

Q.P. Code : 11121

**First Semester B.Sc. Degree Examination,
November/December 2019**

(Semester Scheme – CBCS – Freshers & Repeaters – 2018–2019 and onwards)

Physics

Paper I – MECHANICS – 1, HEAT AND THERMODYNAMICS – 1

Time : 3 Hours]

[Max. Marks : 70

Instructions to Candidates :

- 1) Answer **any five** questions from each Part.
- 2) Use of non-programmable scientific calculations/mathematical tables are allowed.

PART – A

Answer any **FIVE** questions. Each question carries **8** marks : **(5 × 8 = 40)**

1. (a) Define terminal velocity of a body moving in a resistive medium.
(b) Assuming the resistive force to be proportional to the velocity, obtain an expression for the velocity of a particle moving in a resistive medium under gravity. **(2 + 6)**
2. (a) Define the terms “Kinetic friction” and “angle of repose”.
(b) Derive an expression for radial and transverse component of velocity of a particle moving along a curve in a plane using polar coordinates. **(2 + 6)**
3. (a) State and explain Work-Energy theorem.
(b) Obtain an expression for linear momentum of a system of particles. **(3 + 5)**
4. (a) Explain with graph, the distribution of energy in Blackbody spectrum.
(b) State and explain :
 - (i) Wien’s displacement law and
 - (ii) Kirchhoff’s law of radiation. **(4 + 4)**
5. (a) Write any two assumptions of kinetic theory of gases.
(b) Describe with a diagram Andrew’s experiments on carbon dioxide. **(2 + 6)**

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6. (a) Derive an expression for the coefficient of viscosity of a gas on the basis of kinetic theory of gases. (7 + 1)
- (b) Write Van der Waal's equation of state for a real gas.
7. (a) State and explain first law of thermodynamics. (2 + 6)
- (b) Show that $PV^\gamma = \text{constant}$, with usual notation.
8. (a) Explain the PV - diagram for Carnot cycle and hence obtain an expression for the net work done.
- (b) Show that, the total change in entropy in a reversible process is always zero. (5 + 3)

PART - B

Solve any **FIVE** of the following problems. Each problem carries **4** marks :
(5 × 4 = 20)

9. Two masses 6 kg and 12 kg are connected at the two ends of a light inextensible string that goes over a frictionless pulley. Find the acceleration of the masses when masses are released.
10. An artificial satellite is moving in a circular orbit around the earth with a speed equal to half the magnitude of escape velocity from the earth. Calculate the height above the surface of earth at which satellite is moving. Radius of the earth = 6400 km and $g = 9.8 \text{ ms}^{-2}$.
11. A force of 4.8 N is applied to a block attached to the free end of a spring to keep the spring stretched from its relaxed length by 12 mm.
- (a) What is the spring constant of spring?
- (b) What force does the spring exert on the block if the spring is stretched by 16 mm?
12. Two bodies of masses 10 kg and 2 kg are moving with velocities $(2\hat{i} - 7\hat{j} + 3\hat{k})$ and $(-10\hat{i} - 35\hat{j} - 3\hat{k})$ respectively. Find the velocity of centre of mass.
13. Calculate the average kinetic energy of a molecule at 27°C and Avogadro number, given Boltzmann constant $K = 1.38 \times 10^{-23} \text{ Jk}^{-1}$ and gas constant $R = 8.31 \text{ Jk}^{-1} \text{ mole}^{-1}$.
14. If the Van der Waals' constant for carbon dioxide are $a = 1.32 \times 10^4 \text{ Nm}^4 \text{ mole}^{-2}$ and $b = 3.64 \times 10^{-5} \text{ m}^3 \text{ mole}^{-1}$. Calculate its critical pressure and critical volume.

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15. A refrigerator takes heat from water at 0°C and rejects heat at room temperature at 27°C . Find the amount of work to be done to convert 100 kg of water at 0°C to an equal amount of ice at 0°C . Given specific latent heat of ice = $333 \times 10^3 \text{ J kg}^{-1}$.
16. What is the entropy change of 0.20 kg of block of copper when its temperature is increased from 10°C to 20°C ? Given specific heat of copper = $388 \text{ J kg}^{-1} \text{ K}^{-1}$.

PART - C

Answer any **FIVE** of the following. Each question carries 2 marks : **(5 × 2 = 10)**

17. (a) Action and reaction are equal and opposite. Will they cancel each other? Explain.
- (b) Is frictional force a "self adjusting force"? Explain.
- (c) Is the force exerted by a spring, conservative or non-conservative force? Explain.
- (d) Can a body have energy without momentum? Explain.
- (e) Given sample of 1 cm^3 hydrogen and 1 cm^3 of oxygen both are at NTP. Does the number of molecule differ? Explain.
- (f) Does the coefficient of viscosity of gas depend on its pressure? Explain.
- (g) Does adiabatic expansion produce cooling? Explain.
- (h) Can a heat engine have 100% efficiency? Explain.