

CARMEL COLLEGE OF ARTS, SCIENCE AND COMMERCE FOR WOMEN
SEMESTER END EXAMINATION, April / June 2019
Semester II of B. Sc. Subject: Physics Subject code: PYC 102

Section I: Heat and Thermodynamics

Section II: Properties of matter and Acoustics

Total Marks : 80

Date: 17-04-2019

Duration 2 Hours

Instructions: 1. Answer Section I and Section II Separately

2. All questions are compulsory, however internal choice is available.

3. Figures to the right indicate maximum marks to the question/sub question.

4. Use of non-programmable calculator is permitted.

5. Symbols have their usual meaning unless specified. Draw neat diagrams wherever necessary.

Section I: Heat and Thermodynamics

Q 1.

2x5=10

- a) What is meant by transport phenomenon? Name one.
- b) What is meant by thermodynamic equilibrium?
- c) What is meant by coefficient of performance in refrigeration?
- d) Give two assumptions of Kinetic theory of gases
- e) Give two points of difference between an adiabatic and isothermal processes.
- f) A gas at 1atmosphere pressure expands adiabatically until its volume is doubled. Determine the new pressure if the value of $\gamma=1.4$.
- g) Calculate the mean free path of gas molecules using Clausius formula. Given: Diameter of gas molecule $\sigma = 3\text{\AA}$, number of molecules per unit volume $n = 2.7 \times 10^{25}$.

Q 2.

A. a) Derive Clausius expression for mean free path(λ) of a molecule. **3**

b) Calculate average kinetic energy of oxygen at a temperature of 300°K . Given: $k=1.38 \times 10^{-16}$ ergs/molecule **2**

OR

B. a) What do you mean by degrees of freedom of a dynamical system? How is this related to total energy associated with one gram molecule of a gas, and hence to specific heats of gases. **3**

b) Calculate the root mean square velocity of hydrogen molecule at 37°C . Given $k=1.38 \times 10^{-23}$ joule/ $^\circ\text{C}$ mass of hydrogen molecule is 3.34×10^{-27} kg. **2**

C. Obtain the expression for coefficient of thermal conductivity in transport phenomenon. **5**

Q 3.

- A. a) Draw the diagram of the apparatus used to study Andrew's experiment on carbon dioxide gas. Draw Andrew's curves. 3
- b) A mass of air at 27°C is compressed suddenly to $1/2$ of its original volume. Calculate the change of temperature in each case given $\gamma=1.4$. 2

OR

- B. a) Give Van-der-Waal's correction to volume term only, for a real gas. 3
- b) Determine the critical temperature of Helium from the following data:
 $a=3.44 \times 10^3 \text{ Jm}^3/(\text{kmole})^2$, $b=0.0234 \text{ m}^3/\text{kmole}$, $R=8.31 \text{ J/mole}^{\circ}\text{K}$. 2
- C Show that for an adiabatic process change in a perfect gas is $PV^{\gamma}=\text{constant}$. 5

Q 4.

- A. a) Prove that the entropy of all irreversible processes always increases. 3
- b) A Carnot engine is operated between 150°C and 20°C . Calculate its efficiency. 2

OR

- B. a) What is meant by efficiency of engine? Arrive at the efficiency of Carnot's reversible engine. 3
- b) Briefly discuss the Thermodynamic scale of temperature. 2
- C. Derive the expression for the efficiency of a Carnot engine 5

Section II: Properties of matter and Acoustics

Q 5. Answer any five of the following.

2x5=10

- a) Define Young's modulus and Rigidity modulus.
- b) What do you mean by critical load for pillars and columns?
- c) Water near the bed of a deep river is quiet and near the surface there is a flow. Give reason.
- d) What is the difference between streamline flow and turbulent flow?
- e) What is Doppler effect?
- f) Explain briefly one method of detecting ultrasonic waves.
- g) Define reverberation time with reference to the design of an auditorium for good acoustics.

Q 6.

- A. Calculate the force required to stretch a steel wire 1 cm^2 in cross section to double its length. Y for steel $= 2 \times 10^{11} \text{ N/m}^2$. 4

OR

- B. A metal wire of length 3 meters and diameter 1 mm is stretched by a weight of 10 kg. If Young's modulus of the material is $12 \times 10^{11} \text{ dynes/cm}^2$ and Poisson's ratio $\sigma = 0.26$. Calculate lateral compression produced. 4

- C. Derive an expression for couple per unit twist for a cylindrical rod clamped at one end and twisted at the other end. 6

Q 7.

- A. Define absorption coefficient with reference to the design of an auditorium for good acoustics.

The volume of a hall is 50,000 cu ft and its total absorption equals 1500 sabines. of an open window. Entry of people in the hall raises the absorption by 3000 sabines. Determine the change in reverberation time. 4

OR

- B. A flat metal plate 100 cm^2 in area rests on a layer of castor oil 2 mm thick and viscosity 15 poise. calculate the horizontal force required to move the plate with a speed of 3cm/s. 4

- C. What is capillarity? Derive an expression rise of liquid in a capillary tube. 6

Q 8.

- A. What are ultrasonic waves? Describe any one method of generating the same. 4

OR

- B. Discuss the case of Doppler Effect when a source of sound crosses a stationary listener. 4

- C. Derive an expression for velocity of longitudinal waves in fluids. 6
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