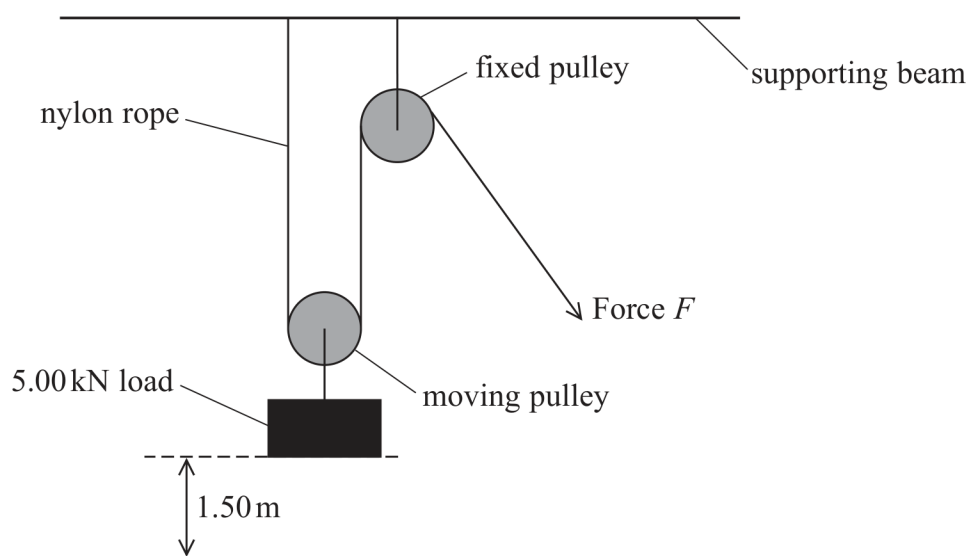


- 17 A pulley system is used to lift a 5.00 kN load through a height of 1.50 m. The system consists of one fixed pulley and the other pulley can move. The pulleys are connected by a nylon rope, as shown.



The nylon rope will stretch when it is used in this way. The weight of the pulleys and the rope can be ignored, and you may assume that there is no friction in the pulleys.

The properties of the nylon rope are:

| | |
|---|-----------------------------------|
| Young modulus of nylon | 2.70 GPa |
| overall length of rope before adding the load | 6.00 m |
| area of cross-section | $3.00 \times 10^{-4} \text{ m}^2$ |

- (a) The greater the length of a rope, the smaller the stiffness of the rope.

Explain why.

(2)

- (b) (i) Show that the stiffness k of the nylon rope is about $1.4 \times 10^5 \text{ N m}^{-1}$.

(3)



(ii) The pulley system lifts the 5.00 kN weight at a steady rate.

Determine the extension of the rope while the lift is taking place.

(3)

Extension of rope =

(iii) Calculate the work done in stretching the rope.

(2)

Work done in stretching rope =

(c) Assess whether the stretching of the rope has a significant effect on the efficiency of the pulley system.

(2)

(Total for Question 17 = 12 marks)