

# Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

## 6 Connected particles

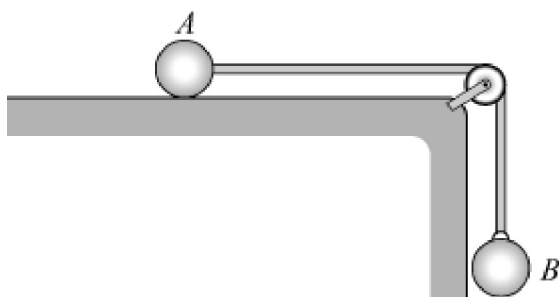
### Exercise A, Question 13

#### Question:

Two particles are connected by a light, inextensible string, which passes over a smooth, light pulley, as shown in the diagram. The particle  $A$ , of mass  $0.5$  kg, is in contact with a rough horizontal surface, and the particle  $B$ , of mass  $0.2$  kg, hangs freely. The coefficient of friction between  $A$  and the surface is  $\frac{2}{7}$ .

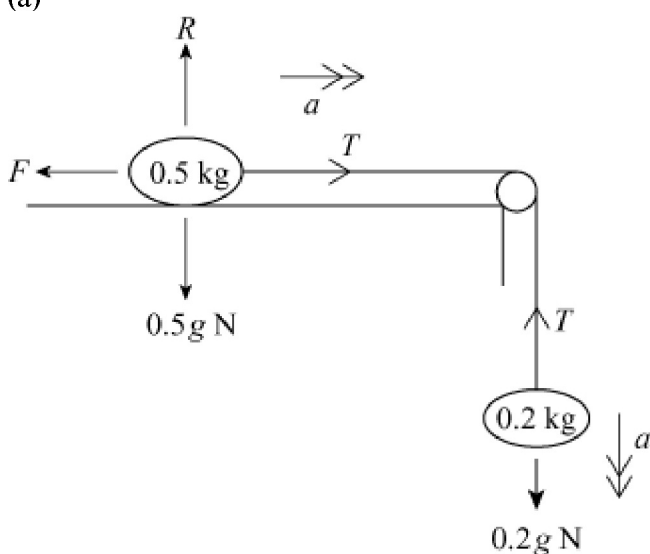
The system is released from rest with the string taut and  $A$  moves towards the pulley.

- Show that the frictional force between  $A$  and the surface is of magnitude  $1.4$  N.
- Find the acceleration of the particles.
- Find the tension in the string.
- Find the time taken for the particles to travel  $0.625$  metres, given that  $A$  has not then reached the pulley. [A]



#### Solution:

(a)



$$\begin{aligned}
 \text{At } A, \text{ resolve vertically } R &= 0.5g \\
 \text{Using } F &= \mu R, \\
 F &= \frac{2}{7} \times 0.5g = 1.4
 \end{aligned}$$

Frictional force is 1.4 N

(b) Using  $F = ma$  at

$$\begin{aligned}
 0.2 \text{ kg particle; } 0.2g - T &= 0.2a \\
 0.5 \text{ kg particle (in the direction of movement); } T - F &= 0.5a \quad [1] \\
 \text{Adding } 0.2g - F &= 0.7a \\
 0.7a &= 0.2g - 1.4 \\
 a &= 0.8 \text{ m s}^{-2}
 \end{aligned}$$

$$\begin{aligned}
 \text{(c) From [1], } T &= F + 0.5 \times 0.8 \\
 &= 1.8 \Rightarrow \text{Tension is 1.8 N}
 \end{aligned}$$

$$\text{Using } s = ut + \frac{1}{2}at^2,$$

$$\begin{aligned}
 \text{(d) } 0.625 &= \frac{1}{2} \times 0.8t^2 \\
 t^2 &= 1.5625
 \end{aligned}$$

$\therefore$  Time is 1.25 sec.