11121

560

# I Semester B.Sc. Examination, December 2018
## (CBCS) (F)
## PHYSICS – 1
## Mechanics – I, Heat and Thermodynamics – I

Time : 3 Hours Max. Marks : 70

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

PART – A

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

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

2. a) State Kepler's laws of planetary motion.
   b) Derive an expression for time period of satellite orbiting in a circular orbit around the earth. **(3+5)**

3. a) Distinguish between conservative and non-conservative force with an example for each.
   b) Derive Newton second law of motion for a system of particles. **(4+4)**

4. Derive Planck's radiation law. **8**

5. a) Define the terms : Average velocity, rms velocity and most probable velocity of a gas molecule and write the expressions for each of them.
   b) Explain the concept of degrees of freedom with relevance to gas molecules. **(6+2)**

6. Derive the expression for critical constants of a gas in terms of Van der Waals constants 'a' and 'b'. **8**

P.T.O.

7. a) State zeroth law of thermodynamics.

   b) Obtain an expression for the efficiency of a Carnot engine in terms of temperature of source and sink. (2+6)

8. a) State and prove Carnot's theorem.

   b) Show that the entropy remains constant in a cyclic process. (5+3)

## PART – B

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

9. What is the velocity of a sphere falling in a resistance medium under gravity at a time 8 ms if its terminal velocity is 0.05 $ms^{-1}$ assuming the force to be proportional to velocity ? Given Time constant $\tau = \frac{m}{k} = 1.6\,s$.



10. Calculate the escape velocity of a body projected from a point on the earths surface using the following data. $G = 6.67 \times 10^{-11}\ Nm^2\ Kg^{-2}$, $M_E = 6 \times 10^{24}$ Kg, $R_E = 6400$ Km.

11. Calculate the work done in stretching the spring by 2 cm from its relaxed position. Given : spring constant = 15 $Nm^{-1}$.

12. A fully fuelled rocket of mass 6000 Kg is set to be fired vertically. If the rocket ejects its gases at a speed of 2000 $ms^{-1}$ with respect to the rocket and burns fuel at the rate of 50 $Kgs^{-1}$, what is the rockets initial upward acceleration ? (Include the effect of gravity)

13. Find the mean free path of hydrogen molecules at NTP given molecular diameter to be $2.46 \times 10^{-10}$ m and the number of molecules per cubic meter is $2.68 \times 10^{25}$.

14. The average speed of gas molecule is 450 $ms^{-1}$. Calculate the coefficient of thermal conductivity of gas.

    Given : Density of gas = 1.25 $Kg.m^{-3}$, mean free path = $8.85 \times 10^{-8}$ m and specific heat at constant volume = 21 J $mol^{-1}\ K^{-1}$.

15. $10^{-3}$ $m^3$ of hydrogen at temperature of 400 K and pressure $10^5$ $Nm^{-2}$ expands isothermally until its volume is 1.5 times the original volume. Find the amount of work done. Given : R = 8.31 J $mol^{-1}$ $K^{-1}$.

16. What is the entropy change of a 0.4 Kg block of copper when its temperature is increased from 285 K to 295 K. Given : Specific heat of copper = 385 J $kg^{-1}$ $K^{-1}$.

## PART – C

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

17. a) Do action and reaction forces cancel each other ? Explain.

b) Is a geostationary satellite at rest relative to earth ? Explain.

c) Where is the centre of mass of oxygen molecule located ? Explain.

d) Does a piece of red glass appear red under blue light ? Explain.

e) The ratio of specific heats $\gamma$ of two gases are 1.3 and 1.66 respectively. Mention their atomicity.

f) Is the coefficient of viscosity of a gas independent of pressure ? Explain.

g) In an adiabatic process for an ideal gas the pressure increases. Does the internal energy of the gas increase or decrease ? Explain.

h) Does the entropy of a gas change during an isothermal process ? Explain.