A solid object consists of a uniform hemisphere of radius 0.4 m attached to a uniform cylinder of radius 0.4 m so that the circumferences of their circular faces coincide. The hemisphere and cylinder each have weight 20 N. The centre of mass of the object lies at the centre O of their common circular face.

(i) Show that the height of the cylinder is 0.3 m. [2]

A new object is made by cutting the cylinder in half and removing the half not attached to the hemisphere. The cut is perpendicular to the axis of symmetry, so the new object consists of a hemisphere and a cylinder half the height of the original cylinder.

(ii) Find the distance of the centre of mass of the new object from O. [4]

The new object is placed with its hemispherical part on a rough horizontal surface. The new object is held in equilibrium by a force of magnitude P N acting along its axis of symmetry, which is inclined at 30° to the horizontal.

(iii) Find P. [3]