Model Question Paper

(Model 1, Model II and Model III)

MAHATMA GANDHI UNIVERSITY

V SEMESTER B.Sc. PHYSICS Programme EXAMINATION……(Year)

PH5B03U – THERMAL AND STATISTICAL PHYSICS

Instructions:

1. Time allotted for the examination is 3 Hours.
2. Answer **all** questions in Part A. This contains 4 bunches of 4 objective type questions. For each bunch, Grade A will be awarded if all the 4 questions are correct, B for 3, C for 2, D for 1 and E for 0.
   Answer any 5 questions from Part B, any 4 from Part C and any 2 from Part D.
3. Candidates can use …….(type of calculator/tables)

Part A (Objective type- weight 1 each)

Bunch 1

1. In a reversible adiabatic process, entropy:

(a) increases (b) remains unchanged

(c) decreases (d) becomes zero

2. A piece of ice is added to a cup. The entropy

(a) increases (b) remains unchanged

(c) decreases (d.) first decreases and then increases.

3. Gibbs potential is defined as

(a) G=U-PV+TS (b) G=U+PV+TS

(c) G=U-PV-TS (d) G=U+PV-TS

4. Rice takes longer time to cook

   (a) in a submarine under sea (b) at sea level

   (c) at mount-Everest. (d) it does not depend on the place where we cook

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Bunch II

5. The thermodynamic potentials are:

   (a) Pressure, Volume, temperature and internal energy

   (b) Pressure, Volume, Helmholtz function and internal energy

   (c) Helmholtz function Gibbs free energy, Enthalpy and internal energy

   (d) None of these

6. Average energy of a Planck's oscillator is

   (a) $E = h\nu$ (b) $E = nh\nu$

   (c) $E = h\nu/[e^{h\nu/Kt} - 1]$ (d) $E = mc^2$

7. The radiation emitted by a perfectly black body is proportional to

   (a) Temperature of an ideal gas

   (b) Fourth root of temperature on ideal gas scale

   (c.) Fourth power of temperature on ideal gas scale

   (d) Source of temperature on an ideal gas scale.

8. When a rubber band is quickly stretched its temperature

   (a) Rises (b). remains unchanged

   (c) falls (d.) first falls then rises

Bunch III

9. The internal energy of an ideal gas at constant temperature is

a. independent of its volume c. zero

(c) dependant on its volume d. none of the above

10. The internal energy of an actual gas at constant temperature

(a) increases as its volume increases (b) decreases as its volume increases

(c) remains unchanged with the increase in its volume (d) is zero

11. In a Carnot's engine when heat is taken by a perfect gas from the hot source, then the temperature of the source :

(a) increases (b) decreases

(c) remains unchanged (d) first decreases and then increases

12. The total gain in entropy of the working substance in Carnot's cycle is

(a) zero (b) negative

(c) remains unchanged (d) positive

Bunch IV

13. In a Carnot's cycle at the termination of the cycle, the temperature of the working substance is

(a) equal to its initial temperature (b) less than its initial temperature

(c) greater than its initial temperature (d) becomes zero

14. An ideal heat engine absorbs heat at a temperature of $150^{o}C$ and its exhaust temperature is $50^{o}C$. The efficiency of the engine is about

(a) 60% (b) 100%

(c) 10% (d) 25%

15. If the door of the refrigerator is kept open in a hall, the temperature of

(a) The hall will become cooler (b) The hall will become warmer

(c) remains unchanged (d) It depends on the temperature of the surrounding

16.In quantum Statistics, the volume of phase cells is

(a) zero (b) h

(c) h^2 (d) $1/h^2$

Part B (Short answerquestions- weight 1 each)

17. State first law of thermodynamics. Give its physical significance. What are its limitations
18. Give applications of first law to (a) isobaric (b) adiabatic process.
19. Explain why the Entropy of the Universe increases.
20. What is T-S diagram? Explain its physical significance.
21 Discuss the short comings of Rayleigh – Jeans law?
22. Distinguish the following particles as Bosons or Fermions:
    (i) Hydrogen atom, (ii) ^3He, (iii) α-particle, (iv)$^6Li^+$ ion, (v) $^7 Li^+$ ion.
23. Comment on work scale of temperature.
24. Defend or refute the following statement: "It is acclaimed that with surrounding temperature 300K, 1200K cal of heat available from a reservoir at 900K is more useful than 1500Kcal of heat available at 600K".

Part C (Short Essay/Problems- weight 2 each)

25 Write short notes on (a) External and Internal work (b) Reversible and Irreversible process
26. Prove that $TdS = C_v\, dT + T\left(\partial P/\partial T\right)_v\, dV$.
27. Explain Thermodynamic probability.Derive an expression for macro-state
28. State and explain clearly the basic difference between Classical and Quantum statistics.
29. Define Fermi Energy through the distribution law in Fermi-Dirac Statistics. Explain the significance of Fermi Function.
30. Discuss the limiting cases of Planck's radiation formula.

Part D (Essay type- weight 4 each)

31. (a) Explain with the help of a diagram describe the working of a petrol engine. Comment on its efficiency. Also compare with diesel engine.

    (b) A petrol engine consumes 25 Kg of petrol per hour. The calorific value of petrol is 11.4 x 106 cal/kg. The power of the engine is 99.75K Watts. Calculate the efficiency of the engine.

32. (a) What do you understand by thermodynamic probability? How is it related with entropy of a system? Establish the necessary relationship

    (b) Establish the gas equation for a perfect gas assuming it to obey MB statistics

33. Deduce Maxwell's thermodynamic relations.

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