

Total number of printed pages-4

UG/Sem-1/PHY-HC2

2022

Physics (Honours)
Paper : PHY-HC-1026
(Mechanics)

Time : 3 hours

Full Marks : 60

The figures in the margin indicate full marks for the questions.

1. Answer the following questions as directed: 1×7=7

(a) For a body in stable equilibrium

- (i) The potential energy is maximum
- (ii) The kinetic energy is maximum
- (iii) The potential energy is minimum
- (iv) The kinetic energy is minimum

(Choose the correct option)

(b) What is the value of co-efficient of restitution in case of perfectly elastic collision?

(c) Radius of gyration of a body depends upon

- (i) Axis of rotation
- (ii) Translational motion
- (iii) Area of the body
- (iv) Shape of the body

(Choose the correct option)

(d) There are two types of metals A and B with Young's modulli Y_A and Y_B respectively, where $Y_A > Y_B$. Which is a better metal for construction of concrete structures?

Contd.

- (e) A load attached to a spring is in simple harmonic motion. The maximum potential energy of the system is $100J$. At a particular point the kinetic energy of the load is found to be $75J$. What is the potential energy of the system at that point?
- (f) What do you mean by an ideal fluid?
- (g) Two beams of light are incident on a spaceship moving at a speed $\frac{c}{2}$, one from the front and the other from the rear of the spaceship. Here c is the speed of light. What is the ratio of the speeds of the beams of light for the two cases as seen by an observer on the spaceship?

2. Answer the following questions:

2×4=8

- (a) Find the mass of water flowing in 10 minutes through a tube of diameter 0.5cm, length 30cm under a constant pressure head of 20cm of water. η of water is 0.0089 in CGS.
- (b) Draw a diagram showing how the gravitational potential V of a thin spherical shell of mass M and radius R varies with distance r from the centre of the shell, where r extends from the centre of the shell to $> R$.
- (c) What do you mean by resonance and sharpness of resonance?
- (d) Prove that the four dimensional volume element $dx dy dz dt$ is invariant under Lorentz transformations.

3. Answer *any three* of the following questions :

5×3=15

- (a) What is Galilean invariance? Show that length or distance is a Galilean invariant.

1+4=5

- (b) What do you mean by a conservative force? For a conservative force prove that, $\vec{\nabla} \times \vec{F} = 0$. 1+4=5
- (c) What is the characteristic of simple harmonic motion? Write the equation of damped vibration and explain various terms. Define relaxation time. 2+2+1=5
- (d) What is Coriolis force? Discuss in general terms the effect of Coriolis force produced as a result of the earth's rotation. 1+4=5
- (e) On the basis of Lorentz transformation equation explain length contraction and time dilation. 2½+2½=5

4. Answer *any three* of the following questions : 10×3=30

- (a) Show that the final velocity v of rocket at any instant is given by $v = v_0 \log\left(\frac{m_0}{m}\right)$, where, v_0 = initial velocity, m_0 = initial mass, m = final mass. 10
- (b) Obtain an expression for torsional couple per unit angular twist of a cylindrical wire. The restoring couple per unit angular twist of a solid cylinder of radius 5cm is 1×10^8 dyn-cm. Obtain the restoring couple per unit twist in a hollow cylinder of the same material and of same mass and length, but internal radius 12.0 cm. 6+4=10
- (c) Give two characteristics of central force. Derive the equation of motion of a body under a central force. Show that the total energy of a body under a central force is given by

$$\frac{1}{2}\mu\dot{r}^2 + \frac{L^2}{2\mu r^2} + V = E$$
 where, r is the separation between the

two bodies, L is the angular momentum and μ is the reduced mass. 5+5=10

(d) Derive the Poiseulli's Equation for the coefficient of viscosity of a fluid and what are its limitations? 8+2=10

(e) Describe with a figure Michelson and Morley experiment and explain the physical significance of the negative results. 8+2=10

