

**CARMEL COLLEGE OF ARTS, SCIENCE & COMMERCE FOR WOMEN,
NUVEM-GOA
SEMESTER END EXAMINATION, JUNE 2022**

Semester: II

Subject: Physics

Course Name: Section 1: Heat & Thermodynamics

Course Code: PYC 102

Section 2: Properties of Matter & Acoustics

Total Marks: 80 **Date:** 10/06/2022 **Duration:** 2 Hours **Total Number of Pages:** 03

Instructions:

- 1) Answer Section-1 and Section-2 on separate answer book.*
- 2) All questions are compulsory, however internal choice is available.*
- 3) Figures to the right indicate maximum marks to the question.*
- 4) Symbols have their usual meanings unless otherwise stated.*
- 5) Draw neat diagram wherever necessary.*
- 6) Use of non-programmable calculator is permitted.*

Section -1

Q1. Answer **any FOUR** of the following questions.

(4x4=16)

- (A) Calculate the root mean square velocity of hydrogen molecule at 27°C. Given $k=1.38 \times 10^{-23} \text{ joule/}^\circ\text{C}$, mass of hydrogen molecule is $3.34 \times 10^{-27} \text{ kg}$.
- (B) Obtain the expression for the pressure of a gas.
- (C) Draw the Andrews curves for CO_2 gas. Give two characteristics of these curves.
- (D) Show that work is a path dependent entity.
- (E) Give two points of differences between an isothermal and adiabatic processes.
0.2 kg of carbon dioxide is enclosed and isothermally expanded to 5 times its initial volume at 27°C. Calculate the work done. Given $R=8.37 \text{ J/K-mol}$.
- (F) How was the correction to the ideal gas equation for the volume term obtained by Van-der-Waal? Explain.

Q2. (A)

- (p) State the law of corresponding states. What is the advantage of using the reduced gas equation?

(3)

- (q) What is meant by mean free path? Calculate the diameter of gas molecules on the basis Maxwell's formula. Given mean free path = 100 \AA , $n = 2.5 \times 10^{25} \text{ molecules/m}^3$. (3)

OR

- (x) Obtain the relation between Boyle temperature and critical temperature. (3)
- (y) State the law of corresponding states. What is the advantage of using the reduced gas equation? (3)

Q.2 B. Obtain the expression for coefficient of viscosity in transport phenomena. (6)

Q.3.A

- (p) Write a short note on thermodynamic temperature scale. (3)
- (q) A Carnot engine takes in heat from a source at a temperature of 327°C and rejects it to the surroundings at 27°C respectively. Calculate the heat rejected to the sink, when each cycle absorbs 10 Kcalories. (3)

OR

- (x) What is meant by a thermodynamic equilibrium? Explain. (3)
- (y) Show that the entropy of irreversible processes always increases. (3)

Q.3 B. Obtain the expression for efficiency of Carnot engine. (6)

Section – 2

Q4. Answer **any FOUR** of the following questions. (4x4=16)

- (A) Define elasticity, stress, strain and modulus of elasticity.
- (B) Show that Torsional Pendulum undergoes simple harmonic motion.
- (C) A copper rod of cross-sectional area 0.5 cm^2 and length 1m is elongated by $2 \times 10^{-2} \text{ mm}$, and a steel rod of the same cross-sectional area but 0.1m in length is elongated by $2 \times 10^{-3} \text{ mm}$. Which rod has greater longitudinal strain?
- (D) Calculate the excess pressure inside and outside of soap bubble of radius 1cm. Surface tension of soap is $3.2 \times 10^{-2} \text{ N/m}$.

- (E) Calculate the mass of water flowing in 10 minutes through a tube 0.1cm in diameter, 40cm long if there is constant pressure head of 20cm of water. The coefficient of viscosity is 0.0089 Poise.
- (F) Derive the equation of motion for a harmonic oscillator.
- (G) Assuming the movement of air to be an isothermal process, get an expression for speed of sound in air. Also, find it's value at N.T.P. ($\rho=1.3\text{kg/m}^3$).

Q5.(A)

- (p) Define Poisson's ratio. What are the limiting values of Poisson's ratio? (3)
- (q) What is streamline and turbulent flow? Is Poiseuille's equation valid for both the flows? Explain. (3)

OR

- (x) A rectangular bar is 1m in length, 2m in breadth and 1 cm in depth. It is supported at it's ends and a load of 2kg is applied at it's mid point. Find the depression at the mid-point if $Y = 20 \times 10^{10} \text{ N/m}^2$. (3)
- (y) Is it easier to spray soapy water than pure water? Explain. (3)
- (B) Derive an expression for couple per unit twist required to twist a cylinder which is fixed at one end. (6)

Q6.(A)

- (p) A long piece of piano wire of a mass of $3.9 \times 10^{-3} \text{ kg}$ per meter is under a tension of $1 \times 10^3 \text{ N}$. What is the speed of transverse waves on this wire? (3)
- (q) A steel rod of length 50 cm, width 2 cm and thickness 1 cm is bent into the form of an arc of radius of curvature 2m. Calculate the bending moment. $Y_{\text{steel}} = 2 \times 10^{11} \text{ N/m}^2$. (3)

OR

- (x) Comment on superposition of two waves and phenomena of beats? (3)
- (y) The fundamental mode of the G string of a violin has a frequency of 196 Hz. What are the frequencies of the first, second and third overtones? (3)
- (B) Explain the phenomenon of surface tension on the basis of molecular theory. (6)
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