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(Pages: 3)

Name:

Reg. No.....

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, APRIL 2020

(CUCBCSS-UG)

(Regular/Supplementary/Improvement)

CC15U PH6 B10 - THERMAL AND STATISTICAL PHYSICS

Physics - Core Course

(2015 Admission onwards)

Time: Three Hours

Maximum: 80 Marks

Section A

(Answer in a word or phrase)

Answer *all* questions. Each question carries 1 mark.

1. The amount of work done in an isochoric process is
2. In an adiabatic process, the change in enthalpy of the system is given by
3. Internal energy is a.....function (path/state)
4. For the same change in volume, the work done by a thermodynamic system is minimum forprocess
5. The efficiency of a heat engine working between reservoirs at temperature 600K and 300K is.....
6.of a system is a measure of the unavailability of energy from it.
7. Electrons obeystatistics
8. Entropy of the universe can reach a maximum value. This statement is..... (True/False).
9. The first law of thermodynamics is law of conservation of
10. For a perfect black body, emissivity is.....

(10 × 1 = 10 Marks)

Section B

(Answer in two or three sentences)

Answer *all* questions. Each question carries 2 marks.

11. What is meant by a cyclic process?
12. State and explain second law of thermodynamics.
13. Explain principle of increase of entropy.
14. State and explain Equipartition theorem.
15. Explain Planck's radiation law.
16. What is meant by coefficient of performance of a refrigerator?
17. What are the limitations of the first law of thermodynamics?

(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. Derive the relation connecting pressure (P), volume (V) and temperature (T) in an adiabatic process.
19. State and explain Carnot's theorem.
20. Show that the slope of an adiabatic curve is ' γ ' times slope of isothermal curve.
21. Starting from Maxwell's relation, arrive at Clausius- Clapeyron equation.
22. Discuss the change in entropy of a perfect gas during free expansion.
23. What is meant by phase change? What are the characteristics of a first order phase change?
24. Discuss the effect of pressure on boiling point of a liquid. How is this used in pressure cookers?

(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 gas filled in a container at a pressure 10^5 Pascal and temperature 273K is isothermally compressed to half its original volume by applying pressure. Calculate the final pressure and the work done. $R = 8.3\text{J mole}^{-1}\text{K}^{-1}$
26. A Carnot engine with cold body at 0°C has an efficiency of 90%. By how much should the temperature of the hot body (27°C) be increased to increase the efficiency by 2%?
27. When lead with melting point 600K is melted at atmospheric pressure, the density decreases from 11010 to 10650 and the latent heat of fusion is 24500J/Kg. What will be the melting point at a pressure of 100 atmosphere?
28. Calculate the change in entropy when 5Kg of ice is completely converted to water at its melting point 273K. Latent heat of ice = 335×10^3 J/Kg.
29. An ideal refrigerator takes heat from water at 0°C and rejects it to a room at temperature 27°C . If 1Kg of water at 0°C is to be changed into ice at 0°C , how many calories of heat are rejected to the room?
30. Obtain the probability of distribution of 10 molecules in 16 energy levels in such a way that one molecule is in one energy level.

(2)

17U606

31. Obtain the value of Stephan's constant (σ) if the temperature of the filament of a 40W lamp is 2443K and the effective area of the filament is $0.66 \times 10^{-4} \text{ m}^2$. The relative emittance of the filament is 0.31. Radiation from glass envelope may be neglected.

(4 × 4 = 16 Marks)

Section E

(Essays-answer in about two pages)

Answer any **two** questions. Each question carries 10 marks.

32. What is a T-S diagram? Discuss the T-S diagram for a Carnot cycle and prove that for a given temperature of the sink, the unavailable energy is proportional to the gain in entropy.
33. Discuss the Otto cycle with a neat PV diagram and obtain an expression for its efficiency.
34. Obtain Maxwell's thermodynamic relations starting from thermodynamic potentials.
35. a) What do you mean by 'distribution function'? Explain Maxwell-Boltzmann distribution function
b) With the help of Maxwell-Boltzmann statistics, discuss the distribution of molecular speeds in an ideal gas.

(2 × 10 = 20 Marks)

(3)