SUBJECT CODE : PH/MC/TS24

## B.Sc. DEGREE EXAMINATION APRIL 2011 <br> BRANCH III - PHYSICS <br> SECOND SEMESTER

REG. No.

| COURSE | $:$ | MAJOR - CORE |
| :--- | :--- | :--- |
| PAPER | $:$ | THERMAL PHYSICS AND STATISTICAL MECHANICS |
| TIME | $:$ | 30 MINS. |

## SECTION - A <br> TO BE ANSWERED IN THE QUESTION PAPER ITSELF

ANSWER ALL QUESTIONS:
( $\mathbf{3 0} \times 1=30$ )

I CHOOSE THE CORRECT ANSWER:

1. In diffusion, the transport of the following occurs
a) momentum
b) mass
c) energy
d) temperature
2. Average energy of a Planck's oscillator is
a) $E=h v$
b) $E=\frac{h v}{m c^{2}}$
c) $E=\frac{h v}{e^{h v / K T-1}}$
d) $E=m c^{2}$
3. The absolute temperature of a perfectly black body is increased to twice its value. The rate of emission of energy per unit area will be
a) 2 times
b) 4 times
c) 8 times
d) 16 times
4. Out of the following, the physical quantity that relates with first law of thermodynamics is
a) temperature
b) pressure
c) energy
d) Number of moles
5. Internal energy of a real gas depends upon
a) size of the molecule
b) only on the volume of the gas
c) only on the pressure of the gas
d) only on the temperature of the gas
6. The door of running refrigerator inside a room is left open. Mark the correct statement.
a) the room will be cooled slightly
b) the room will be warmed up gradually
c) the room will be cooled to the temperature inside the refrigerator
d) the temperature of the room will remain unaffected.
7. The unit of entropy is
a) Joule/Kelvin
b) $\mathrm{Cal} /$ Kelvin
c) Both a and b
d) none of the above
8. Entropy is maximum in $\qquad$ state
a) gas
b) solid
c) liquid
d) can be any
9. Maxwell's thermodynamic relation is
a) $\left(\frac{\partial S}{\partial T}\right)_{T}=\left(\frac{\partial P}{\partial V}\right)_{T}$
b) $\left(\frac{\partial T}{\partial V}\right)_{S}=-\left(\frac{\partial P}{\partial S}\right)_{V}$
c) $\left(\frac{\partial V}{\partial T}\right)=-\left(\frac{\partial P}{\partial S}\right)_{V}$
d) $\left(\frac{\partial T}{\partial P}\right)_{P}=\left(\frac{\partial V}{\partial P}\right)_{P}$
10. For a gas at N.T.P which shall be maximum?
a) $V_{a v}$
b) $V_{r m s}$
c) $V_{m p}$
d) none
11. The particles obeying Maxwell-Boltzmann statistics are
a) identical
b) identical and distinguishable
c) distinguishable
d) none
12. The ratio of most probable speed and average speed of a gas enclosed in a vessel is
a) $\frac{\sqrt{\pi}}{4}$
b) 1
c) $\frac{2}{\sqrt{\pi}}$
d) $\frac{\sqrt{\pi}}{2}$
13. Using adiabatic demagnetisation, the minimum temperature produced is
a) 1 K
b) $10^{-3} \mathrm{~K}$
c) $10^{-4} \mathrm{~K}$
d) $10^{-5} \mathrm{~K}$
14. The unit of specific heat of the substance $\left(\mathrm{C}_{\mathrm{H}}\right)$ at constant magnetic field H is
a) Joule/mole K
b) Joule K/mole
c) Joule mole/K
d) K/Joule mole
15. According to which statistics, the energy of absolute zero can not be zero.
a) $\mathrm{M}-\mathrm{B}$
b) B-E
c) F-D
d) none of the these

## II STATE WHETHER TRUE OR FALSE:

16. Rayleigh-Jeans law of radiation applies to longer wavelength.
17. The efficiency of Carnot's engine working between $127^{\circ} \mathrm{C}$ and $27^{\circ} \mathrm{C}$ is $100 \%$.
18. When water-vapour condenses into water its entropy decreases.
19. K.Onnes observed sign of solidification when liquid helium was cooled at ordinary pressures.
20. The temperature of the paramagnetic substance decreases on decreasing the magnetizing field H .

## III FILL IN THE BLANKS:

21. Wien's displacement law is expressed by the equation $\qquad$ .
22. The ratio of adiabatic and isothermal elasticities of a gas is $\qquad$ .
23. $\qquad$ is called the first T.ds equation.
24. Viscosity of liquid He I decreases with $\qquad$ in temperature.
25. The first law of thermodynamics is a special case of the law of conservation of

## IV ANSWER BRIEFLY:

26. State Zeroth law of Thermodynamics.
27. Define mean free path.
28. Define entropy.
29. Write any two methods of liquefaction of gases.
30. The average kinetic energy of a gas molecule at a certain temperature is $6.21 \times 10^{-21}$ joule. Find the temperature. (Boltzmann's constant $\mathrm{K}=1.38 \times 10^{-23}$ joule $\mathrm{k}^{-1}$.

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| TIME | $:$ | $211 / 2$ HOURS |}

## SECTION - B ANSWER ANY FIVE QUESTIONS: (5 x $5=25$ )

1. What is a perfectly black body? Draw curves for the distribution of energy in the spectrum of a black body for two temperatures. Explain the important results obtained from these curves.
2. Calculate the energy of an Planck's oscillator of frequency $0.60 \times 10^{14} \mathrm{sec}^{-1}$ at $T=1800 \mathrm{~K}$.
3. A Carnot's refrigerator takes heat from water at $0^{\circ} \mathrm{C}$ and discards it to a room temperature at $27^{\circ} \mathrm{C} .1 \mathrm{~kg}$ of water at $0^{\circ} \mathrm{C}$ is to be changed into ice at $0^{\circ} \mathrm{C}$. How many calories of heat are discarded to the room? What is the workdone by the refrigerator in this process? What is the coefficient of performance of the machine? ( $1 \mathrm{cal}=4.2$ joule)
4. Find the increase in the boiling point of water at $100^{\circ} \mathrm{C}$ when the pressure in increased by one atmosphere. Latent heat of vaporization of steam is $540 \mathrm{cal} / \mathrm{gram}$ and 1 gram of steam occupies a volume of $1677 \mathrm{~cm}^{3}$.
5. Explain the term of macrostate and microstate with the help of an example.
6. Explain the peculiar properties of Helium II.
7. Prove that the adiabatic elasticity of a gas is $\gamma$ times the isothermal elasticity.

## SECTION - C

ANSWER ANY THREE QUESTIONS: ( $3 \times 15=45$ )
8. Derive an expression $\eta$ of a gas in terms of mean free path of its molecule. Discuss the effect of pressure and temperature on coefficient of viscosity.
9. (i) What is internal energy of a system? Internal energy is state function and not path function explain.
(ii) What is the principle used in the working of a refrigerator? Define coefficient of performance. Is it greater than 1 explain.
10. Show that entropy remains constant in reversible process but increases in irreversible process.
11. Using Maxwell's law of distribution of speeds of molecules in a gas obtain expressions for most probable speed, average speed and root mean square speed.
12. Describe the Joule-Thomson porous plug experiment with necessary theory.

