

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)

P.T.O.



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 $87 \times 10^{-8} \text{ N}$. If the distance between the centers of spherical bodies is 0.5 m. Calculate the value of G . Given $g = 9.8 \text{ ms}^{-2}$.
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 $K = 750 \text{ Nm}^{-1}$. 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 $5.67 \times 10^{-8} \text{ Wm}^{-2} \text{ K}^{-4}$.
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 $9 \times 10^{-8} \text{ m}$.
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 $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$ and $\gamma = 1.67$.



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 is 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.
-