QP – 220

I Semester B.Sc. Examination, April/May 2021
(CBCS) (Fresh + Repeaters)
(2016 – 2017 and Onwards)
PHYSICS – I
Mechanics – I, Heat and Thermodynamics – I

Time : 3 Hours Max. Marks : 70

Instructions : *a) Answer **any five** questions from **each** Part.*
*b) Non-programmable scientific calculators are **allowed**.*

PART – A

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

1. a) Write the laws of friction.
   b) Obtain an expression for the acceleration of a body sliding down a rough inclined plane. **(2+6)**

2. Obtain expressions for the radial and transverse components of velocity and acceleration of a particle moving along a curve in a plane. **8**

3. a) Define the center of mass of a system of particles.
   b) Derive Newton's second law of motion for a system of particles. **(2+6)**

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 pressure exerted by gas molecules on the basis of kinetic theory of gases. **8**

6. a) Define the critical temperature of a real gas.
   b) Derive the expressions for the critical constants, V_C and T_C, in terms of the Van der Waals' constants, 'a' and 'b'. **(2+6)**

P.T.O.

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7. a) State and explain the first law of thermodynamics, giving its significance.
   b) Derive an expression for the work done by an ideal gas during an adiabatic process. **(4+4)**

8. Derive an expression for the change in entropy of an ideal gas in terms of
   a) Temperature and volume
   b) Temperature and pressure. **(4+4)**

PART – B

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

9. A sphere of mass 3×10^{-3} kg moving vertically downward in a resistive medium has a terminal velocity of 0.05 ms^{-1} and the drag coefficient is 0.6. Calculate the time constant and the time taken by the sphere to reach 80% of its terminal speed. Assume the resistive force is proportional to its velocity.

10. Calculate the time period of a satellite orbiting earth from given data $G = 6.7 \times 10^{-11}$ $Nm^2 kg^{-2}$, $M_E = 6 \times 10^{24}$ kg, $R_E = 6400$ km, $h = 3.563 \times 10^3$ km.

11. A rocket of mass 5000 kg is fired vertically upward. The exhaust velocity of the fuel is 3 kms^{-1} and the rate of consumption of the fuel is 50 kgs^{-1}. Calculate the rockets initial upward acceleration.

12. Determine the temperature at which a blackbody losses thermal energy per second equal to 10^4 Wm^{-2}, given Stefans' constant = 5.67×10^{-8} $Wm^{-2} K^{-4}$.

13. The mean free path of N_2 at 273 K and one atmospheric pressure is 8×10^{-8}m. Calculate the number of nitrogen molecules per m^3, if the diameter of the molecule is 3.2 Å.

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 kgm^{-3} and mean free path of the gas molecule is 9×10^{-8} m.

15. One mole of an ideal gas is maintained at 0°C during an expansion from 3 m^3 to 10 m^3. How much work is done by the gas during this expansion ? Given $R = 8.314$ $JK^{-1}mol^{-1}$.

16. Determine the efficiency of a Carnot heat engine working between the temperatures 127°C and 27°C.

PART – C

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

17. a) Is it better for a cricket player to lower his hands as he catches a cricket ball that is falling from a great height ? Why ?

    b) Is the speed of a planet the same at all points in its orbit around the sun ? Explain.

    c) Can the center of mass of a body lie where there is absolutely no mass ? Explain.

    d) What is the work done by an object in uniform linear motion at a constant velocity on a absolutely frictionless surface ? Why ?

    e) Why gas laws are not applicable completely at a low temperature and high pressure ?

    f) Is C_p greater than C_v ? Why ?

    g) Explain why a diesel engine is preferred to an Otto engine.

    h) Does the entropy of the universe always increase ? Why ?
