ACTIVITY

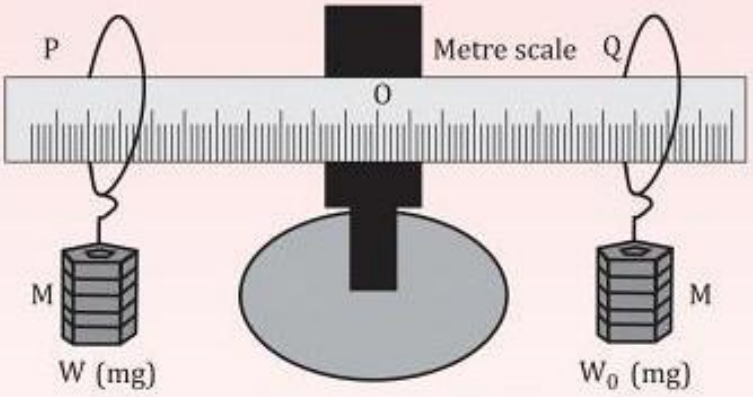
AIM

To determine mass of a given body using a meter scale by principle of moments.

MATERIAL REQUIRED

A meter scale, a sharp-edged metal or wooden wedge, a weight box, thread and a body of unknown mass.

DIAGRAM



THEORY

Consider a meter scale supported on its centre of gravity. It will stay horizontal on the wedge in this situation. If a body of unknown mass m be suspended at one end P of a meter scale and a known weight W_0 of mass M be suspended at the end Q as shown in the following figure and then the position of the point Q (i.e., wooden wedge) is so adjusted that the meter scale is in equilibrium at O.

By the principle of moments, we have

$$W \times OP = W_0 \times OQ$$

Since

$$W = mg$$
$$W_0 = Mg$$
$$OP = l_1$$
$$OQ = l_2$$

Then, we have

$$mg \times l_1 = Mg \times l_2$$
$$m = \left(\frac{M \times l_2}{l_1}\right)$$

By knowing M, l_1 and l_2, m may be calculated.

PROCEDURE

1. Place the sharp wedge on a wooden block which is already placed on the table.
2. Place the meter scale on the wedge and graduated side facing you.

3. Move the scale on the wedge and balance it on the edge of the wedge, then find its centre of gravity.
4. Take two pieces of thread of equal lengths. Make their loops. With the help of these, suspend the known standard weight W_0 (i.e., Mg) on the right-hand side of the wedge (at Q) and the body of unknown mass (i.e., W = mg) on the left-hand side of wedge (i.e., at P).
5. Keeping the position of w_0 fixed. Adjust the position of the weight W at P to maintain scale in equilibrium in the horizontal position.
6. When the meter scale becomes in stable position then note the balancing position of W, W_0 and centre of gravity O on the scale.
7. Changing the position of w, and adjusting the position of W_0, repeat the procedure for three more observations.
8. Record the observations in the following table.

OBSERVATION

1. Position of centre of gravity O on the scale = _____ cm.
2. Magnitude of known mass, M = _____ g
3. Known weight W_0 = Mg = _____ g wt.

TABLE FOR DETERMINATION OF UNKNOWN MASS

Number of observations	Position of W P (cm)	Position of W_0 Q (cm)	OP= l_1 (cm)	OQ= l_2 (cm)	m= M $\left(\frac{l_2}{l_1}\right)$
1.					
2.					
3.					
4.					

CALCULATION

The mean value of unknown mass, $m = \frac{m_1 + m_2 + m_3 + m_4}{4}$ = _____ g.

RESULT

The value of unknown mass, m determined using principle of moments is _____ g.

PRECAUTIONS

1. Meter scale must have uniform mass distribution.
2. You must determine the centre of gravity of the scale accurately and check before and after every reading.
3. That the edge of the wedge remains under this position only.
4. In equilibrium position, the meter scale should be made horizontal.
5. Threads used for loops should be thin, light, and strong. Their loops must be parallel to the marks on the scale and of equal length.

SOURCES OF ERROR

1. The wooden wedge may not be sharp.
2. The fulcrum may not be at the center of gravity of the meter scale.
3. The threads used for making loops may be thick and heavy.

VIVA VOCE

Q1. Define the mass of a body.

Ans. It is defined as the quantity of matter possessed by the body.

Q2. What is the S.I. unit of mass?

Ans. Kilogram (Kg) is the S.I. unit of mass.

Q3. Write C.G.S. unit of mass.

Ans. Gram is the C.G.S. unit of mass. It is represented by g.

Q4. Define weight of a body.

Ans. Weight of a body on earth is defined as the gravitational pull exerted by the earth on it towards its center.

Q5. What is the S.I. unit of weight?

Ans. S.I. unit of weight is newton (N).

Q6. Is mass a vector quantity?

Ans. No.

Q7. Which instrument determines the inertial mass of a body?

Ans. Inertial balance.

Q8. What is the S.I. unit of moment of force?

Ans. Nm.

Q9. What is the basic difference between work and torque?

Ans. Work is a scalar quantity, but torque is a vector quantity.

Q10. Name a simple machine whose work is based on the principle of moments.

Ans. Lever.