermodynamics and comment on unattainability of absolute zero.
11. Give physical significance of entropy.
12. Solved examples

- ***Long Answer question for 10 marks***

1. Define specific heat at constant volume and constant pressure .Obtain Mayer's relation.
2. Define adiabatic process? Obtain adiabatic relations for perfect gas.
3. Explain Carnot's ideal heat engine. Obtain expression for efficiency of Carnot's heat engine working between the temperatures T_1 and T_2.
4. Explain entropy changes in reversible and irreversible process.
5. Find the % efficiency of the Carnot's engine working between the steam point and ice point.
6. What is thermodynamic system? Explain thermodynamic equilibrium with example.