2016

PHYSICS

(Major)

Paper : 2.2

Full Marks : 60

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Answer the following questions : 1×7=7

(a) At what temperature in centigrade scale, the platinum scale temperature coincides with centigrade scale?

(b) What is the value of $\int_0^\infty F\,dc$, where F = Maxwell's velocity distribution function and integration is taken w.r.t. c, for all possible velocities of gas molecules?

(c) Which physical quantity remains constant during an adiabatic process?

(d) What is triple point?

(e) State Carnot's theorem of heat engine.

(f) What is Brownian motion?

(g) Why are two specific heats defined for gases?

2. Answer the following questions : 2×6=12

(a) Calculate the value of R using the relation $PV = RT$.

(b) Using Maxwell's velocity distribution law, deduce the expression of root-mean-square velocity of gas molecules of an ideal gas.

(c) Calculate the work done during isothermal expansion from volume V_1 to V_2 of a van der Waals' gas.

(d) From Planck's law of radiation, deduce Rayleigh-Jeans law.

(e) The specific volumes of water and steam at 100 °C and 760 mm of Hg pressure are 1 cc/gm and 1601 cc/gm respectively and $L = 536$ cal/gm. Calculate the change in the boiling point of water due to a pressure change of 1 cm Hg.

(f) Write four defects of van der Waals' equation of state.

3. Answer any *four* of the following : 5×4=20

(a) Derive an expression of pressure of ideal gas using kinetic theory of gases. 5

(b) A cylindrical tube of radii 1 cm and 4 cm has temperatures θ_1 and θ_2 at the inner and outer surfaces respectively. Find at what distance from the axis, the temperature will be $\frac{\theta_1 + \theta_2}{2}$. 5

(c) Explain the meaning of entropy. One mole of perfect gas is changed from P_1, V_1, T_1 to P_2, V_2, T_2. Show that the change in entropy

$$\Delta S = C_V \log_e \frac{P_2}{P_1} + C_P \log_e \frac{V_2}{V_1}$$ 1+4

(d) Write the four Maxwell's equations in thermodynamics. Using these equations, prove

$$C_P - C_V = T\left(\frac{dP}{dT}\right)_V \left(\frac{dV}{dT}\right)_P$$ 2+3

(e) Derive Wien's radiation law. 5

4. Answer any *three* of the following : 7×3=21

(a) Derive the expression of mean free path using Maxwell's velocity distribution law. 7

(b) Deduce the general equation of transport phenomena. From this equation, derive the expression of coefficient of viscosity. 5+2

(c) Describe Andrews' experiment. What are the inferences drawn from this experimental results? 4+3

(d) State the first law of thermodynamics. Write its limitations. Explain how from efficiency of Carnot's engine the second law of thermodynamics can be derived and how it explains the limitation of first law. Also, explain the second law in terms of entropy. 1+2+2+1+1

(e) How do you account theoretically for pressure of radiation? Give a method to determine it experimentally. 4+3

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