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Reg. No. : .....

Name : .....

Second Semester B.Sc. Degree Examination, September 2022

First Degree Programme under CBCSS

Physics

Complementary Course for Mathematics

PY 1231.1 — THERMAL PHYSICS AND STATISTICAL MECHANICS

(2020 Admission Onwards)

Time : 3 Hours

Max. Marks : 80

PART – A

Answer **all** questions in **one** word or maximum **two** sentences. Each question carries **1** mark.

1. State Wiedmann-Franz law.
2. Mention a practical application of conduction of heat.
3. What does statistical mechanics deal with?
4. Define a macrostate.
5. What is an adiabatic process?
6. Write down the equation of state of an isothermal process.
7. Define entropy.
8. Give an expression for the efficiency of heat engine.

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9. State Plank's statement of second law of thermodynamics.

10. Draw a T-S diagram for a Carnot cycle.

(10 × 1 = 10 Marks)

PART – B

Answer any **eight** questions in about **one** paragraph. Each question carries **2** marks.

11. Define solar constant. Name the instrument used to measure the solar constant.

12. What are postulates of statistical mechanics?

13. Derive an expression for entropy.

14. Discuss the change in entropy during a reversible process.

15. Prove that entropy is a state function.

16. What are the characteristics of a black body?

17. Explain the concept of phase space.

18. State principle of increase of entropy.

19. State and explain Rayleigh-Jeans law.

20. Define probability. When will be the probability be zero?

21. A heat engine cannot attain 100% efficiency. Explain why?

22. Explain the work done by an ideal gas in an isothermal process.

23. Define temperature gradient and thermal conductivity.

24. Define an ensemble.

25. What is meant by reversible and irreversible process?

26. Write a note on microcanonical ensemble.

(8 × 2 = 16 Marks)

PART – C

Answer any **six** questions. Each carry **4** marks.

27. Find the change in entropy when a perfect gas expands isothermally and adiabatically.

28. Give the concept of ensemble. Calculate the number of states per unit volume of phase space.

29. Show that the adiabatic curve has a steeper negative slope than does an isothermal curve at the same point.

30. A Carnot's engine has an efficiency of 30% when the temperature of the sink is 27°C. What must be the change in temperature of the source to make its efficiency 50%.

31. Obtain the expression for change in entropy when ice changes to steam.

32. A Carnot engine takes 200 calories of heat from a source at temperature 400K and rejects 150 calories of heat to the sink. What is the temperature of the sink? Also calculate the efficiency of the engine.

33. The efficiency of an ideal engine is 0.2. If the temperature of the sink is lowered by 20°C, the efficiency becomes 0.25. Find the temperature of the source and sink.

34. If a black body at a temperature 6174 K emits 4700 A° with maximum energy; calculate the temperature at which it will emit a wavelength of 1.4×10^{-5} m with maximum energy.

35. Four molecules are to be distributed in 2 cells. Find the number of macrostates and microstates.

36. Derive maxwell's law of distribution of velocities of the molecules of an ideal gas.

37. Ten particles are distributed in two equal sized cells. Find the number of macrostates and microstates.

38. A thermal conductor in the form of a long bar is heated at one end at constant temperature. Discuss the distribution of temperature along the bar before and after the steady state is reached.

(6 × 4 = 24 Marks)

PART – D

Answer any **two** questions. Each carry **15** marks.

39. Derive Maxwell-Boltzmann distribution Law.

40. Describe the distribution of energy of a black body at different temperatures by drawing the graphs. Discuss briefly the different laws which explain the above energy spectrum.

41. Describe with necessary theory, the construction and working of petrol engine.

42. Describe Carnot's cycle and obtain an expression for the efficiency of an ideal heat engine.

43. Explain the Lee's disc experiment to measure thermal conductivity.

44. What are Kelvin-plank and Clausius statement of second law of thermodynamics? Prove that they are correct in terms of principle of increase of entropy.

(2 × 15 = 30 Marks)
