

STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2019 – 2020 and thereafter)
SUBJECT CODE: 19PH/MC/TS23

B.Sc. DEGREE EXAMINATION APRIL 2022
BRANCH III - PHYSICS
SECOND SEMESTER

COURSE : MAJOR – CORE
PAPER : THERMAL PHYSICS AND STATISTICAL MECHANICS
TIME : 3 HOURS. MAX. MARKS: 100

SECTION – A

ANSWER ALL QUESTIONS:

I CHOOSE THE CORRECT ANSWER: (10 x 1 = 10)

1. Bolometer measures _____
a) Thermal conductivity b) Specific heat c) Heat radiation d) Thermo emf
2. According to Stefan-Boltzman law the relation between the heat energy radiated per unit area of black body (E) and its temperature T is
a) $E \propto T^2$ b) $E \propto T^4$ c) $E \propto \frac{1}{T^4}$ d) $E \propto \frac{1}{T^2}$
3. 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
4. The equivalence of two systems in thermal equilibrium is represented by the property
a) Energy b) Heat c) Specific heat d) Temperature
5. Which of the following represents a reversible process?
a) $dS < 0$ b) $dS > 0$ c) $dS = 0$ d) none of these
6. A piece of ice is added to water in a cup. The entropy
a) Is increased b) Decreased
c) Undergoes no change d) sometime increase, sometimes not
7. Paraffin wax contracts on solidification. The melting point of wax will
a) Increase with pressure b) decrease with pressure
c) no change with pressure d) decreases linearly with pressure
8. The area enclosed in the Temperature-Entropy diagram represents
a) Heat energy absorbed b) Heat energy liberated
c) Work converted to energy d) energy converted to work
9. The particle obeying Maxwell-Boltzmann statistics are
a) Identical b) Identical and distinguishable
c) Distinguishable d) Non identical
10. In a canonical ensemble a system A of fixed volume is in contact with large reservoir B
a) A can exchange only energy with B
b) A can exchange only Particles with B
c) A can exchange neither energy nor particles with B
d) A can exchange both energy and particle with B

FILL IN THE BLANKS:**(5x1=5)**

11. Heat transfer that occurs in the absence of medium across the space is called _____
12. The Gibb's function G of a system is given by _____
13. Unit of entropy is _____
14. Maxwell's second TdS equation is
15. The six-dimensional space for a single molecule is called _____

ANSWER BRIEFLY:**(5x2=10)**

16. What does a black body mean?
17. Define the coefficient of performance of a reversible refrigerator.
18. State third law of thermodynamics.
19. Give the Clausius Clapeyron equation.
20. What is thermodynamic probability?

SECTION B**ANSWER ANY FIVE QUESTIONS****(5x6=30)**

21. Discuss the distribution of energy in black body radiation.
22. Calculate the average energy of an oscillator of frequency $0.60 \times 10^{14} \text{ sec}^{-1}$ at $T = 1800 \text{ K}$ treating it as (i) classical oscillator, (ii) Planck's oscillator.
23. A carnot engine has an efficiency 30% when the temperature of the sink is 27°C . Find the temperature of the source. By how much should the temperature of the source be raised if the efficiency is to be raised to 70%.
24. 50 grams of water at 0°C is mixed with an equal mass of water at 80°C . Calculate the resultant increase in entropy.
25. Calculate the change in melting point of ice when subjected to a pressure of 100 atmosphere. Density of ice = 0.917 g/cm^3 , Latent heat of ice = 336 J/g .
26. Use Maxwell's relation to obtain $C_P - C_V = R$ for an ideal gas where C_P and C_V are molar specific heats at constant pressure and constant volume respectively.
27. Explain the terms macrostate and microstate with the help of an example.

SECTION C**ANSWER ANY THREE QUESTION****(3x15=45)**

28. Derive Planck's radiation formula. Show that Rayleigh-Jeans law and Wien's law are special case of Planck's law.
29. Describe Carnot's reversible heat engine. Deduce an expression for its efficiency.
30. Show that entropy remains constant in reversible process but increase in irreversible process.
31. Derive Maxwell's thermodynamical relations.
32. What do you mean by ensemble? Explain concept of microcanonical, canonical and grand-canonical ensemble.
