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Second Semester B.Sc. Degree Examination, May 2020

First Degree Programme under CBCSS

Complementary course for Mathematics

PY 1231.1 : THERMAL PHYSICS AND STATISTICAL MECHANICS

(2018 Admission Onwards)

Time : 3 Hours Max. Marks : 80

SECTION – A

Very short answer type questions. (One word to Maximum **2** sentences). Answer **all**. Each carries one **1** mark.

1. State Weidmann Franz law.

2. In a toss of 4 coins a macro state with 2 Heads has ———— number of microstates.

3. There are three furnaces, Furnace A with blue flame, Furnace B with yellow flame and Furnace C with red flame which has the highest temperature ————

4. State postulate of 'equal a priori probabilities'.

5. The efficiency of Carnot engine working between steam point and ice point is ————

6. The expression for work done in isothermal process is ————

7. Which states of matter (solid, tiquid or gas) has the highest entropy

8. State Wien's displacement law?

9. Why it is cooler at the top of the mountain than at the sea level.

10. If $dU = -dW$ in a thermodynamic process, then process is:

(10 × 1 = 10 Marks)

SECTION – B

Short answer type question. Answer any **eight** questions. Each carry **2** marks. (Not to exceed one paragraph).

11. Explain Plank's radiation law

12. Differentiate between thermal conductivity and thermometric conductivity.

13. Distinguish between isothermal and adiabatic process.

14. When a tyre bursts, the air coming out is cooler Than the surrounding air. Why

15. State Kelvin and Clausius statement of second Jaw of thermodynamics.

16. Discuss the relation between entropy and disorder.

17. What do you mean by "ultra violet catastrophe"

18. Rate of formation of ice in lakes decreases with increase in the thickness of ice layer. Why?

19. Explain phase-space and ensemble.

20. Explain the concept of macro states and micro state.

21. Briefly explain Maxwell Boltzmann distribution.

22. Nine particles have speeds of 5.00, 8.00, 12.0, 12.0, 12.0,14.0, 14.0, 17.0, and 20.0 m/s.

    (a) Find the particles average speed

    (b) r.m.s. speed.

(8 × 2 = 16 Marks)

SECTION – C

Short essay questions. (not to exceed **120** words). Answer any **six**. Each carries **4** marks.

23. Explain how the temperature of sun can be measured by knowing solar constant.

24. State and explain the principle of increase of entropy.

25. (a) Find the populations of the first and second excited states *relative* to the ground state for atomic hydrogen at room temperature, assuming that hydrogen obeys Maxwell—Boltzmann statistics.

    (b) Find the populations of the first and second excited states relative to the ground state for hydrogen heated to 20,000 K in a star. Given that Energy n th level $En = 13.6/n^2\ eV$ and the degeneracy $g_n = 2n^2$.

26. Calculate rms speed, most probable speed and avenge speed of oxygen molecule at 27 °C. Molar mass of oxygen is 32 u.

27. Calculate the increase in entropy of! kg of ice when it is converted into steam. Given that specific heat of water is 1 kcal /kg°C, latent heat of ice is 80 kcal /Kg and latent heat of steam is 540 k cal/kg.

28. A petrol engine using ideal air as working substance has its compression ratio raised from 5 to 6. Find the % increase in efficiency.

29. Two identical samples of monatomic gases are allowed to expand to twice their initial volume. One sample expands isothermally, while the other sample expands adiabatically. In which sample is the pressure higher? Explain.

30. A Carnot engine has an efficiency of 0.4 when its cold reservoir is at 300K. Find the change in its hot reservoir temperature so that efficiency becomes 0.65.

31. A house has wooden siding 1.0cm thick, with total surface area of 275 m^2. Suppose it is 19 °C inside and 1 °C outside.

    (a) What is the rate of energy loss through the walls?

    (b) What is the daily heating cost with energy at $ 0.10 per kWh? Thermal conductivity for wood 0.12 W/°C.m^2

(6 × 4 = 24 Marks)

SECTION D

Long essay questions. Answer any **two**. Each carries **15** marks.

32 Obtain the relation connecting pressure and volume in an adiabatic process. Derive an expression for work done in adiabatic process?

33 Define entropy? What is its physical meaning? Explain T-S diagram? Find an expression for efficiency of reversible Carnot engine with help of T-S diagram?

34 What is perfect black body? Draw curves for the distribution of energy in the spectrum of a black body for three different temperatures. Explain important results obtained from these curves?

35 Describe an experiment with necessary theory to determine the thermal conductivity of a poor conductor by Lee's disc method.

(2 × 15 = 30 Marks)
