61121

First Semester B.Sc. Degree Examination, December 2018

(CBCS Scheme – Freshers – 2016-17 and onwards)

Physics

Paper 101 – MECHANICS – 1, HEAT AND THERMODYNAMICS – 1

Time : 3 Hours]   [Max. Marks : 70

Instructions to Candidates : Answer any five questions from each Part.

PART – A

Answer any **FIVE** of the following questions. Each question carries **8** marks :

(5 × 8 = 40)

1. (a) State and explain Newton's second law of motion.

    (b) Derive an expression for the velocity of a body moving through a resistive medium at low speed under gravity.   (3 + 5)

2. (a) State Kepler's laws of planetary motion.

    (b) Define orbital velocity and derive an expression for the same.   (3 + 5)

3. (a) Obtain an expression for the potential energy of a spring when it is stretched through a distance from its equilibrium position.

    (b) What are conservative and non-conservative forces? Give an example for each.   (4 + 4)

4. (a) State and explain Kirchoff's law of Radiation.

    (b) Derive Wien's law and Rayleigh-Jean's law from Planck's law.   (2 + 6)

5. (a) Write any four assumptions of kinetic theory of gases.

    (b) Deduce the perfect gas equation from Kinetic theory of gases.   (4 + 4)

6. Describe Andrew's experiment on the isothermals of CO_2 and discuss its results.
                                                                                (8)

7. (a) State and explain First law of Thermodynamics. What is its significance?

    (b) Derive an expression for work done by a gas during an adiabatic process.

    (4 + 4)

8. (a) What are reversible and irreversible processes?

    (b) Obtain an expression for the change in entropy of a gas in terms of volume and temperature.

    (2 + 6)

PART – B

Solve any **FIVE** of the following problems. Each problem carries **4** marks :

(5 × 4 = 20)

9. A block of wood of mass 2 kg resting on a horizontal table is connected by a horizontal table is connected by a horizontal string passing over a smooth fixed pulley to a mass of 0.5 kg hanging from its free end. If the coefficient of friction between the block and the table is 0.1, calculate the acceleration of the system.

10. What is the orbital velocity and escape velocity of an artificial satellite revolving round the Earth at a height 100 km?

    Given :

    Radius of the Earth is 6400 km and acceleration due to gravity is 9.8 ms^{-2}.

11. A 0.08 kg bullet is accelerated by a rifle barrel 0.6 m long to a speed of 840 ms^{-1}. Calculate the average force exerted on the bullet while it is accelerated using Work-Energy theorem.

12. A 5 kg body and a 8 kg body are moving along the X-axis. At a particular instant the 5 kg body is 1 m from the origin and has a velocity of 3 ms^{-1} and 8 kg body is 2 m from the origin and has a velocity of -1 ms^{-1}. Find the position and velocity of centre of mass.

13. Find (a) the mean free path and (b) collision frequency for N_2 molecules. Assume a molecular diameter of 2×10^{-10} m, given that the average speed of N_2 molecule is 511 ms^{-1} and molecular density is 2.5×10^{25} moles m^{-3}.

14. The critical temperature, pressure and volume of a gas are 33.1 K, 1.316×10^{11} Nm^{-2} and 6.56×10^{-5} m^3 per mole respectively. Calculate the van der Waal's constants of the gas.

15. One litre air at a pressure of 10^5 Nm^{-2} is suddenly compressed to 10^{-3} litre. Find the final pressure. Given : $\gamma = \dfrac{5}{3}$.

16. A Carnot engine, whose sink is at a temperature of 7°C, has an efficiency of 50%. It is desired to increase the efficiency to 70%. By how many degrees, the temperature of the source be increased.

PART – C

Answer any **FIVE** of the following questions. Each question carries **2** marks :

(5 × 2 = 10)

17. (a) A swimmer pushes water backward while swimming. Why?

 (b) "It is easier to make a body roll over a surface than to slide." Justify.

 (c) Can a pendulum vibrate in an artificial satellite? Explain.

 (d) A light body and a heavy body have the same momentum. Which one has a larger kinetic energy? Explain.

 (e) In summer, black clothes are not preferred. Justify.

 (f) Why does the temperature of a gas increase when it is suddenly compressed?

 (g) Is Carnot's engine reversible? Explain.

 (h) A reversible adiabatic change is isentropic. Explain.

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