

**Chapter 4**  
**Short answer question**

This question is about using a helicopter to transport a heavy load.

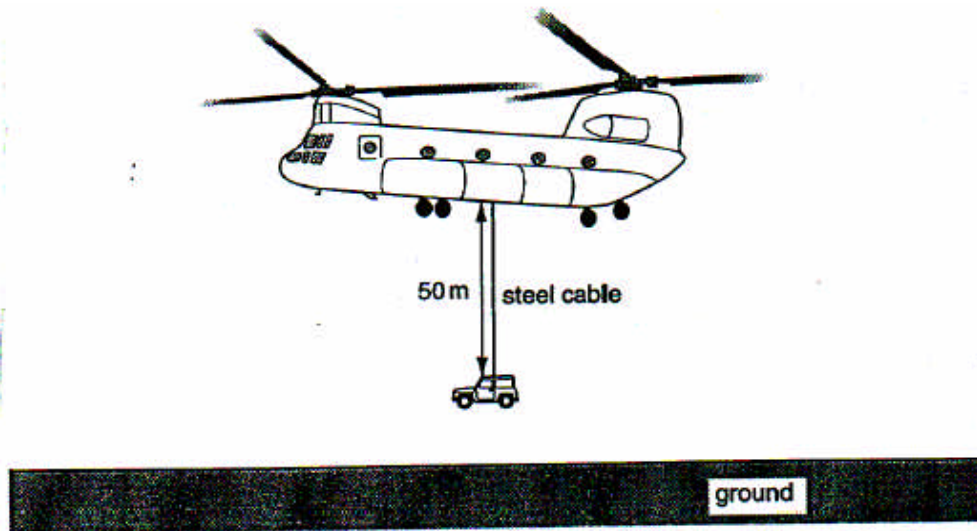


Fig. 1(not to scale)

A vehicle is suspended beneath a helicopter on a steel cable.

- (a) The helicopter lifts the vehicle of mass 1500kg at a vertical acceleration of  $3.0 \text{ ms}^{-2}$ . Show that the tension in the cable is  $1.9 \times 10^4 \text{ N}$ .  
 $g = 9.8 \text{ N kg}^{-1}$ .

$$\begin{aligned}\text{Tension} &= mg + ma \\ &= 1500 \times 9.8 + 1500 \times 3 \\ &= 19,200 \text{ N}\end{aligned}$$

- (b) This steel cable, of length 50m and cross-sectional area  $8.0 \times 10^{-5} \text{ m}^2$ , stretches elastically during lifting.

- (i) Calculate the stress in the steel cable caused by the tension.

$$\begin{aligned}\text{Stress} &= \frac{F}{A} &= \frac{19,200}{8 \times 10^{-5}} &= 2.4 \times 10^8 \text{ Pa}\end{aligned}$$

- (ii) Show that this stress causes the cable to extend by 0.055m.  
The Young Modulus for steel  $E = 2.2 \times 10^{11} \text{ N m}^{-2}$ .

$$\text{Strain} = \frac{\text{Stress}}{E} = \frac{2.4 \times 10^8}{2.2 \times 10^{11}} = 0.0011$$

$$\text{Extension} = \text{Strain} \times L = 0.0011 \times 50 = 0.055 \text{ m}$$

- (iii) Calculate the energy stored in the stretched cable.

$$\text{Energy} = \frac{1}{2}Fx$$

$$= \frac{1}{2} \times 19,200 \times 0.055$$

$$= 528 \text{ J}$$