This question paper contains 4 printed pages]

Your Roll No.....

5192B

B.Sc. (Prog.) PHYSICAL SCIENCES/II Sem. B

Paper—PHPT-202 : Thermal Physics

Time : 3 *Hours* *Maximum Marks* : 75

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

Attempt *five* questions in all including

Q. No. 1 which is compulsory.

Note : Use of non-programmable scientific calculator is allowed.

1. Attempt any *five* of the following :

   (*a*) State zeroth law of thermodynamics and show how this law gives the concept of temperature.

   (*b*) Write the differential form of First Law of Thermodynamics explaining various terms used in this law. What is the significance and limitation of this law ?

   (*c*) Show that for an ideal gas :

   $$C_P - C_V = R.$$

   (*d*) Derive an expression for the work done by an ideal gas during an adiabatic expansion.

P.T.O.

(*e*) What are reversible and irreversible processes ? Give conditions of reversibility of a process.

(*f*) If two black bodies have their peak radiations corresponding to violet and red respectively, which of the two is at a higher temperature. Explain using relevant expressions.

(*g*) Calculate the mean free path of a gas molecule whose diameter is 2Å and number of molecules per unit volume is 3×10^{25} m^{-3}.

(*h*) Write down the expression for coefficient of viscosity of a gas. How does it depend on :

(*i*) Pressure and

(*ii*) Temperature of the gas ? 3×5=15

2. (*a*) State Kelvin-Planck and Clausius statements of second law of thermodynamics.

(*b*) State and prove Carnot's theorem.

(*c*) A Carnot engine is made to work between 0°C and – 200°C. Calculate its efficiency. 4,8,3

3. (*a*) What is entropy ? Show that the change in entropy for a cyclic reversible process is zero.

(*b*) Draw T-S diagram of a Carnot cycle. What is the use of T-S diagram ?

(*c*) What is the change in entropy when m gm of ice at 0°C is converted into steam at 100°C ?

(*d*) One mole of an ideal gas expands isothermally to four times its initial volume. Calculate the entropy change in terms of R, the gas constant. 5,3,4,3

4. (*a*) What are the thermodynamic potentials ? Using them derive Maxwell's thermodynamical relations.

(*b*) Prove that :

$$C_P - C_V = (TV\alpha^2)/\beta$$

where symbols have their usual meanings. 8,7

5. (*a*) What is Joule-Thomson effect ? Show that enthalpy remains constant during Joule-Thomson experiment.

(*b*) Obtain the expressions for Joule-Thomson coefficient for :

(*i*) An ideal gas

(*ii*) Real gas. 6,9

6. (*a*) Derive Planck's law of black-body radiation.

(*b*) Using this law derive Wien's radiation formula and Rayleigh-Jeans law. 9,6

7. Derive Maxwell-Boltzmann's distribution law of molecular velocities and give its experimental verification. 12,3

8. (*a*) Apply kinetic theory of gases to obtain coefficient of thermal conductivity (K) of a gas and hence show that :

$$\frac{KM}{\eta C_V} = 1$$

symbols have their usual meanings.

(*b*) State law of equipartition of energy and apply it to study the specific heat of gases. 8,7