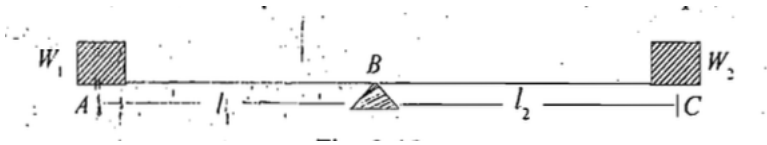
FYUGP B.Sc 4th Semester Sessional Examination, 2025
Paper: Classical Mechanics
Paper Code: PHY040104

Marks: 30 **Time: 90 minutes**

1. **Answer the following: (any two)** $2 \times 2 = 4$
   (a) What will be the number of generalized coordinates of a system of 3 particles having 2 constraints of motion?
   (b) What are constraints? Classify the different types of constraints.
   (c) What is four vector?
   (d) Write the postulates of theory of relativity.

2. **Answer the following: (any two)** $2 \times 3 = 6$
   (a) What are generalized coordinates? If a generalized coordinate has the dimension of momentum, what would be the dimension of generalized velocity?
   (b) Determine the number of degrees of freedom in the following cases:
      (i) A particle moving on a curve
      (ii) Four particles moving freely in a plane
      (iii) Three particles connected by three rigid massless rods
   (c) Discuss D'Alembert's principle.
   (d) Show that $□^2 + □^2 + □^2 - □^2□^2$ is invariant under Lorentz Transformation.
   (e) What is length contraction? Derive the expression for length contraction.

3. **Answer the following: (any four)** $4 \times 5 = 20$
   (a) Obtain the equation of motion of a simple pendulum by using Lagrangian method and hence deduce the formula for its time period for small amplitude oscillation.
   (b) A lever ABC has weights W_1 and W_2 at distances l_1 and l_2 from the fixed support B. Apply the principle of virtual work to prove that the condition of equilibrium is $\frac{W_1}{W_2} = \frac{l_1}{l_2}$.



   (c) Derive the Lagrangian expression for a charged particle in an electromagnetic field.
   (d) Define generalized momentum and cyclic coordinates. Show that the generalized momentum corresponding to a cyclic coordinate remains conserved.
   (e) Explain time dilation in special theory of relativity. How is time dilation experimentally verified?
   (f) Deduce Einstein's mass-energy relation. What are massless particles?
   (g) What is the space-time interval? Discuss space-like and time-like intervals and explain in terms of the light cone.