61121

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

(CBCS Scheme – Freshers)

Physics

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

Time : 3 Hours] *[Max. Marks : 70*

*Instructions to Candidates : Answer any **FIVE** questions from each Part.*

PART – A

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

1. (a) Derive the relation between coefficient of static friction and angle of repose.

   (b) Obtain an expression for the velocity of the accelerating body moving along an inclined plane without friction. **(4 + 4)**

2. (a) Define orbital velocity.

   (b) Obtain an expression for the escape velocity of an object from the earth surface. **(1 + 7)**

3. (a) Explain conservative and non-conservative forces with examples.

   (b) Derive an expression for work done by a variable force. **(4 + 4)**

4. Derive Planck's law of radiation for a black body. **(8)**

5. Show that the pressure exerted by a gas, $pv = \frac{1}{3}mnc^2$. **(8)**

6. (a) Mention the assumptions of kinetic theory of gases.

   (b) Deduce the relation for the coefficient of viscosity of a gas on the basis of kinetic theory of gases. **(2 + 6)**

7. (a) State the first law of thermodynamics and explain its significance.

   (b) Obtain an expression for the amount of work done by an ideal gas during isothermal process. **(3 + 5)**

8. (a) State Carnot's theorem. Write the expression for the efficiency of Carnot's heat engine.

   (b) Derive an expression for change in entropy for a cyclic process. **(4 + 4)**

PART – B

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

9. A 2 kg block is placed on a horizontal surface. The coefficient of static friction between the block and the surface is 0.15. If an external force of 5 N is applied on the block parallel to the surface, find the acceleration of the block. Given $g = 9.8 m/sec^2$.

10. Calculate the mass of the earth, given that the gravitational constant = 6.67×10^{-11} $Nm^2 kg^{-2}$, radius of the earth = 6.38×10^6 m and acceleration due to gravity = 9.8 m/sec^2.

11. Calculate the work done in lifting a body of mass 28 kg to a height of 1.5 m.

12. Determine the temperature at which a black body loses thermal energy at the rate of 10^4 Wm^{-2}. Given, Stefan's constant = 5.7×10^{-8} $Wm^{-2}k^{-4}$.

13. The mean free path of nitrogen molecules of 0°C and one atmosphere is 0.8×10^7m and the number of nitrogen molecules is $2.7 \times 10^{25} m^{-3}$. Calculate the molecular diameter of nitrogen molecules.

14. Calculate Vander Waal's constants a and b. Given that critical pressure of the gas is 2.1×10^6 Nm^{-2} and critical volume for a mole is 45×10^{-6} Nm^3.

15. One mole of an ideal gas at 273 K is subjected to a reversible adiabatic expansion to double its volume. Calculate the change in temperature of the gas. Given $r = 1.4$.

16. Calculate the change in entropy when 0.5 kg of ice at 273 K melts into water and the temperature of water is raised to 300 K. Given entropy change in melting ice at 273 K = 61.5 JK^{-1} and specific heat of water = 4200 J $kg^{-1}k^{-1}$.

PART – C

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

17. (a) Why it is difficult to run fast on sand?

(b) Is it possible to shield a body from gravitational effects? Explain.

(c) Does the momentum of a system of particles is always conserved? Justify.

(d) Why does a good absorber of radiant energy appears black?

(e) Does the temperature of the gas increase when it is compressed suddenly? Explain.

(f) What are the factors on which the Vander Waal's correction for the pressure depends?

(g) Does the internal energy of a substance is a state function? Justify.

(h) Can the efficiency of Carnot's engine 100%? Explain.