

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

5 Newton's laws of motion

Exercise B, Question 7

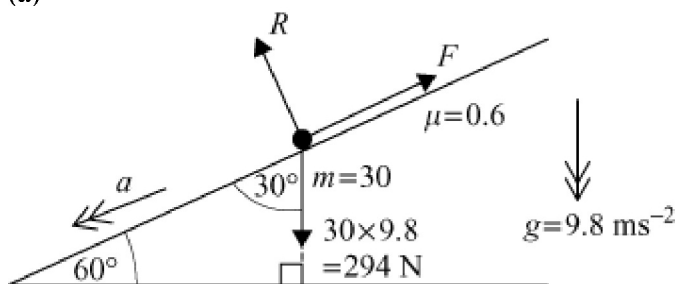
Question:

A child slides down a steep, straight slide that is inclined at 60° to the horizontal. The child has mass 30 kg and the coefficient of friction between the slide and the child is 0.6. Assume that there is no air resistance.

- Draw a diagram to show the forces acting on the child, while sliding down the slide.
- Calculate the magnitude of the normal reaction force on the child.
- Show that the magnitude of the friction force that acts on the child is 88.2 N.
- Calculate the acceleration of the child.
- What modelling assumption have you made about the child in your solution? [A]

Solution:

(a)



(b) Newton's 2nd Law perpendicular to slide

$$\begin{aligned}
 R - 294 \sin 30^\circ &= 30 \times 0 \\
 \therefore R &= 294 \times \sin 30^\circ \\
 R &= 147 \text{ N}
 \end{aligned}$$

(c) Limiting friction

$$\begin{aligned}
 F &= 0.6 \times R \\
 \therefore F &= 0.6 \times 147 \\
 \therefore F &= 88.2 \text{ N}
 \end{aligned}$$

(d) Newton's 2nd Law down slide

$$294 \cos 30^\circ - F = 30 \times a$$

$$\therefore \frac{294 \cos 30^\circ - 88.2}{30} = a$$

$$\text{i.e. } a = 5.5470$$

$$a = 5.55 \text{ m s}^{-2} \text{ (3 s.f.)}$$

(e) The child is a particle.

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