C 21078

(Pages : 3)

Name...

Reg. No...................................

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, MARCH 2017

(CUCBCSS—UG)

Physics/Applied Physics

PHY 6B 10/APY 6B 11—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 phrase.)

Answer all questions ; each question carries 1 mark.

1. The physical quantity that determines whether a system is in thermal equilibrium with another system is ————.

2. In an otto engine, greater the compression produced before ignition, the ———— is the efficiency of the engine. (higher/smaller)

3. The change of entropy in a completely reversible thermodynamic cycle is ————.

4. Is there any change in internal energy of a perfect gas during an isothermal change in volume ?

5. Is it possible for two photons to occupy the same quantum state ?

Questions 6 to 10. Write True or False.

6. Heat is a path function.

7. An infinitely slow adiabatic expansion is not a reversible process.

8. Entropy change can never be negative.

9. Classical particles obey Maxwell-Boltzmann statistics.

10. The emissivity of a substance depends on its temperature.

(10 × 1 = 10 marks)

Section B

(Answer in two or three sentences)

Answer all questions.

Each question carries 2 marks.

11. Define a thermodynamic system ? Give an example.

12. Distinguish between extensive and intensive variables.

Turn over

13. What do you mean by a quasistatic process ? How can you realize a quasistatic process ?

14. Distinguish between isobaric and isochoric processes.

15. Explain Clausius inequality.

16. Draw the entropy versus temperature curve of first and second order phase transitions.

17. Discuss the equipartition theorem.

$(7 \times 2 = 14 \text{ marks})$

Section C

(Answer in a paragraph of about half a page to **one page***)*
Answer any **five** *questions ; each question carries 4 marks*

18. What are the features of a cyclic process ?

19. Show that the slope of an adiabatic is γ times that of an isothermal.

20. What are internal combustion engines ? Discuss the different classes.

21. What is the third law of thermodynamics ? Explain its outcome.

22. Show that the Joule-Kelvin co-efficient for a perfect gas is zero.

23. Compare the properties of fermions and bosons.

24. What do you mean by Fermi energy ? Write down an expression for the same.

$(5 \times 4 = 20 \text{ marks})$

Section D

(Problems-write all relevant formulas, all important steps carry separate marks)
Answer any **four** *questions; each question carries 4 marks.*

25. A quantity of dry air at 300 K is compressed suddenly to one third of its volume. Determine the change in temperature. Given, $\gamma = 1.4$.

26. 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 ?

27. One mole of oxygen gas expands isothermally to four times of its initial volume. Determine the change in entropy. Given, the gas constant R = 8.314 J/mol/K.

28. Explain the working principle of a refrigerator.

29. Show that the different statements of the second of thermodynamics are equivalent to each other.

30. Calculate the rms velocity of hydrogen gas at 27°C.

31. Consider a system of two fermions 1 and 2 with two possible states a and b. Write down the expression for the wave function of the system. Prove that for this system, the presence of a particle in a certain state prevents any other particles from being in that state.

(4 × 4 = 16 marks)

Section E

*(Essays-answer in about **two pages**)*

*Answer any **two** questions ; each question carries 10 marks.*

32. Using an indicator diagram, obtain expressions for work done during an isothermal and adiabatic processes.

33. Discuss the otto cycle and obtain an expression for the efficiency.

34. What are the basic thermodynamic potentials ? Obtain Maxwell's thermodynamic relations from the thermodynamic potentials.

35. Explain briefly the :

    (i) Planck's radiation law ;

    (ii) Wien's displacement law ; and

    (iii) Stefan-Boltzmann law.

(2 × 10 = 20 marks)