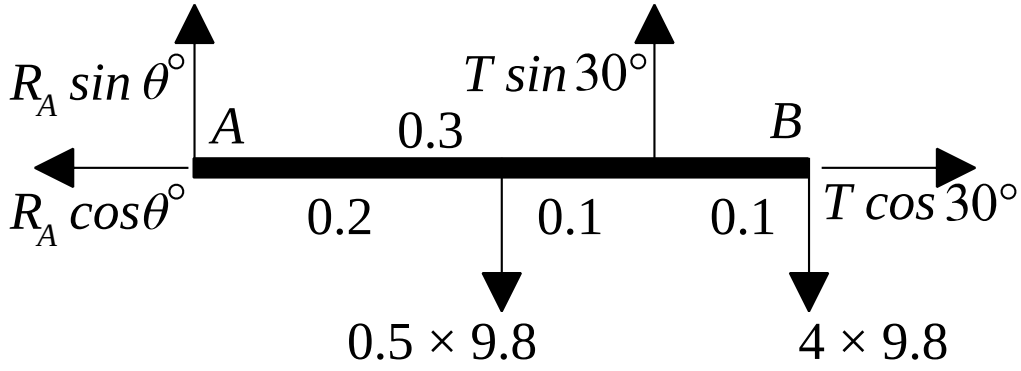
1.6 Answers

1.6.1 Solution to 1.4 Example



(i) Taking moments about A,

$$T \sin 30 \times 0.3 = 0.5 \times 9.8 \times 0.2 + 4 \times 9.8 \times 0.4$$

$$0.5T = 0.98 + 15.68$$

$$T = 33.3 \text{ N}$$

(ii) Balancing forces horizontally,

$$R_A \cos\theta = T \cos 30$$

$$R_A \cos\theta = 33.3 \times 0.866$$

$$= 28.8 \text{ N}$$

Balancing forces vertically,

$$R_A \sin\theta + T \sin 30° = 0.5 \times 9.8 + 4 \times 9.8$$

$$R_A \sin\theta + 33.3 \times 0.5 = 4.9 + 39.2$$

$$R_A \sin\theta = 27.5 \text{ N}$$

Solving the latter two equations simultaneously,

$$\frac{R_A \sin\theta}{R_A \cos\theta} = \frac{27.5}{28.8}$$

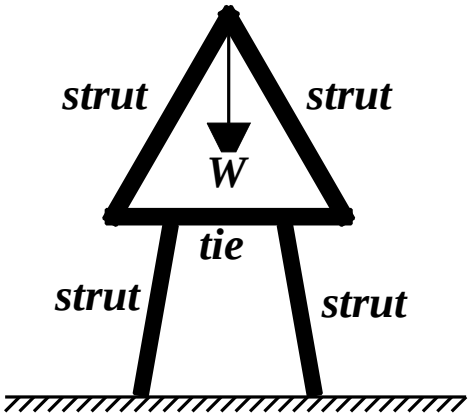
$$\tan\theta = 0.955$$

$$\theta = 43.7°$$

$$\therefore \; R_A = 39.8 \text{ N}$$

1.6.2 Solutions to 1.5 Exercise

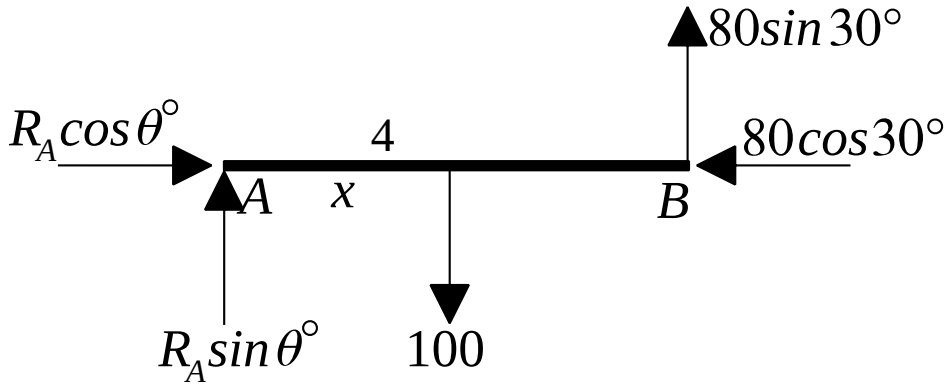
Answer 1



Answer 2

(i) a tie

(ii)



