



A uniform rod  $AB$  of length  $2x$  and weight  $W$  rests on the smooth rim of a fixed hemispherical bowl of radius  $a$ . The end  $B$  of the rod is in contact with the rough inner surface of the bowl. The coefficient of friction between the rod and the bowl at  $B$  is  $\frac{1}{3}$ . A particle of weight  $\frac{1}{4}W$  is attached to the end  $A$  of the rod. The end  $B$  is about to slip upwards when  $AB$  is inclined at an angle  $\theta$  to the horizontal, where  $\tan \theta = \frac{3}{4}$  (see diagram).

- (i) By resolving parallel to the rod, show that the normal component of the reaction of the bowl on the rod at  $B$  is  $\frac{3}{4}W$ . [5]
- (ii) Find, in terms of  $W$ , the reaction between the rod and the smooth rim of the bowl. [4]
- (iii) Find  $x$  in terms of  $a$ . [3]