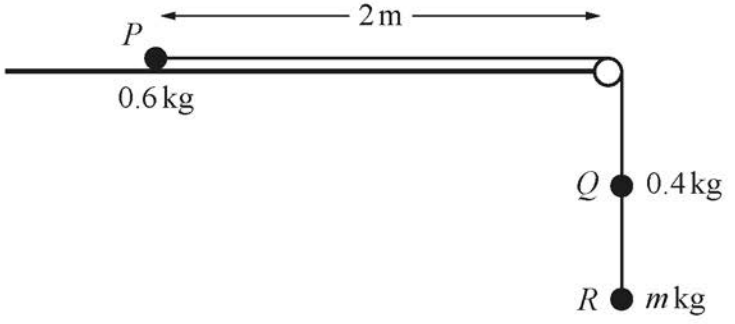
11 Two balls P and Q have masses 0.6 kg and 0.4 kg respectively. The balls are attached to the ends of a string. The string passes over a pulley which is fixed at the edge of a rough horizontal surface. Ball P is held at rest on the surface 2 m from the pulley. Ball Q hangs vertically below the pulley. Ball Q is attached to a third ball R of mass m kg by another string and R hangs vertically below Q (see diagram).



The system is released from rest with the strings taut. Ball P moves towards the pulley with acceleration $3.5\,\text{m s}^{-2}$ and a constant frictional force of magnitude 4.5 N opposes the motion of P.

The balls are modelled as particles, the pulley is modelled as being small and smooth, and the strings are modelled as being light and inextensible.

(a) By considering the motion of P, find the tension in the string connecting P and Q. **[2]**

(b) Hence determine the value of m. Give your answer correct to **3** significant figures. **[4]**

When the balls have been in motion for 0.4 seconds the string connecting Q and R breaks.

(c) Show that, according to the model, P does not reach the pulley. **[6]**

It is given that in fact ball P does reach the pulley.

(d) Identify one factor in the modelling that could account for this difference. **[1]**