

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

5 Newton's laws of motion

Exercise B, Question 18

Question:

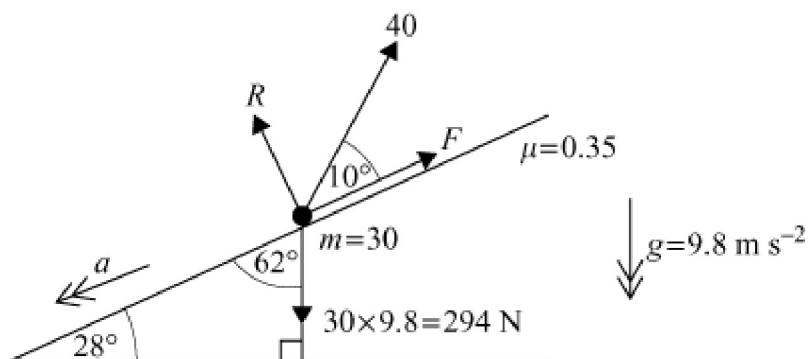
A sledge of mass 30 kg is accelerating down a hill while a boy is trying to prevent it from sliding by pulling on a rope attached to the sledge with a force of 40 N. The hill has inclination 28° and the rope is inclined to the hill at 10° . The coefficient of friction between the sledge and the hill is 0.35. Find:

- the magnitude of the normal reaction force on the sledge,
- the resultant force on the sledge acting down the hill,
- the magnitude of the sledge's acceleration.

Solution:

- (a) Newton's 2nd Law perpendicular to the slope

$$\begin{aligned}
 R + 40 \sin 10^\circ - 294 \sin 62^\circ &= 30 \times 0 \\
 \therefore R &= 294 \sin 62^\circ - 40 \sin 10^\circ \\
 R &= 252.64\dots \\
 R &= 253 \text{ N (3 s.f.)}
 \end{aligned}$$



- (b) Limiting friction

$$\begin{aligned}
 F &= 0.35 \times R \\
 \therefore F &= 0.35 \times 252.64 \\
 F &= 88.424\dots \text{ N} \\
 \therefore \text{Resultant force down hill} &= 294 \cos 62^\circ - 40 \cos 10^\circ - F \\
 &= 294 \cos 62^\circ - 40 \cos 10^\circ - 88.424\dots \\
 &= 10.208\dots \\
 &= 10.2 \text{ N (3 s.f.)}
 \end{aligned}$$

- (c) Newton's 2nd Law down slope

$$10.208\dots = 30 \times a$$

$$\therefore \frac{10.208}{30} = a$$

$$a = 0.34026\dots$$

$$a = 0.340 \text{ m s}^{-2} \text{ (3 s.f.)}$$

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