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Roll No. | | | | | | | | | | |

S. No. of Question Paper : 2750

Unique Paper Code : 32225415 GC-4

Name of the Paper : Thermal Physics and Statistical Physics

Name of the Course : Generic Elective : Physics

Semester : IV

Duration : 3 Hours Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any *five* questions.

Question No. 1 is compulsory.

All questions carry equal marks.

1. Attempt any *five* of the following : 5×3=15

(*a*) A reversible engine works between two temperatures whose difference is 100°C. If it absorbs 746 J from the source and gives 546 K to the sink, calculate the temperature of the source and sink.

P.T.O.

(*b*) Calculate the change in entropy when 1 gram atom solid mercury at its melting point is raised to a temperature of 40°C. Given for mercury, melting point = –39°C, latent heat of fusion = 3 cal/gm, mean specific heat = 0.0335 cal/gm-K and one gram atom of mercury = 200 gm.

(*c*) A motor car tyre has a pressure of 2 atm at a room temperature of 27°C. If the tyre suddenly bursts, find the final temperature considering the process to be adiabatic.

(*d*) Arrange the root mean square speeds of H, He. H_2O molecules in ascending order at room temperature and for He molecule, arrange the root mean square velocity, most probable velocity and average velocity in ascending order at room temperature.

(*e*) Is "glass of hot milk" an isolated system ? Justify your answer.

(*f*) Consider that a system consisting of N number of molecules initially in a volume V and at temperature T, pressure P is disintegrated into two systems. Which of all the system properties will change and which will remain unchanged ?

(*g*) Define entropy and then relate it to second law of thermodynamics.

2. (*a*) Using the first law of thermodynamics, establish :

$$C_P - C_V = R\left[1 + \frac{2a}{RTV} + \ldots\ldots\right]$$

for a van der Waals' gas, where the symbols have their usual meaning. 9

(*b*) Compute the work done by a perfect gas for a quasi-static adiabatic expansion. 6

3. (*a*) Show the equivalence of Kelvin Planck and Clausius statements for second law of thermodynamics. 8

(*b*) Verify Carnot theorem. Is the refrigerator at home a Carnot engine ? 7

4. (*a*) Establish the Maxwell's relations of thermodynamics. 8

(*b*) Using Maxwell's relation, derive Clausius Clapeyron equation and inter-pret the results. 4,3

5. (*a*) What do you understand by transport phenomena in gases. Verify that $\kappa = \eta C_v$, where κ is conductivity and η represents viscosity. 3,6

(*b*) Derive Maxwell's velocity distribution law in terms of energy of the molecules. 6

P.T.O.

6. (*a*) Explain the spectral distribution of Black Body radiation with proper graphical representation. 6

(*b*) Derive Planck's law of radiation and hence derive Rayleigh Jean's law and Wein's law from it. 9

7. (*a*) Obtain the expression for thermodynamic probability and the most probable distribution function for a system obeying Fermi-Dirac statistics. 10

(*b*) Find the number of microstates for a system of two particles and three quantum states if the system obeys M-B, B-E and F-D statistics. 5