1. A string ABC of length 2 m hangs between two vertical walls as shown in Fig. 1. At B, this string carries a weightless pulley that rolls without friction. A load of 15 N is suspended from the pulley. In the position of equilibrium, determine $\angle ABC$ when $a = 1$ m and $b = 0.5$ m. If the distance $b$ becomes zero, determine $\angle ABC$.

![Fig. 1](image)

2. Using Varignon's theorem, determine the magnitude and the line of action of the resultant of the forces shown in Fig. 2.

![Fig. 2](image)

3. Two children are playing seesaw game in a park. The uniform board of weight 20 N supports two children weighing 250 N and 175 N respectively. The fulcrum is under the centre of gravity of the board. The child of weight 175 N is sitting at one end of the board that is 2 m from the centre. Determine (i) the upward force exerted by the board on support and (ii) the position at which the child of weight 250 N should sit to balance the system.

OR

4. The pitch of a single threaded screw jack is 6 mm and its mean diameter is 60 mm. If the coefficient of friction is 0.1, determine the friction angle, and force required at the end of the lever 250 mm long measured from the axis of screw to: (i) raise 50 kN load and (ii) lower the same load.
5. Determine the position of centre of gravity of an unequal angle section shown in Fig. 3.

6. Find the moment of inertia of a hollow section shown in Fig. 4 about an axis passing through its centre of gravity and parallel to X-X axis.

7. A rigid chute plate, 2 m in length is supported horizontally at a height of 250 mm above a hopper by a spring 1 (stiffness 23 N/mm) at one end 'A' and a second spring 2 (stiffness 15 N/mm) at the mid-length as shown in Fig. 5. A finished-component of a machinery weighs 1.5 kN and slides on the chute plate towards the hopper. Determine the position of the component from the end ‘A’ at which the unsupported end, ‘B’ of the chute plate just touches the edge of the hopper.

8. Three balls A, B and C having masses 12.5 kg, 25 kg and 50 kg respectively move in the same direction along a straight line with velocities of 16 m/s, 4 m/s and 3 m/s. If ‘A’ collides with ‘B’ and subsequently ‘B’ collides with ‘C’, find the final velocities of balls assuming perfectly elastic impacts.

9. A flywheel in the form a solid uniform disc of mass 40 kg and radius 125 mm is mounted on a horizontal shaft of 32 mm diameter, supported in bearing on at each end. A light cord is wrapped around the shaft and supports a mass of 4 kg at the free end. Find the acceleration of the descending mass neglecting the friction at the bearings.

10. A roller of weight 11.772 kN and radius 0.5 m is pulled with a force of 2 kN on a rough ground. If the roller starts from rest and rolls without slipping, find the distance moved by the centre of the roller at which the roller acquires a velocity of 4 m/s.