

Reg. No. : .....

Name : .....

Third Semester B.Sc Degree Examination, October 2019

First Degree Programme under CBCSS

Physics

Core course

PY 1341-THERMODYNAMICS AND STATISTICAL PHYSICS

(2013-2017 Admissions )

Time : 3 Hours

Max. Marks : 80

SECTION A

Answer **all** questions in one or two sentences. Each carries **one** mark.

1. If mean speed, most probable speed, r.m.s. speed of ideal gas molecules are 'a', 'b' and 'c' respectively. Then correct relation is \_\_\_\_\_
  - (a)  $a=b=c$
  - (b)  $a < b < c$
  - (c)  $b < a < c$
  - (d)  $b > a > c$
2. If  $dU = -dW$  in a thermodynamic process, then process is:
  - (a) Adiabatic
  - (b) Isothermal
  - (c) Isobaric
  - (d) Isochoric
3. An example for Fermions is \_\_\_\_\_

4. What is the unit of thermal conductivity.
5. The efficiency of Carnot engine working between steam point and ice point is
6. What is the relation between thermodynamic probability  $\Omega$  and entropy
7. State Stefan's law.
8. Define Helmholtz function.
9. State postulate of 'equal priori probabilities'
10. Define phase space.

**(10 × 1 = 10 Marks)**

### SECTION B

Answer **any eight** of the following. Each carries **2** marks. The answer should not exceed one paragraph.

11. State Wiedemann Franz law.
12. State Liouville's theorem
13. If a drop of water falls on a very hot iron, it takes long time to evaporate. Why?
14. Distinguish first and second order phase transition?
15. Write Clausius – Clapeyron equation and explain the terms.
16. Sketch Fermi-Dirac distribution function at (a)  $T=0$  K and (b)  $T>0$  K
17. Write a note on ensembles.
18. What is Bose-Einstein condensation?
19. State and explain second law of thermodynamics.
20. Explain why the temperature of a gas drops in adiabatic expansion
21. How is the thermal conductivity of rubber determined by radial heat flow method?
22. What is the principle of increase of entropy?

**(8 × 2 = 16 Marks)**

## SECTION C

.Answer **any six** of the following. Each carries **4** marks.

23. Define solar constant. How do you find the temperature of the sun from a knowledge of solar constant? (Radius of sun =  $6.928 \times 10^5$  km and R is mean distance of sun from the earth =  $148.48 \times 10^7$  km).
24. A motor car tyre has a pressure of 3 atm at room temperature of  $27^\circ\text{C}$ . If tyre suddenly burst. What is the resulting temperature.  $\gamma = 1.4$ .
25. Show that work done along any adiabatic between two isothermals is independent of particular adiabatic.
26. A carnot engine working between source at 600 K and sink at  $T^2\text{K}$  has an efficiency of 50%. If the temperature of source and sink are increased by 100 K, what is the efficiency of engine?
27. Obtain first and second Maxwell's thermodynamic equations.
28. Surface area of an electric heater is  $350 \text{ cm}^2$ . when heated its temperature becomes  $727^\circ\text{C}$ . How much energy will it radiate in one minute? Black body radiation may be assumed. Stefan's constant  $\sigma = 5.67 \times 10^{-8} \text{ J.m}^2\text{S}^{-1}\text{K}^{-4}$ .
29. A collection of three non interacting particles shares 3 units of energy. Each particle is restricted to having an integral number of units of energy.
  - (a) How many macrostates are there?
  - (b) How many microstates are there in each of the macrostates?
  - (c) What is the probability of finding one of the particles with 2 units of energy?
30. Compute the Fermi energy  $E_F$  for sodium on the assumption that each sodium atom contribute one free electron to the electron gas. The density of sodium is  $971 \text{ kg/m}^3$  and its atomic mass is 23 u.
31. The Latent Heat of Fusion of Ice I is  $3.34 \times 10^5 \text{ J/Kg}$  at  $0^\circ\text{C}$  and atmospheric pressure. If the change in specific volume on melting is  $-9.05 \times 10^{-5} \text{ m}^3/\text{kg}$  then calculate change in melting temperature due to change of pressure.

**(6 × 4 = 24 Marks)**

## SECTION D

Answer **any two** questions Each carries **fifteen** marks.

32. Describe with necessary theory the construction and working of a diesel engine. Explain its merit over Otto engine.
33. Discuss briefly the Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac Statistics. Compare the three statistics.
34. Define Entropy. What is its physical significance? Show that entropy remains constant in a reversible process while increases in irreversible process?
35. Define Coefficient of Thermal conductivity? Describe an experiment with necessary theory to find out thermal conductivity of a bad conductor.

**(2 × 15 = 30 Marks)**