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ST. JOSEPH'S COLLEGE (AUTONOMOUS),BENGALURU-27
B.Sc PHYSICS – I SEMESTER
SEMESTER EXAMINATION :OCTOBER 2019
PH118: Mechanics, Heat and Thermodynamics

Time: $2^1/_2$Hours MaxMarks:70

This question paper contains **two** printed pages and **three** parts

PART A

Answer any **four** of the following. Each question carries **10** marks. (4x10=40)

1 A particle is moving along a curve in a plane. Derive expressions for its radial and transverse components of velocity and acceleration. Explain the term centripetal acceleration. (10)

2a) Obtain the relation that gives the equation of motion of centre of mass of a two body problem and explain the term reduced mass of system.
b) Discuss the phenomenon of collision in one dimension between two particles when the collision is inelastic in the laboratory frame. (4+6)

3 Derive an expression for the acceleration of a body rolling down a smooth inclined plane without slipping. What are the values of acceleration for a cylinder,solid sphere and hollow sphere of the same radius. (10)

4 a) Mention the basic assumptions (any three) of kinetic theory of gases.
b) Derive an expression for pressure of an ideal monoatomic gas on the basis of kinetic theory of gases (3+7)

5 a) State and explain zeroth law of thermodynamics.
b) Derive expressions for the work done in an isothermal and adiabatic process of an ideal gas. (2+8)

6 a) Obtain any two Maxwell's thermodynamic relations from thermodynamic potentials and give their significance.
b) Distinguish between Joule Thomson expansion and adiabatic expansion (6+4=10)

PART B

Solve any **four** of the following. Each question carries **5** marks (4x5=20 marks)

7 A rocket of mass 10 kg has 90 kg of fuel.The exhaust velocity of fuel is 1.6km/s. Calculate the ultimate vertical speed gained by the rocket,when the rate of consumption of fuel is 2kg/s.

8 Calculate the effective weight of an astronaut ordinarily weighing 80kg when his rocket moves vertically upward with 2g acceleration.

9 A frame **S'** is moving with velocity $3\hat{i}+5\hat{j}$ m/s relative to an inertial frame **S**. A particle is moving with velocity $(t+3)\,\hat{i} + 7\,\hat{j}$ m/s with respect to **S**. Find the acceleration of the particle in the frame **S'**.

10 Calculate the rms speed of a molecule of Hydrogen at NTP given $k=1.38 \times 10^{-23}\ JK^{-1}$, Avogadro number = 6.02×10^{23} molecules/mol. Hence calculate most probable speed and average speed. Molecular mass of hydrogen 2 g/mol.

11 For Carbondioxide gas the Van der Waals constants are a= 0.364 Pa m^6/mol^2 and b= $4.27 \times 10^{-5}\ m^3/mol$. If 1 mol of CO_2 gas at 400K is confined to a volume of 300 cm^3, find the pressure of gas.

12 The value of γ for air is 1.4. One mole of air is initially occupying a volume $0.45m^3$ at 205KPa expands adiabatically to a final volume of $0.65m^3$. Determine a) the final pressure b)the final temperature c) the initial temperature. Molar gas constant $R=8.31JK^{-1}mol^{-1}$

PART C

Answer any **five** of the following. Each question carries **2** marks.

13 a) The torque of the weight of any body about any vertical axis is zero. Is it a correct statement? Explain.

b) Let I_1 and I_2 be the moments of inertia of two bodies of identical geometrical shape, the first one is made up of aluminium and the second iron. Which is greater I_1or I_2? Explain.

c) A person sitting firmly over a rotating stool has his arms stretched. If he folds his arms, what will happen to his angular momentum.

d) When we rub our hands they become warm.Have we supplied heat to the hands? Explain.

e) Can we define the temperature of vacuum? Explain.

f) A car accelerates on a horizontal road due to the force exerted by the engine of the car. Is the statement true? Explain.