

# Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

## Exam style practice papers

### Exercise MM1B, Question 6

#### Question:

A child pulls a sledge, of mass 20 kg, along a snow-covered surface. The child uses a rope that remains horizontal as he pulls. The coefficient of friction between the ground and the sledge is 0.2. The tension in the rope is  $T$  N.

(a) The sledge is pulled along a horizontal surface.

(i) Show that the magnitude of the friction force acting on the sledge is 39.2 N. (2 marks)

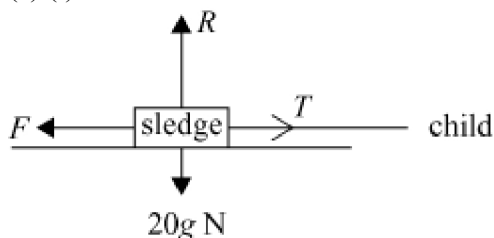
(ii) Find the tension in the rope if the sledge accelerates at  $0.05 \text{ m s}^{-2}$  on a horizontal surface. (4 marks)

(iii) State the tension needed to keep the sledge moving at a constant speed. (2 marks)

(b) The child then pulls the sledge up a slope inclined at an angle of  $10^\circ$  to the horizontal. The rope is parallel to the slope. Find the tension if the sledge moves at a constant speed. (4 marks)

#### Solution:

(a) (i)



For the sledge; resolve vertically  $R = 20g$

$$F = \mu R$$

$$F = 0.2 \times 20g$$

$$F = 4g$$

$\therefore$  Magnitude of the friction force is 39.2 N

For the sledge, using  $F = ma$  horizontally

$$(ii) \quad T - F = 20 \times 0.05$$

$$T = 40.2$$

$$\text{Tension is } 40.2 \text{ N}$$

(iii) If the sledge is to move at a constant speed,

$a = 0$  and  $T = F \therefore$  Tension is 39.2 N

$$\begin{aligned} \text{Resolve perpendicular to the slope } R &= 20g \cos 10^\circ \\ &= 193.02 \end{aligned}$$

$$\begin{aligned} \text{(b) Using } F &= \mu R, \\ F &= 0.2 \times 193.02 \\ &= 38.6 \end{aligned}$$

$$\begin{aligned} \text{Resolve along the slope (constant speed } \Rightarrow \text{ body in equilibrium) } T &= F + 20g \sin 10^\circ \\ &= 38.6 + 34.03 \end{aligned}$$

Tension is

$$72.6 \text{ N.}$$

