

Section 2: Newton's second law

Solutions to Exercise level 1

1. (i) Resolving horizontally and using Newton's 2nd law gives

$$150 \cos 30^\circ - 100 = 60a$$

$$a = 0.498 \text{ ms}^{-2} \text{ (3 s.f.)}$$

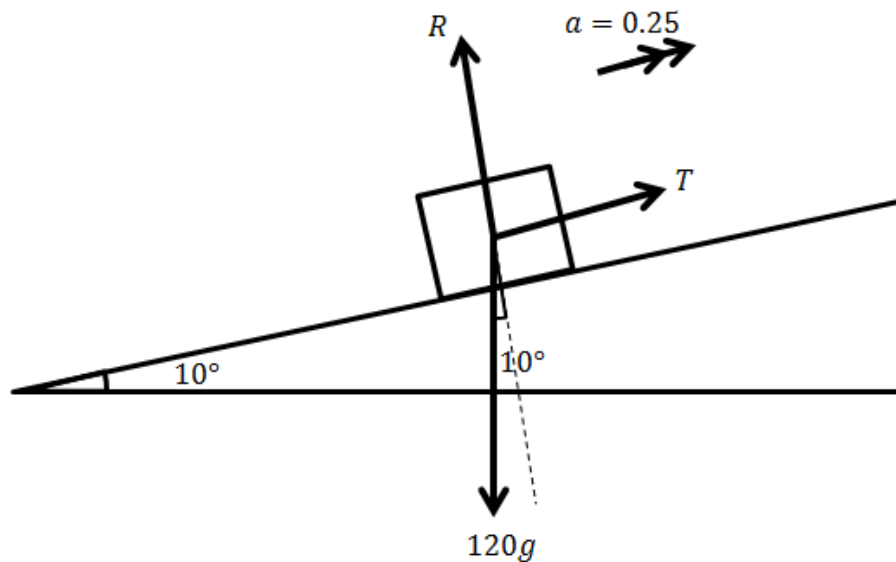
- (ii) Resolving vertically gives

$$R + 150 \sin 30^\circ = 60g$$

$$R = 60 \times 9.8 - 75$$

$$R = 513 \text{ N}$$

2. (i)



- (ii) $T - 120g \sin 10^\circ = 120 \times 0.25$

$$T = 30 + 120 \times 9.8 \sin 10^\circ$$

$$T = 234 \text{ N (3 s.f.)}$$

3. (i) Horizontal component of 10 N force = $10 \cos 60^\circ = 5 \text{ N}$

- (ii) Resultant horizontal force = $10 \cos 60^\circ - 4$
 $= 1 \text{ N}$

- (iii) Horizontal motion: $F = ma$

$$1 = 2a$$

$$a = 0.5 \text{ ms}^{-2}$$

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$$(iv) s = ut + \frac{1}{2}at^2$$

$$s = 0 + \frac{1}{2} \times 0.5t^2$$

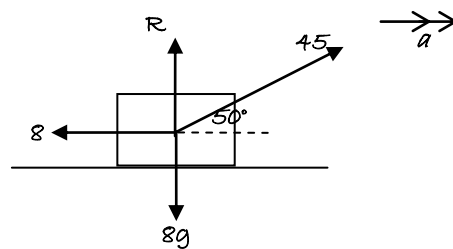
$$s = \frac{1}{4}t^2$$

$$(v) \text{ Resolving vertically: } R + 10 \sin 60^\circ - 2g = 0$$

$$R = 2g - 10 \times \frac{1}{2} \sqrt{3}$$

$$R = 10.9 \text{ N (3 s.f.)}$$

4.



$$\text{Horizontally: } F = ma$$

$$45 \cos 50^\circ - 8 = 8a$$

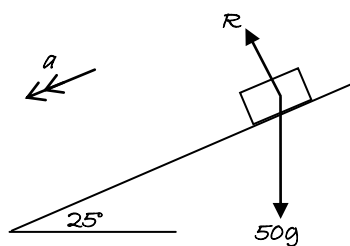
$$a = 2.62 \text{ ms}^{-2} \text{ (3 s.f.)}$$

$$s = ut + \frac{1}{2}at^2$$

$$s = 0 + \frac{1}{2} \times 2.616 \times 25$$

$$= 32.7 \text{ m}$$

5.



$$\text{Resolving down the plane: } F = ma$$

$$50g \sin 25^\circ = 50a$$

$$a = g \sin 25^\circ$$

$$a = 4.14 \text{ ms}^{-2} \text{ (3 s.f.)}$$

$$u = 0, a = 4.141, s = 20, v = ?$$

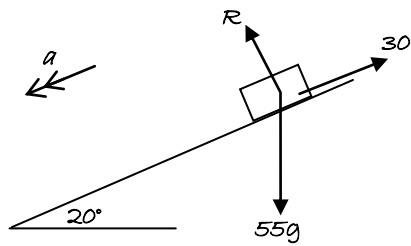
$$v^2 = u^2 + 2as$$

$$= 0 + 2 \times 4.141 \times 20$$

$$v = 12.9 \text{ ms}^{-1} \text{ (3 s.f.)}$$

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6.



(i) Resolving down the slope: $F = ma$

$$55g \sin 20^\circ - 30 = 55a$$

$$55 \times 9.8 \sin 20^\circ - 30 = 55a$$

$$a = 2.81 \text{ ms}^{-2} \text{ (3 s.f.)}$$

(ii) $u = 0, a = 2.806, t = 5, v = ?$

$$v = u + at$$

$$= 0 + 2.806 \times 5$$

$$= 14.0 \text{ ms}^{-1}$$