WEST BENGAL STATE UNIVERSITY

B.Sc. Honours Part-I Examination, 2020

PHYSICS

PAPER-PHSA-IIA

Time Allotted: 2 Hours | Full Marks: 50

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

Question No. 1 is compulsory. Answer any *two* other questions from the rest

1. Answer any ***ten*** questions from the following: 3×10 = 30

(a) The velocities of twenty molecules are 1, 1, 2, 3, 3, 3, 4, 5, 5, 5, 5, 5, 5, 6, 6, 7, 7, 8, 8 and 9 unit. Find average, R.M.S. and most probable velocities of the molecules.

(b) Find out the ratio of molar specific heats, C_P/C_V, for a diatomic gas.

(c) Show that the probability to traverse a distance x without suffering any collision by a molecule is $e^{-x/\lambda}$.

(d) What is the physical quantity that is transported in diffusion process? Define the diffusion co-efficient.What is the dimension of diffusion coefficient?

(e) Define the critical volume, critical temperature and critical pressure of a gas.

(f) Find the Boyle temperature of a Van der Waals gas.

(g) What is inversion temperature related with Joule-Thomson effect? State the difference between inversion temperature and Boyle temperature.

(h) What is meant by quasi-static process? Is a quasi-static process always reversible?

(i) What is meant by 'state function'? What is free energy?

(j) Show that the work, W, done on expansion of a mole of an ideal gas is not exact differential, but $\frac{dW}{T}$ is an exact differential.

(k) State Gibbs' phase rule. What is triple point?

(l) What are the differences between first order and second order phase transitions?

(m) What is Joule-Thomson coefficient? Show that Joule-Thomson coefficient is zero in case of an ideal gas.

(n) What is the difference between vapour and gas?

(o) Define emissive power and absorptive power of a body.

(p) Derive Newton's law of cooling from Stefan's law of radiation.

2. (a) Write the mathematical expression of Maxwell's speed distribution law and calculate the most probable speed. 1+3

   (b) Show that if the most probable speed is taken as the unit of speed for gas molecules, then the speed distribution becomes independent of temperature. 2

   (c) What do you mean by mean free path of a gas molecule? Show that the expression of free path is $\frac{1}{\pi n^2}$, when all the molecules, except the one under consideration, are at rest. 1+3

3. (a) Write down Van der Waals' equation for *n* mole of a real gas and then obtain the expression of reduced equation of state. State the law of corresponding states. 1+3+1

   (b) State and prove Kirchhoff's law of thermal radiation. 1+4

4. (a) The internal energy of a thermodynamic system is given by $U = AP^2V$, A being a positive constant of dimension $[P]^{-1}$. Prove that the equation of adiabats in $P-V$ plane is given by $V(AP+1)^2 = B$, where B is a constant. 3

   (b) Prove that for working between the same temperature limits, all reversible engines are equally efficient. 4

   (c) A reversible engine converts one-sixth of heat input in work. When the temperature of the sink is reduced by 335 K, the efficiency is doubled. Find the temperature of the source and sink. 3

5. (a) What do you understand by absolute or thermodynamic scale of temperature? Show that this scale may be identical to the ideal gas temperature scale. 1+3

   (b) 10 gm of steam at 100°C are blown on the surface of 90 gm water at 0°C, contained in a calorimeter of water equivalent 10 gm, all the steam being condensed. Calculate the increase in entropy of the system. 3

   (c) Prove that, $U = -T^2\left[\frac{\partial}{\partial T}\left(\frac{F}{T}\right)\right]_V$. 3

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within 1 hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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