

## STEP II, 2003, Q10

- 10 A bead  $B$  of mass  $m$  can slide along a rough horizontal wire. A light inextensible string of length  $2\ell$  has one end attached to a fixed point  $A$  of the wire and the other to  $B$ . A particle  $P$  of mass  $3m$  is attached to the mid-point of the string and  $B$  is held at a distance  $\ell$  from  $A$ . The bead is released from rest.

Let  $a_1$  and  $a_2$  be the magnitudes of the horizontal and vertical components of the initial acceleration of  $P$ . Show by considering the motion of  $P$  relative to  $A$ , or otherwise, that  $a_1 = \sqrt{3}a_2$ . Show also that the magnitude of the initial acceleration of  $B$  is  $2a_1$ .

Given that the frictional force opposing the motion of  $B$  is equal to  $(\sqrt{3}/6)R$ , where  $R$  is the normal reaction between  $B$  and the wire, show that the magnitude of the initial acceleration of  $P$  is  $g/18$ .



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