

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

5 Newton's laws of motion

Exercise Test yourself, Question 1

Question:

A helicopter of mass 880 kg is rising vertically at a constant rate. Find the magnitude of the lift force acting on the helicopter. How would your answer change if the helicopter was descending at a constant rate?

Solution:

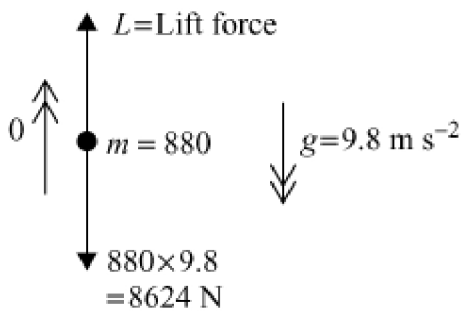
Newton's 2nd Law upwards

$$L - 8624 = 880 \times 0$$

$$\therefore L = 8624 \text{ N}$$

$$L = 8620 \text{ N (3 s.f.)}$$

If descending the equation remains the same i.e. no change, $L = 8620 \text{ N}$



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Exercise Test yourself, Question 2

Question:

A child, of mass 30 kg, slides down a slide at a constant speed. Assume that there is no air resistance acting on the child. The slide makes an angle of 40° with the horizontal. Find the magnitude of the friction force on the child and the coefficient of friction.

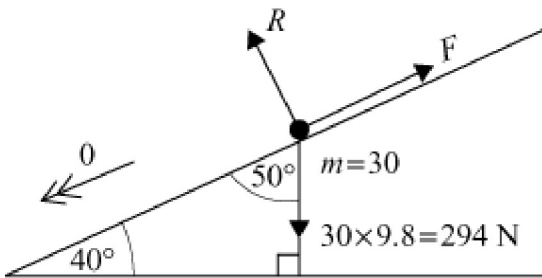
Solution:

Newton's 2nd Law down slope

$$294 \times \cos 50^\circ - F = 30 \times 0$$

$$\therefore F = 294 \cos 50^\circ = 188.979\dots$$

$$F = 189 \text{ N (3 s.f.)}$$



Newton's 2nd Law perpendicular to slope

$$R - 294 \sin 50^\circ = 30 \times 0$$

$$\therefore R = 294 \sin 50^\circ$$

$$R = 225.21\dots \text{ N}$$

and limiting friction

$$F = \mu R$$

gives $\mu = \frac{F}{R}$

$$\mu = \frac{188.979\dots}{225.21\dots} = 0.83909\dots$$

$$\mu = 0.839 \text{ (3 s.f.)}$$

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Exercise Test yourself, Question 3

Question:

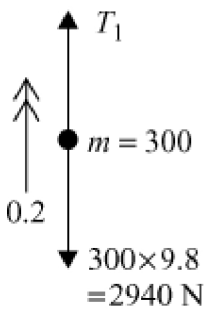
A lift and its passengers have a total mass of 300 kg. Find the tension in the lift cable if:

- (a) it accelerates upwards at 0.2 m s^{-2}
 (b) it accelerates downwards at 0.05 m s^{-2} .

Solution:

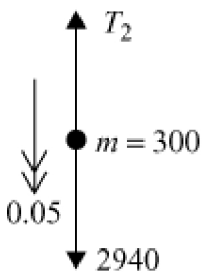
- (a) Newton's 2nd law, \uparrow

$$\begin{aligned} T_1 - 2940 &= 300 \times 0.2 \\ T_1 &= 2940 + 300 \times 0.2 \\ T_1 &= 3000 \text{ N} \end{aligned}$$



- (b) Newton's 2nd Law, \downarrow

$$\begin{aligned} 2940 - T_2 &= 300 \times 0.05 \\ 2940 - 300 \times 0.05 &= T_2 \\ T_2 &= 2925 \text{ N} \end{aligned}$$



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Exercise Test yourself, Question 4

Question:

A van, of mass 1200 kg, rolls down a slope, inclined at 3° to the horizontal and experiences a resistance force of magnitude 400 N. Find the acceleration of the van.

Solution:

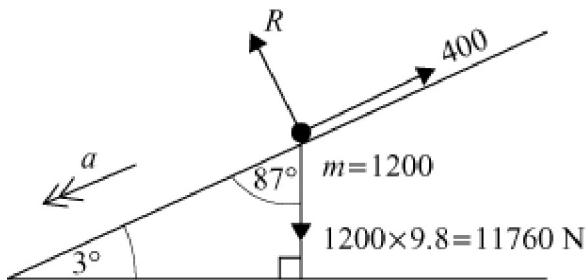
Newton's 2nd Law down slope

$$11760 \times \cos 87^\circ - 400 = 1200 \times a$$

$$\therefore \frac{11760 \cos 87^\circ - 400}{1200} = a$$

$$a = 0.17955..$$

$$a = 0.180 \text{ m s}^{-2} \text{ (3 s.f.)}$$



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