D 40049 (Pages : 3) Name.....

Reg. No.....

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, MARCH/APRIL 2018

(CUCBCSS—UG)

Physics/Applied Physics

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

Time : Three Hours Maximum : 80 Marks

The symbols used in this question paper have their usual meanings.

Section A

Answer in a word **or** *a phrase.*

Answer **all** *questions.*

Each question carries 1 *mark.*

1. The quantity that remains constant during an isobaric process is ———.
2. What happens to the boiling point of water when pressure increases ?
3. ——— of a system is a measure of the unavailability of energy from it.
4. ——— represents the free energy of the system in an isothermal process at constant pressure.
5. For a perfect black body, the emissivity is ———.

Questions 6 to 10 : write True **or** *False.*

6. A Carnot engine can have 100 percent efficiency.
7. If we keep the door of a refrigerator open for some time, the temperature of the room increases.
8. Entropy is an extensive property.
9. Electrons obey Bose-Einstein statistics.
10. The peak of the black body spectrum shifts to higher frequencies as the temperature is increased.

(10 × 1 = 10 marks)

Section B

Answer in two **or** *three sentences.*

Answer **all** *questions.*

Each question carries 2 *marks.*

11. Explain the zeroth law of thermodynamics.
12. What is the condition for a system to be in thermodynamic equilibrium ?

Turn over

13. What do you mean by a quasistatic process ? How can you realize a quasistatic process ?
14. What do you mean by a heat engine ? What are its essential parts ?
15. Draw the TS diagram of a Carnot cycle.
16. Draw the volume versus temperature curve for first and second order phase transitions.
17. Write down an expression for the distribution of molecular speeds in a classical ideal gas and plot it.

(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. Obtain the relation between isothermal and adiabatic elasticity of a gas.
19. Show that the slope of an adiabatic is y times that of an isothermal.
20. Write down the Planck and Clausius statements of the second law of thermodynamics.
21. Obtain an expression connecting the first and second laws of thermodynamics.
22. Discuss the equipartition theorem.
23. Explain Planck radiation law.
24. Explain the term degeneracy pressure and mention any of its astrophysical significance.

(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. A Carnot engine whose low temperature reservoir is at 7 degree Celsius has an efficiency of 50%. If it is desired to increase the efficiency to 70 %, by how many degrees should the temperature of the high temperature reservoir be increased ?
26. Air at NTP is compressed adiabatically to half of its volume. What is the change in its temperature ? Given, $\gamma = 1.4$.
27. Calculate the change in entropy when 0.0273 kg of ice at zero degree Celsius is converted into water at the same temperature. Given latent heat = 80 cal/g.
28. Using Clausius Clapeyron equation, prove that the boiling point of a liquid rises when the pressure increases.

29. Discuss the principle of increase of entropy.

30. Calculate the net rate of energy transfer between two closely spaced concentric spheres (black bodies) maintained at temperatures 200 K and 300 K. Assume that the space between the spheres is evacuated. Given, the Stefan's constant = 5.67×10^{-8} $W/m^2.K^4$.

31. Prove that the probability for two bosons to occupy the same state is twice the case if the particles are distinguishable.

(4 × 4 = 16 marks)

Section E

Essays-answer in about **two pages.**
Answer any **two** *questions.*
Each question carries 10 *marks.*

32. Obtain the relation between the specific heat at constant volume and pressure using the first law of thermodynamics.

33. Explain the Carnot cycle with a neat PV diagram. Obtain an expression for the work done in a Carnot cycle.

34. Obtain Maxwell's thermodynamic relations from thermodynamic potentials.

35. Discuss briefly the Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics. Compare the three statistics.

(2 × 10 = 20 marks)