

SIXTH SEMESTER B.A./B.Sc. DEGREE EXAMINATION, MARCH 2020

(CUCBCSS—UG)

Physics/Applied Physics

PHY 6B 10/APY 6B 11—THERMAL AND STATISTICAL PHYSICS

Time : Three Hours

Maximum : 80 Marks

*Symbols used in this question paper have their usual meanings.***Section A***(Answer in a word or phrase).**Answer all questions.**Each question carries 1 mark.*

1. Isothermal elasticity of a gas is its _____.
(a) Pressure. (b) Volume.
(c) Entropy. (d) Temperature.
2. The slope of an adiabatic is _____ than that of isothermal.
3. The area under the indicator diagram of a thermodynamic system represents pressure.
(True or False)
4. The entropy of a system _____ in an irreversible process.
5. In Carnot's cycle, the first step is _____.
6. Write down the FD distribution function.
7. What is Wiedmann Franz law ?
8. What is meant by thermodynamic equilibrium ?
9. What kinds of particles obey the Maxwell-Boltzmann statistics ?
10. What is an isobaric process ?

(10 × 1 = 10 marks)

Section B*(Answer in a short paragraph- three or four sentences).**Answer all questions.**Each question carries 2 marks.*

11. How do you find the slope of an isotherm ?
12. State the first law of thermodynamics.

Turn over

13. What are the parts of a heat engine ?
14. Explain the difference between distinguishable and indistinguishable particles.
15. Give the expression for the efficiency of a diesel engine and explain the symbols.
16. What is T-S diagram ? Give its use.
17. What is the difference between a canonical ensemble and a microcanonical ensemble.

(7 × 2 = 14 marks)

Section C

(Answer in a paragraph of about half a page to one page).

Answer any five questions.

Each question carries 4 marks.

18. Give two versions of the second law of thermodynamics.
19. State and prove the principle of increase of entropy.
20. Using Maxwell's thermodynamic relations, prove that the ratio of the adiabatic to the isobaric coefficient of expansion is $1/(1 - \gamma)$.
21. Explain the term Helmholtz free energy. Show that in a natural isothermal change at constant volume, Helmholtz free energy decreases.
22. Draw the Maxwell-Boltzmann velocity distribution curve and state the features of the distribution curve.
23. Distinguish between Classical and Quantum Statistics.
24. From the first law of thermodynamics prove that $C_p - C_v = R$.

(5 × 4 = 20 marks)

Section D

(Problems- write all relevant formulas. All important steps carry separate marks)

Answer any four questions.

Each question carries 4 marks

25. Find the most probable, average and root mean square speeds of nitrogen molecule at 27°C. Given the molecular mass of N_2 molecule = 2.8×10^{-3} kg/mol, the gas constant $R = 8.31$ J/mol K.
26. A quantity of air at 27°C is suddenly compressed to half its original volume. Find the final pressure and temperature. (Given $\gamma = 1.4$, $2^{1.4} = 2.64$).

27. Find the efficiency of a Carnot's engine working between 127°C and 27°C . It absorbs 80 cal of heat. How much heat is rejected ?
28. When 50 g of water is heated from 10°C to 90°C , by how much does its entropy change ?
29. Calculate the specific heat of saturated steam. Given that the specific heat of water at $100^{\circ}\text{C} = 1.01$ and latent heat of vapourization decreases with increase in temperature at the rate of 0.64 cal/K . Latent heat of vapourization of steam is 540 cal.
30. Fermi energy of conduction electrons in silver is 5.48 eV. Calculate the number of such electrons per cm^3 given that $h = 6.62 \times 10^{-27} \text{ erg sec.}$ and $1 \text{ eV} = 1.62 \times 10^{-12} \text{ erg.}$
31. Show that adiabatic curve is steeper than isothermal curve.

(4 × 4 = 16 marks)

Section E

(Essays-Answer in about two pages).

Answer any two questions.

Each question carries 10 marks.

32. Derive the two expressions for the work done in an adiabatic process.
33. State and prove the theorem of equipartition of energy. Give the merits of this theorem.
34. Discuss with necessary theory the construction and working of an Otto engine.
35. What is meant by Fermi energy of conduction electrons? Derive an expression for the same.

(2 × 10 = 20 marks)