UG/1st Sem/PHS(H)/T/19

2019

B.Sc.

1st Semester Examination

PHYSICS (Honours)

Paper - C 2-T

Full Marks : 40 Time : 2 Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practiable.

Group - A

Answer any ***five*** questions 5×2=10

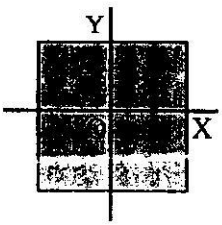
1. Assume that Newton's 2nd law is valid in a reference frame and rest. Now show that it is valid in any reference frame moving with constant velocity. 2

2. A bullet is fired with initial velocity 100 *m/s* making an angle 45° with horizontal. If $g = 10$ m/s^2 then calculate the maximum horizontal distance travelled by the bullet before touching the ground. 2

[Turn Over]

3. A particle moves on X-axis under a potential $V = -\frac{A}{x^n} + \frac{B}{x^2}$. Show that the condition for a stable equilibrium position of the particle on the X axis is $n < 2$. 2

4. A uniform square lamina is lying in the XY plane as shown in the following figure. Given : $I_Y = \frac{1}{12}ma^2$. Find the moment of inertia of the lamina about an arbitrary axis, also lying in the XY plane and passing through the centre of the lamina. 2



5. Show that the total mechanical energy of a particle moving under conservative force is constant. 2

6. Obtain Stokes' law of viscosity by dimensional analysis. 2

7. For an elastic material the Young's Modulus and the Poisson's ratio have the values 7.2×10^{10} N/m^2 and 0.25 respectively. Calculate the modulus of rigidity. 2

Group - C

Answer any ***one*** question $1\times10=10$

15. (a) Using Newton's law of gravitation prove Kepler's 1st law of planetary motion. 3

    (b) Show that the potential of the central force is spherically symmetric. 2

    (c) A spaceship of rest length 400 m has speed 0.8c with respect to certain reference frame. A small meteorite is at rest with respect to this frame. Calculate the time taken by the spaceship to pass by the meteorite as measured by an observer (i) from the meteorite and (ii) from the spaceship. 2+2

    (d) State the relativistic relation between total energy and linear momentum of a particle of rest mass m_0. 1

16. (a) Given that the vector equation of motion of a rocket ejecting fuel at a constant velocity $\vec{u}$ and constant rate $\alpha = -\frac{dm}{dt}$ is :

$$\frac{d\vec{v}}{dt} - \frac{dm}{dt}\vec{u} = \vec{F},$$

[Turn Over]

where $\vec{v}$ is its instantaneous velocity with respect to ground and $\vec{F}$ is the gravitational force.

Find the condition of its soft landing along a vertical line if it starts from rest. 3

(b) Prove the relation $\vec{L} = \vec{L}_0 + \vec{L}'$ for a system of particles, where $\vec{L}$ and $\vec{L}'$ are the angular momenta of the system of particles with respect to the laboratory frame and the center of mass frame respectively and $\vec{L}_0$ is the angular momentum of the system of particles with respect to the laboratory frame if its total mass is assumed to be conserved at its centre of mass. 4

(c) For a forced harmonic oscillator given that : natural frequency $\omega_0 = \pi S^{-1}$ and damping force per unit mass per unit velocity = 1.5π *dyne* g^{-1} $(cm/s)^{-1}$. Calculate the half power frequencies and sharpness of resonance. 3