

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

6 Connected particles

Exercise A, Question 16

Question:

A builder uses a rope that passes over a pulley to raise and lower concrete blocks while building a house. The diagram shows the initial positions of two loads of the blocks.

Each load consists of eight blocks, each of mass 5 kg. Initially the lower load is resting on the ground. When two blocks are accidentally removed from the lower load the system begins to move.

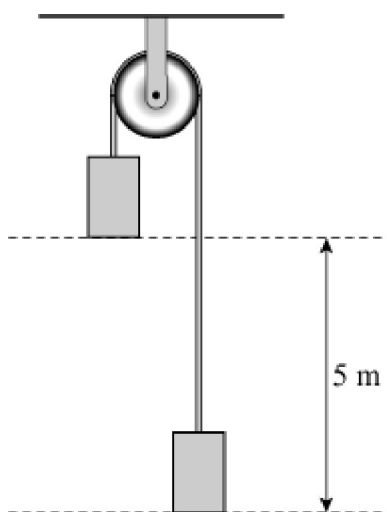
(a) Making any necessary modelling assumptions:

- (i) show that the acceleration of the loads is 1.4 m s^{-2} ,
 (ii) find the tension in the rope.

(b) State two assumptions made in (a).

(c) Find the speed of the two loads when they are at the same level.

[A]



Solution:

(a) (i) Using $F = ma$ for

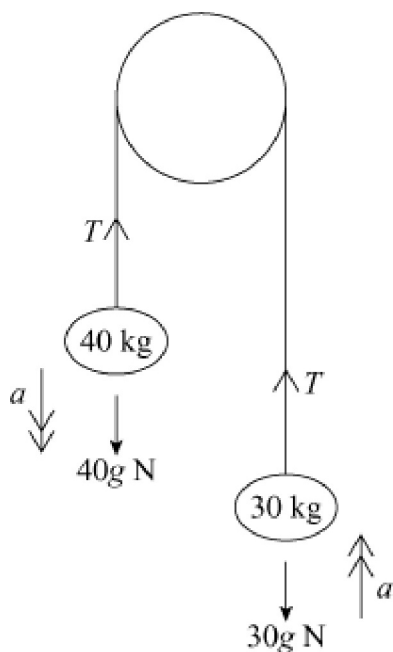
$$40 \text{ kg mass; } 40g - T = 40a$$

$$30 \text{ kg mass; } T - 30g = 30a \quad [1]$$

$$\text{Adding } 10g \quad \quad \quad = 70a$$

$$a \quad \quad \quad = \frac{1}{7} \times g$$

\therefore Acceleration is 1.4 m s^{-2}



(ii) From [1] $T = 30g + 30 \times 1.4$
Tension is 336 N

(b) Assumptions are: smooth pulley light, inextensible string.

(c) When at the same level, each load has moved 2.5 m

Using $v^2 = u^2 + 2as$

$$v^2 = 0 + 2 \times 1.4 \times 2.5$$

$$= 7$$

$$v = 2.6457$$

\therefore speeds are 2.65 m s^{-1} .