

U.G. 3rd Semester Examination - 2021**PHYSICS****Course Code : BPHSCCHC302****Course Title : Thermal Physics**

Full Marks : 30

Time : 2 Hours

*The figures in the right-hand margin indicate marks.**Candidates are required to give their answers in their own words as far as practicable.*

The symbols have their usual meaning.

1. Answer any **ten** questions: $1 \times 10 = 10$

- a) Explain the term:
 - (i) Isochoric process
 - (ii) Isobaric process
- b) What should be the efficiency of Carnot engine working between steam point and ice point?
- c) What is meant by adiabatic demagnetization?
- d) Distinguish between the first order and second order phase transitions.
- e) Find out the temperature of which the r.m.s. velocity of a gas will be $\frac{1}{4}$ of its value at 0°C .

- f) Explain the reasons for modification of perfect gas equation.
- g) What do you understand by Virial coefficients?
- h) In porous plug experiment obtain conditions for heating and cooling of a gas.
- i) Draw a Carnot cycle on T-S diagram.
- j) Plot distribution curve of molecular speed at different temperatures.
- k) Define "Triple Point" and draw the phase diagram of water.
- l) Derive the energy equation

$$\left(\frac{\partial u}{\partial v}\right)_T = \left(\frac{\partial P}{\partial T}\right)_v - P$$

- m) Find the mean free path of gas molecules having diameter of ZA° and number density of molecules is $3 \times 10^{19} \text{cm}^{-3}$.
- n) What is inversion temperature?
- o) Write down the relation between co-efficient of viscosity and mean free path.

2. Answer any **five** questions: $2 \times 5 = 10$

a) What is the principle used in the working of refrigerator? Define coefficient of performance.

b) Establish the following relations :

$$i) \quad Tds = C_v dT + T \left(\frac{\partial P}{\partial T} \right)_v dv$$

$$ii) \quad C_p - C_v = -T \left(\frac{\partial v}{\partial T} \right)_p^2 \left(\frac{\partial P}{\partial v} \right)_T$$

c) Explain the effect of temperature and pressure on coefficient of viscosity.

d) Write down van der Waals equation and give a qualitative explanation of the correction terms.

e) Derive Clausius-Clapeyron equation of latent heat.

f) Using the Maxwell's law of distribution of molecular speed, derive expression for most probable speed.

g) Prove that

$$C_p - C_v = T \left(\frac{\partial P}{\partial T} \right)_v \left(\frac{\partial v}{\partial T} \right)_p$$

h) Show that adiabatics are ' γ ' times steeper than isothermals passing through the same point on a PV diagram.

3. Answer any **two** questions: $5 \times 2 = 10$

a) Deduce expressions for most probable speed and mean speed in case of two-dimensional ideal gas. $2\frac{1}{2} + 2\frac{1}{2}$

b) Define four thermodynamic potentials. Using these potentials derive the four Maxwell's thermodynamic relations. $2+3$

c) i) An ideal gas for which $C_v = \frac{3R}{2}$ is the working substance of a Carnot engine. During the isothermal expansion the volume is doubled. The ratio of the final volume to the initial volume in the adiabatic expansion is 5.7. The work output of the engine is 9×10^5 J in each cycle. Estimate the temperature of the reservoirs between which the engine operates.

ii) Define co-efficient of performance of a refrigerator. $3+2$
