

# Forces

## **Purpose:**

1. To verify the law of the parallelogram of force.
2. To measure the specific gravity of a solid,  $M_3$  using the parallelogram law.

## **Apparatus:**

Known masses,  $M_1$  (100 g),  $M_2$  (150 g), unknown mass,  $M_3$  (? g), two pulleys, strings, ruler and protractor.

## **Method :**

1. Connect the known masses  $M_1$ ,  $M_2$  and the unknown mass,  $M_3$  by two strings running over pulleys as indicated in figure 1.
2. Attach a sheet of paper to the board. The strings will take up a position for which the forces acting at O are in equilibrium.
3. Make small pencil crosses on the paper as far as possible to mark the positions of the strings. A fairly accurate method of doing this is to mark the positions of the shadows of the strings formed by distant lamp.
4. Remove the paper from the board, with a ruler; join the crosses by pencil liner. Then extend the lines until they meet at O.

let 25N=1cm, so that an arrow 150 cm long would represent the force of 6N from the point O along OP and OQ draw arrows to represent the forces.

Using these two forces arrows as sides, complete the parallelogram OPCQ (figure 2).

Draw the resultant arrow OC. measure its length and, remembering that 100N represent 4cm, find what force it represents.

5. Repeat the experiment with  $M_3$  immersed completely in water find its weight in water.

6. Calculate the specific gravity of solid  $M_3$ .

$$\text{S.G.} = W_{\text{air}} / (W_{\text{air}} - W_{\text{water}})$$

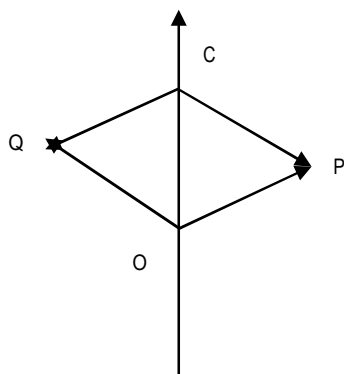


Figure 2

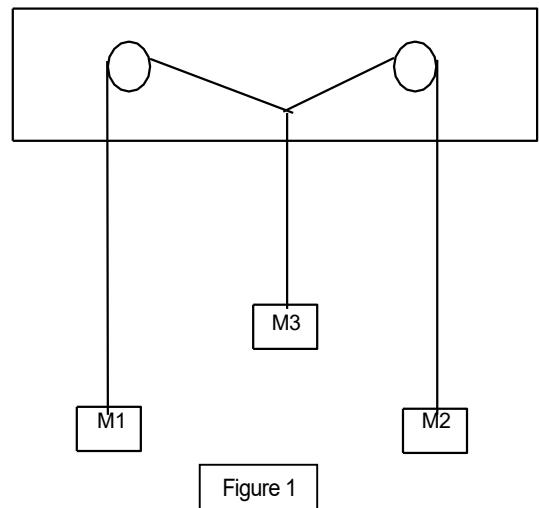


Figure 1

## Readings & Results

### In air:

$$\sum F = 0$$

$$\sum F \uparrow = \sum F \downarrow$$

$$F = mg$$

$$g (m_1 \times \sin \theta_1 + m_2 \times \sin \theta_2) = m_3 \times g$$

$$(m_1 \times \sin \theta_1 + m_2 \times \sin \theta_2) = m_3$$

### In water:

$$\sum F = 0$$

$$\sum F \uparrow = \sum F \downarrow, F = mg$$

$$(m_1 \times \sin \theta_1 + m_2 \times \sin \theta_2) = m_3$$

### In diagram method:

Let  $25g = 1 \text{ cm}$

Draw as fig (2) and find  $m_3$

Find the average of  $m_3$ , and then find S.G

**Discussion:**

1. What is the relation do you find between the weights of the floating body and the weight of water that is displaced?
2. What is the resultant force?
3. What is the equilibrant force?
4. What is the Archimedes principle?
5. Define the specific gravity of a material?