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Figure 4

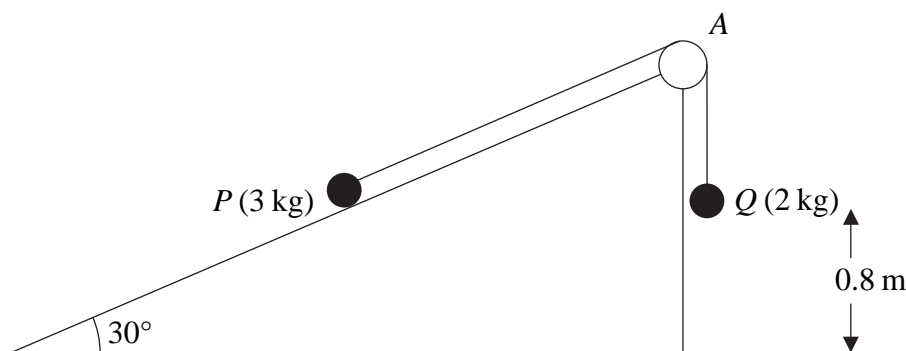


Figure 4 shows two particles  $P$  and  $Q$ , of mass 3 kg and 2 kg respectively, connected by a light inextensible string. Initially  $P$  is held at rest on a fixed smooth plane inclined at  $30^\circ$  to the horizontal. The string passes over a small smooth light pulley  $A$  fixed at the top of the plane. The part of the string from  $P$  to  $A$  is parallel to a line of greatest slope of the plane. The particle  $Q$  hangs freely below  $A$ . The system is released from rest with the string taut.

(a) Write down an equation of motion for  $P$  and an equation of motion for  $Q$ . (4)

(b) Hence show that the acceleration of  $Q$  is  $0.98 \text{ m s}^{-2}$ . (2)

(c) Find the tension in the string. (2)

(d) State where in your calculations you have used the information that the string is inextensible. (1)

On release,  $Q$  is at a height of 0.8 m above the ground. When  $Q$  reaches the ground, it is brought to rest immediately by the impact with the ground and does not rebound. The initial distance of  $P$  from  $A$  is such that in the subsequent motion  $P$  does not reach  $A$ . Find

(e) the speed of  $Q$  as it reaches the ground, (2)

(f) the time between the instant when  $Q$  reaches the ground and the instant when the string becomes taut again. (5)

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