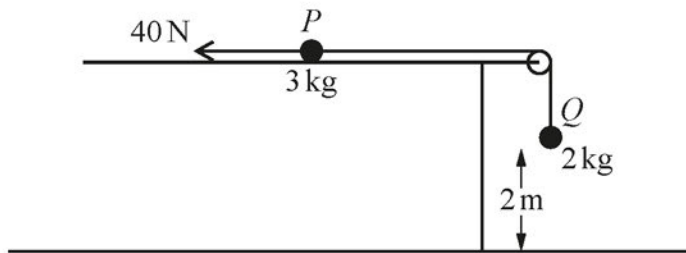


- 11 Two small balls P and Q have masses 3 kg and 2 kg respectively. The balls are attached to the ends of a string. P is held at rest on a rough horizontal surface. The string passes over a pulley which is fixed at the edge of the surface. Q hangs vertically below the pulley at a height of 2 m above a horizontal floor.



The system is initially at rest with the string taut. A horizontal force of magnitude 40 N acts on P as shown in the diagram.

P is released and moves directly away from the pulley. A constant frictional force of magnitude 8 N opposes the motion of P . It is given that P does not leave the horizontal surface and that Q does not reach the pulley in the subsequent motion.

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

- (a) Show that the magnitude of the acceleration of each particle is 2.48 m s^{-2} . [5]
- (b) Find the tension in the string. [2]

When the balls have been in motion for 0.5 seconds, the string breaks.

- (c) Find the additional time that elapses until Q hits the floor. [5]
- (d) Find the speed of Q as it hits the floor. [2]
- (e) Write down the magnitude of the normal reaction force acting on Q when Q has come to rest on the floor. [1]
- (f) State one improvement that could be made to the model. [1]