

Reg. No. :

Name :

**V Semester B.Sc. Degree (C.B.C.S.S. – O.B.E. – Regular/Supplementary/
Improvement) Examination, November 2023
(2019-2021 Admissions)**

CORE COURSE IN PHYSICS

5B08PHY : Thermodynamics and Statistical Mechanics

Time : 3 Hours

Max. Marks : 40

PART – A

(Short answer questions. Answer all questions. Each carries 1 mark.)

1. Give the Rankine and Fahrenheit temperature corresponding to 373.15 K.
2. A quasi static isothermal expansion of ideal N_2 gas enclosed in a cylinder fitted with a frictionless movable piston is a reversible process or not ? Why ?
3. State the significance and limitations of first law of thermodynamics.
4. What are the merits of a diesel engine ?
5. State the physical sense of Helmholtz free energy.
6. Define RMS speed of molecules. (6×1=6)

PART – B

(Short essay questions. Answer any six questions. Each carries 2 marks.)

7. State and explain Zeroth law of thermodynamics with one fundamental application.

P.T.O.



8. The pressure on 300 gm of copper is increased quasistatically and isothermally from 0 to 500 atm at 300K. (Take the density $\rho = 8.96 \times 10^3 \frac{\text{kg}}{\text{m}^3}$ and isothermal compressibility, $k = 6.18 \times 10^{-12} \text{Pa}^{-1}$). How much work is done during compression ?
9. Explain molar heat capacity at constant volume and prove that $dU = C_v dT$.
10. a) Define coefficient of thermal conductivity
b) Prove that $C_p - C_v = R$ for one mole of an ideal gas using the first law of thermodynamics.
11. Explain Carnot's theorem.
12. State Kelvin-Planck statement of second law of thermodynamics. Can we propel a ship across ocean by utilizing the internal energy of the ocean ?
13. Explain the term 'entropy'. How will you relate entropy and disorder for a system which is making a transition from ferromagnetic to paramagnetic behaviour ?
14. Distinguish between bosons and fermions. (6×2=12)

PART – C

(Problems. Answer any four questions. Each carries 3 marks.)

15. Compute the bulk modulus of petrol from the following data. Initial volume = 200 liters, Pressure change = 100 atm and final volume = 201 liters.
16. A tyre filled with Nitrogen gas at a pressure of 1 atm is compressed to $(1/10)^{\text{th}}$ of its volume
a) Very slowly
b) Suddenly. Find the pressure difference of the compressed air between the two cases.
17. Obtain the value of Stefan's constant if the temperature of the filament of a 25 W lamp is 2000°C and the effective area of the filament is $0.60 \times 10^{-4} \text{m}^2$. The relative emittance of the filament is 0.29.



18. Calculate the change in entropy in MKS system when 10 kg of ice at its melting point is converted into water by heating to 283K. [Latent heat of ice = 80 cal/gm. Specific heat of water = 1 cal/gm°C].
19. Calculate under what pressure ice freezes at 270 K if the change in specific volume when 1 kg of water freezes is $80 \times 10^{-6} \text{m}^3$. Given the latent heat of ice = $3.36 \times 10^5 \text{J/kg}$.
20. In how many ways can two particles be distributed in five quantum states. The particles are indistinguishable following B-E statistics. (4×3=12)

PART – D

(Long Essay. Answer any two questions. Each carries 5 marks.)

21. Deduce thermodynamic potentials and derive Maxwell's relation.
22. Describe Carnot engine and obtain expression for its efficiency.
23. Explain with examples
a) Reversible and irreversible process.
b) Quasistatic process.
c) Intensive and extensive variables.
d) Thermodynamic equilibrium.
24. Derive Maxwell-Boltzmann distribution law. (2×5=10)