



An object is formed by removing a solid cylinder, of height  $ka$  and radius  $\frac{1}{2}a$ , from a uniform solid hemisphere of radius  $a$ . The axes of symmetry of the hemisphere and the cylinder coincide and one circular face of the cylinder coincides with the plane face of the hemisphere.  $AB$  is a diameter of the circular face of the hemisphere (see diagram).

- (a) Show that the distance of the centre of mass of the object from  $AB$  is  $\frac{3a(2-k^2)}{2(8-3k)}$ . [4]

When the object is freely suspended from the point  $A$ , the line  $AB$  makes an angle  $\theta$  with the downward vertical, where  $\tan \theta = \frac{7}{18}$ .

- (b) Find the possible values of  $k$ . [3]