(iii) Taking moments about A,

$$100x = 80 \sin 30 \times 4$$

$$x = 1.6 \text{ metres}$$

(iv) Balancing forces vertically,

$$R_A \sin \theta + 80 \sin 30 = 100$$

$$R_A \sin \theta = 60$$

(v) Balancing forces horizontally,

$$R_A \cos \theta = 80 \cos 30$$

$$= 69.3$$

(vi)

$$\frac{R_A \sin \theta}{R_A \cos \theta} = \frac{60}{69\,3}$$

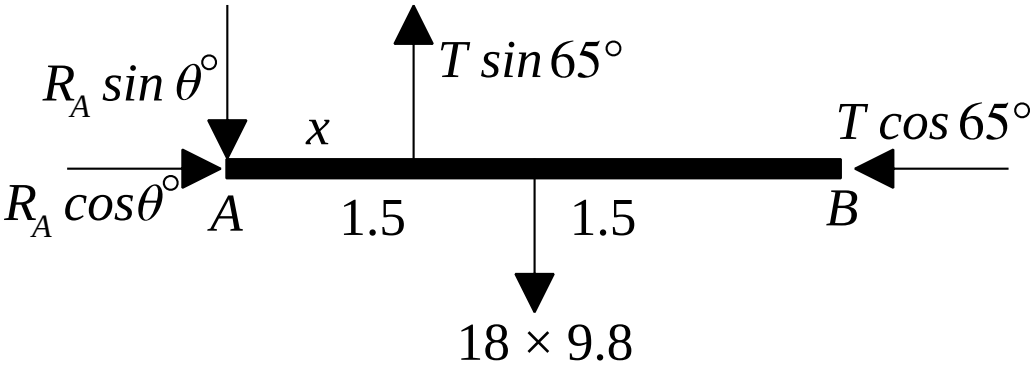
$$\tan \theta = 0.866$$

$$\theta = 40.9°$$

$$\therefore R_A = 91.7 \text{ N}$$

Answer 3

(i)



(ii)

$$\sin 25 = \frac{x}{2}$$

$$x = 0.85$$

(iii) Taking moments about A,

$$T \sin 65 \times x = 18 \times 9.8 \times 1.5$$

$$T \sin 65 \times 0.85 = 265$$

$$T = 343 \text{ N}$$

(iv) Balancing forces vertically,

$$R_A \sin\theta + 18 \times 9.8 = T \sin 65$$

$$R_A \sin\theta + 176 = 343 \times 0.906$$

$$R_A \sin\theta = 135$$

(v) Balancing forces horizontally,

$$R_A \cos\theta = T \cos 65$$

$$= 343 \times 0.423$$

$$= 145$$

(vi)

$$\frac{R_A \sin\theta}{R_A \cos\theta} = \frac{135}{145}$$

$$\tan\theta = 0.931$$

$$\theta = 43.0°$$

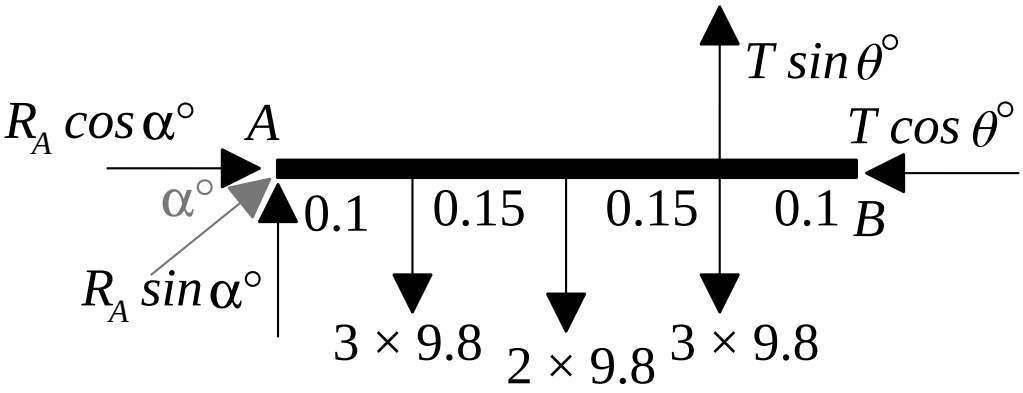
$$\therefore R_A = 198 \text{ N}$$

Answer 4

(i) By simple trigonometry,

$$\cos\theta = \frac{4}{5} \qquad \sin\theta = \frac{3}{5} \qquad \tan\theta = \frac{3}{4} \qquad \theta = 36.9°$$

(ii) The working diagram,



Taking moments about A,

$$T\sin\theta = 3 \times 9.8 \times 0.1 + 2 \times 9.8 \times 0.25 + 3 \times 9.8 \times 0.4$$

$$T \times \frac{3}{5} = 2.94 + 4.9 + 11.76$$

$$0.6\,T = 19.6$$

$$T = 32.7\text{ N}$$

(iii) Balancing forces vertically,

$$R_A\sin\alpha + T\sin\theta = 3 \times 9.8 + 2 \times 9.8 + 3 \times 9.8$$

$$R_A\sin\alpha + 32.7 \times \frac{3}{5} = 29.4 + 19.6 + 29.4$$

$$R_A\sin\alpha = 66.8$$

Balancing forces horizontally,

$$R_A\cos\alpha = T\cos\theta$$

$$= 32.7 \times \frac{4}{5}$$

$$= 26.2$$

Combining equations,

$$\frac{R_A\sin\alpha}{R_A\cos\alpha} = \frac{66.8}{26.2}$$

$$\tan\alpha = 2.55$$

$$\alpha = 68.6°$$

$$\therefore\ R_A = 71.7\text{ N}$$