STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2004-05 & thereafter)

SUBJECT CODE : **PH/MC/TS24**

B.Sc. DEGREE EXAMINATION APRIL 2008
BRANCH III - PHYSICS
SECOND SEMESTER

REG. No._____

COURSE : **MAJOR – CORE**
PAPER : **THERMAL PHYSICS AND STATISTICAL MECHANICS**
TIME : **30 MINS.** MAX. MARKS : 30

SECTION – A

TO BE ANSWERED IN THE QUESTION PAPER ITSELF

ANSWER ALL QUESTIONS: (30 x 1 = 30)

I CHOOSE THE CORRECT ANSWER:

1. The root mean square velocity of the molecules is directly proportional to the _____ of the absolute temperature.
   a) square root b) cube root c) square d) cube

2. If the total distance traveled after N collisions is S, then the mean free path λ is given by
   a) $\lambda = \frac{N}{S}$ b) $\lambda = \frac{S}{N}$ c) $S = \lambda N$ d) $\lambda = SN$

3. The average kinetic energy associated with each degree of freedom is
   a) kT b) $\frac{3}{2}$kT c) $\frac{5}{2}$kT d) $\frac{1}{2}$kT

4. During _____ process, the temperature of the working substance remains constant
   a) adiabatic b) isothermal c) isochoric d) isobaric

5. The equation representing first law of thermodynamics is
   a) $\delta H = dU + \delta W$ b) $dU = \delta H + SW$ c) $\delta W = \delta H - dU$ d) $\delta H = dU - \delta W$

6. The number of ways in which N distinguishable particles can be arranged in order is equal to
   a) n ! b) (N-n) ! c) N ! d) (N+n) !

7. All particles having spin zero or integral multiple of 1 are _____
   a) fermions b) mesons c) bosons d) baryons

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8. The state of the gas is completely known if the position and _____ of each atom of the gas is specified
   a) velocity b) momentum c) energy d) acceleration

9. Energy associated with 1 gram molecule of a diatomic gas
   a) $\frac{5}{2}RT$ b) $\frac{3}{2}RT$ c) $\frac{1}{2}RT$ d) RT

10. The specific heat of a substance decreases with increase in _____.
    a) volume b) pressure c) energy d) temperature

11. The first law of thermodynamics gives the relation between the work done and _____.
    a) energy released b) heat produced c) heat released d) pressure.

12. When ice is converted into water and then into steam, the entropy and disorder of the molecules
    a) increase b) decrease
    c) remain constant d) fall very rapidly

13. All fundamental particles with spin _____ are fermions.
    a) $\frac{3}{2}$ b) $\frac{5}{2}$ c) $\frac{1}{2}$ d) 1

14. The efficiency of a Carnot's engine working between 127°C and 27°C is _____
    a) 10% b) 25% c) 50% d) 100%

15. A diatomic gas molecule has _____ degrees of freedom
    a) 5 b) 3 c) 2 d) 1

II STATE WHETHER TRUE OR FALSE:

16. The entropy remains constant during adiabatic reversible process.

17. The Clausius – Clapeyron latent heat equation holds good in the second order phase transition.

18. When steam is converted into water and then into ice, the entropy and disorder of the molecules decrease.

19. particles are indistinguishable in Maxwell-Boltzmann distribution.

20. The lowest temperature corresponds to O°K called the absolute zero temperature.

III FILL IN THE BLANKS:

21. The Rayleigh – Jean's law holds good in the region of _____ wavelengths.

22. The sudden bursting of a cycle tube is an _____ process.

23. The Carnot's engine is perfectly _____.

24. With the increase in entropy, the disorder of the molecules of a substance _____.

25. The coefficient of thermal conductivity of a gas is directly proportional to the _____ of absolute temperature.

IV ANSWER IN ONE OR TWO SENTENCES:

26. Define viscosity.

27. Define entropy.

28. What are the independent variables for which the state of a system can be specified?

29. Define photons.

30. Define free path.

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SECTION – B

ANSWER ANY FIVE QUESTIONS: (5 x 5 = 25)

1. Show that for an adiabatic change in a perfect gas PV^{r} = constant.

2. Prove that the entropy of the system increases in all irreversible process.

3. Air is compressed adiabatically to half its volume. Calculate the change in its temperature.

4. A carnot engine whose temperature reservoir is at 7°C has an efficiency of 50%. It is desired to increase the efficiency to 70%. By how many degrees should the temperature of the high temperature reservoir be increased?

5. What are the probability theorems in statistical thermodynamics.

6. A 100 K.W engine is operating between 217°C and 17°C. Calculate the amount of heat absorbed, the amount of heat rejected and the efficiency of the engine.

7. Prove that at any temperature, the ratio of the emissive power to the absorptive power of a surface is constant.

SECTION – C

ANSWER ANY THREE QUESTIONS: (3 x 15 = 45)

8. Obtain an expression for Bose – Einstein distribution law.

9. Show that the Planck's law for the energy distribution in a thermal spectrum is applicable for all wavelengths.

10. Describe Carnot's cycle and obtain an expression for the efficiency of an ideal heat engine in terms of temperatures.

11. Deduce Clausius – Clapeyron latent heat equation.

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12. a) Show that the adiabatic curve is steeper than isothermal curve at a point where the two curves intersect each other.

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