I Semester B.Sc. Examination, November/December 2018
(CBCS) (F+R) (2016 – 2017 and Onwards)
PHYSICS – I
Mechanics – I, Heat and Thermodynamics – I

Time : 3 Hours

Max. Marks : 70

Instruction : Answer **five** questions from each **Part.**

PART – A

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

1. a) Define static friction and kinetic friction.

   b) What is the angle of repose ? Derive the relation between the coefficient of static friction and the angle of repose. (2+6)

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

   b) Derive an expression for the escape velocity of a body from the surface of the planet. (3+5)

3. a) What is centre of mass ? Derive an expression for position vector of centre of mass.

   b) Show that the linear momentum of a system of particles is equal to the product of mass of the system and velocity of the centre of mass. (4+4)

4. a) Define solar constant.

   b) Describe the experimental method of determination of solar constant using Angstrom's pyrheliometer. (2+6)

5. Obtain an expression for the pressure exerted by gas molecules on the basis of kinetic theory of gases. 8

6. a) Define critical temperature of a real gas.

   b) Derive the expressions for critical volume and critical temperature of a real gas in terms of the Vander Waal's constants a and b. (2+6)

7. a) State first law of thermodynamics.

   b) Derive an expression for the work done by ideal gas during an adiabatic process.

   (2+6)

8. a) Derive an expression for the change in entropy of an adiabatic process.

   b) Derive an expression for the change in entropy of an isobaric process.

   (4+4)

PART – B

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

9. Two masses 2 kg and 8 kg are connected at the two ends of a light in extensible string that goes over a frictionless pulley. Find the acceleration of the masses and tension in the string when the masses are released. Assume g to be 9.8 ms⁻².

10. The force of attraction between the two spherical bodies of masses 40 kg and 80 kg is equal to 87×10^{-8} N. If the distance between the centers of spherical bodies is 0.5 m. Calculate the value of G. Given $g = 9.8$ ms⁻².

11. A box of mass 0.4 kg slides across horizontal frictionless counter with a speed of 0.5 ms⁻¹. It compresses a spring of spring constant $K = 750$ Nm⁻¹. By what distance is the spring compressed when the box is stopped by the spring momentarily ?

12. The temperature of the furnace is 3000 K. Calculate the heat radiated per unit area for one minute from it. Assume σ to be 5.67×10^{-8} wm⁻² k⁻⁴.

13. Calculate the RMS velocity of oxygen molecules at NTP, if the RMS velocity of hydrogen molecules at NTP is 1840 ms⁻¹. Molecular weights of hydrogen and oxygen are 2 and 32 respectively.

14. The average speed of a gas molecule is 400 ms⁻¹. Calculate the coefficient of viscosity of the gas. If its density is 1.25 kg m⁻³ and mean free path of the molecule is 9×10^{-8} m.

15. Calculate the work done when one mole of perfect gas at NTP is compressed adiabatically till the temperature is increased to 150° C. Assume $R = 8.31$ Jk⁻¹ mol⁻¹ and $r = 1.67$.

16. A Carnot engine has same efficiency

    1) between 1000 K and 500 K and

    2) between TK and 100 K (temperature of the sink). Calculate TK of the source

PART – C

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

17. a) A lighter and heavier fans m, M respectively are running at the same speed. When the switches of both of them are put off which one of them will come to rest first and why ?

    b) Does a satellite need fuel to circle round the earth ? Explain.

    c) Can kinetic energy of a system be increased without applying any external force on the system.

    d) If the temperature of a blackbody raised from 300 K to 600 K, by what factor, the rate of energy emission will increase ?

    e) Why gas laws are not obeyed at low temperature and high pressure ?

    f) How permanent are so called permanent gases like hydrogen and nitrogen ?

    g) In which state the entropy is maximum, solid, liquid or gas ? Why ?

    h) Otto engine is preferred to a Carnot's engine. Explain why.