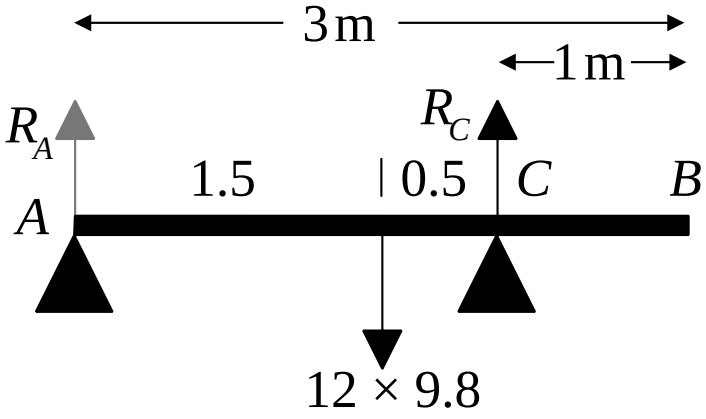
2.4 Answers

2.4.1 Solutions to 2.2 Example

(a)

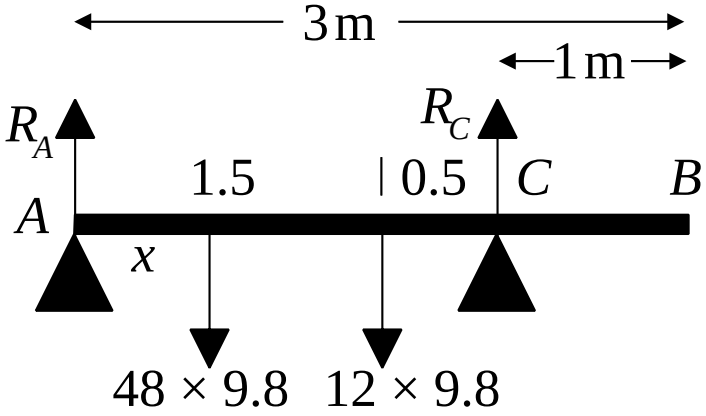


Take moments about A,

$$12 \times 9.8 \times 1.5 = R_C \times 2$$

$$R_C = 88.2 \text{ N}$$

(b)



Balancing linear forces vertically,

$$R_A + R_C = 48 \times 9.8 + 12 \times 9.8$$

$$2R_A = 2R_C = 588$$

$$R_A = R_C = 294 \, TN$$

Take moments about A,

$$R_C \times 2 = 48 \times 9.8 \times x + 12 \times 9.8 \times 1.5$$

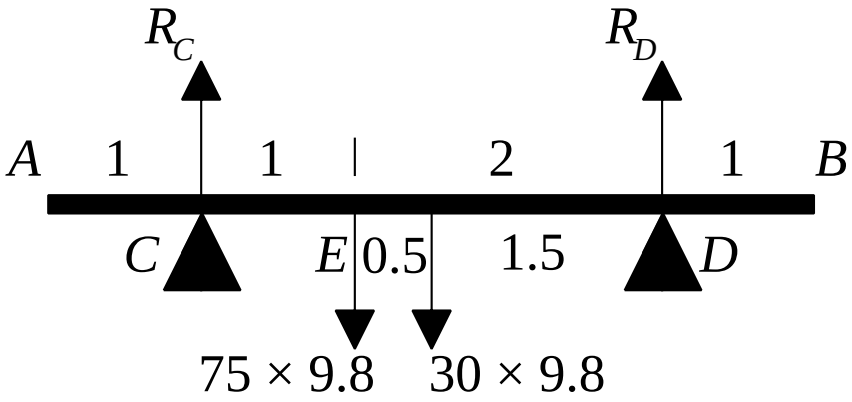
$$294 \times 2 = 470x + 176$$

$$x = 0.88 \text{ metres}$$

2.4.2 Answers to 2.3 Exercise

Answer 1

A clear working diagram is an enormous help in understanding the question.



