61121

First Semester B.Sc. Degree Examination, August/September 2021

(CBCS Scheme – Freshers and Repeaters)

Physics

Paper I – MECHANICS – 1, HEAT AND THERMODYNAMICS – 1

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

Instructions to Candidates :

Answer any Five questions from each Part.

PART – A

I. Answer any **FIVE** of the following questions. Each question carries **8** marks: **(5 × 8 = 40)**

1. (a) Define co-efficient of static friction and co-efficient of kinetic friction.

   (b) Derive an expression for an acceleration of a body with friction. **(2 + 6)**

2. (a) State and explain universal law of gravitation.

   (b) Define orbital velocity. Derive an expression for it. **(3 + 5)**

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

   (b) State and explain work energy theorem. **(4 + 4)**

4. Derive Planck's law of radiation. **(8)**

5. (a) Write any two assumptions of kinetic theory of gases.

   (b) What is meant by free path of gas molecules? Derive an expression for mean free path of gas molecules. **(2 + 6)**

6. Deduce expressions for the critical constants in terms of 'a' and 'b'. **(8)**

7. (a) State and explain zeroth law of thermodynamics. What is its physical significance?

   (b) Derive an expression for work done by a gas during an isothermal process. **(3 + 5)**

8. Obtain an expression for the thermal efficiency of a Carnot heat engine in terms of temperatures of the source and sink. **(8)**

PART – B

II. Solve any **FIVE** of the following questions. Each problem carries **4** marks: **(5 × 4 = 20)**

9. A trolley of mass 4.5 kg is pulled along a table by a string attached to a mass of 0.09 kg hanging down over a pulley. If the trolley starts from rest, calculate the distance travelled by the body in 8 seconds. Given g = 9.8 ms^{-2}.

10. Calculate the mass of the earth from the following data:

    Acceleration due to gravity = 9.8 ms^{-2}, Gravitational constant = 6.67×10^{-11} Nm^2 kg^{-2} and radius of the earth = 6.4×10^6 m.

11. A 7200 kg rocket is set for a vertical firing. If the exhaust speed is 600 ms^{-1}, how much gas must be ejected per second to supply thrust needed to overcome the weight of the rocket.

12. If the average energy radiated per unit area of the surface of the sun is 7.452×10^4 watt. Estimate the surface temperature of the sun by assuming it as a perfect block body. Given : $\sigma = 5.67 \times 10^{-8}$ Wm^{-2} K^{-4}.

13. If the rms velocity of H_2 molecule is 1.84 km s^{-1} at NTP, calculate the velocity of O_2 molecule at NTP. Given molecular weights of hydrogen and oxygen are 2 and 32 respectively.

14. Find the co-efficient of viscosity of a nitrogen gas at NTP from the following data:

    Density of nitrogen, $\rho = 1.25$ kg m^{-3}

    Average velocity, $\bar{c} = 475$ ms^{-1} and

    Mean free path, $\lambda = 9.87 \times 10^{-8}$ m

15. At 30° two moles of an ideal monoatomic gas occupies a volume 'V'. The gas expands adiabatically to a volume '2V'. Find the temperature of the gas. Given $\gamma = \frac{5}{3}$.

16. One mole of an ideal gas expands isothermally to four times of its initial volume. Calculate the change in entropy. Given : R = 8.313 JK^{-1} mol^{-1}.

PART – C

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

17. (a) Can a body have constant speed, but still a varying acceleration? Explain.

(b) Is it possible to expect the co-efficient of friction to be more than one? Explain.

(c) Can centre of mass lie outside the body? Explain.

(d) In Summer, black clothes are not preferred. Justify.

(e) Can an ideal gas be converted into solid or liquid states? Explain.

(f) The co-efficient of viscosity of a gas is independent of pressure. Justify.

(g) Does an adiabatic expansion produces cooling? Explain.

(h) Is entropy a state function like the internal energy? Explain.

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