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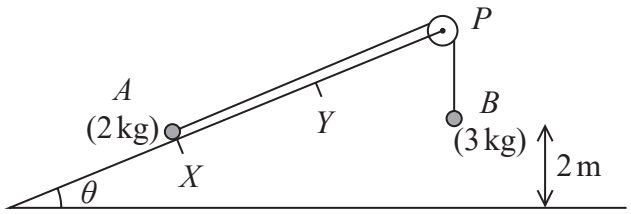


Figure 4

Two particles, A and B, of mass 2 kg and 3 kg respectively, are connected by a light inextensible string. Particle A is held at rest at the point X on a fixed rough ramp that is inclined at an angle θ to the horizontal, where $\tan\theta = \frac{5}{12}$. The string passes over a small smooth pulley P that is fixed at the top of the ramp. Particle B hangs vertically below P, 2 m above the ground, as shown in Figure 4.

The particles are released from rest with the string taut so that A moves up the ramp and the section of the string from A to P is parallel to a line of greatest slope of the ramp. The coefficient of friction between A and the ramp is $\frac{3}{8}$

Air resistance is ignored.

(a) Find the potential energy lost by the system as A moves 2 m up the ramp.

(3)

(b) Find the work done against friction as A moves 2 m up the ramp.

(4)

When B hits the ground, B is brought to rest by the impact and does not rebound and A continues to move up the ramp.

(c) Use the work-energy principle to find the speed of B at the instant before it hits the ground.

(4)

Particle A comes to instantaneous rest at the point Y on the ramp, where $XY = (2 + d)$ m.

(d) Use the work-energy principle to find the value of d.

(4)

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