(a) Taking moments about C,

$$R_D \times 3 = 75 \times 9.8 \times 1 + 30 \times 9.8 \times 1.5$$

$$3R_D = 735 + 441$$

$$R_D = 392 \text{ N}$$

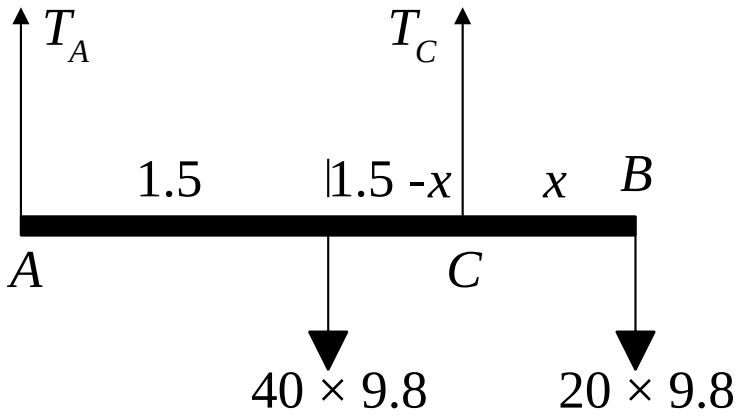
(b) Balancing forces vertically,

$$R_C + R_D = 75 \times 9.8 + 30 \times 9.8$$

$$R_C + 392 = 735 + 294$$

$$R_C = 637 \text{ N}$$

Answer 2



(a) Balancing forces vertically,

$$T_A + T_C = 40 \times 9.8 + 20 \times 9.8$$

$$T_A + 3\,T_A = 392 + 196$$

$$4\,T_A = 588$$

$$T_A = 147 \text{ N}$$

$$\therefore\ T_C = 441 \text{ N}$$

(b) Taking moments about B,

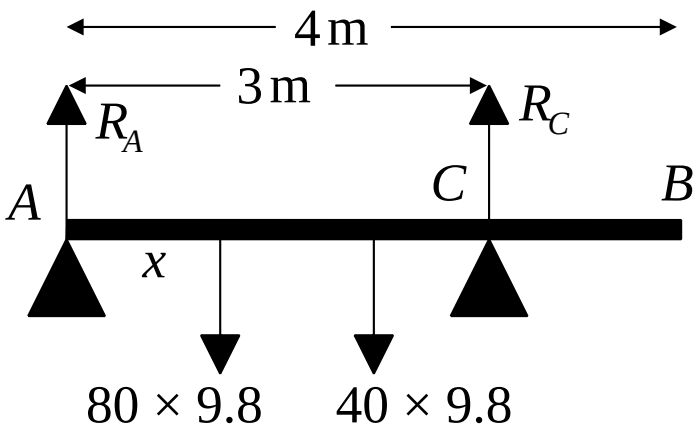
$$T_C \times x + T_A \times 3 = 40 \times 9.8 \times 1.5$$

$$441x + 3 \times 147 = 588$$

$$441x = 147$$

$$x = \frac{1}{3} \text{ metre}$$

Answer 3



(a) Balancing forces vertically,

$$R_A + R_C = 80 \times 9.8 + 40 \times 9.8$$

$$2R = 784 + 392$$

$$R_A = R_C = 588 \text{ N}$$

(b) It's strategically unsound to take moments about any point other than the end-points of the plank when an unknown distance is involved.

Taking moments about *A*,

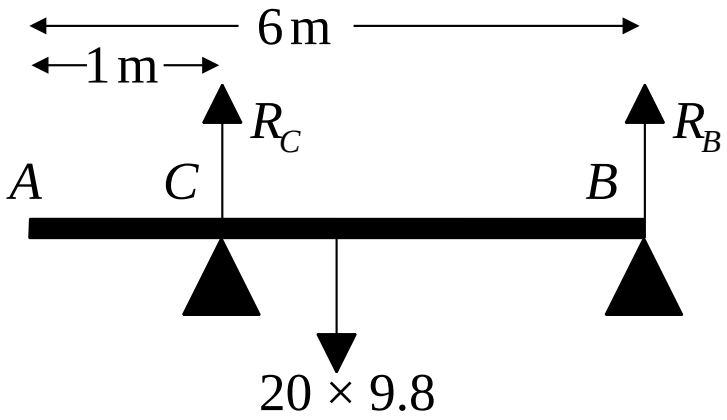
$$R_C \times 3 = 80 \times 9.8 \times x + 40 \times 9.8 \times 2$$

$$3 \times 588 = 784x + 784$$

$$784x = 980$$

$$x = 1.25 \text{ metres}$$

Answer 4



(a) Take moments about *C* is valid although taking moments about *B* is marginally easier to get correct. So, taking moments about *B*,

$$R_C \times 5 = 20 \times 9.8 \times 3$$

$$R_C = 118 \text{ N}$$

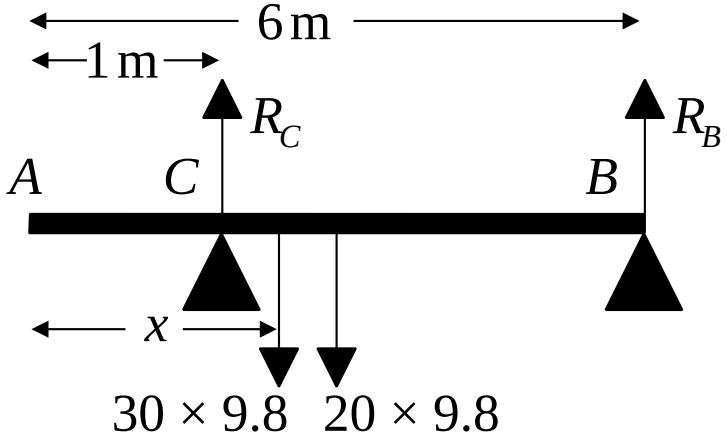
Balancing forces vertically,

$$R_B + R_C = 20 \times 9.8$$

$$R_B = 196 - 118$$

$$= 78 \text{ N}$$

(b)



Balancing forces vertically,

$$R_C + R_B = 30 \times 9.8 + 20 \times 9.8$$

$$2R = 294 + 196$$

$$R_C = R_B = 245 \text{ N}$$

Taking moments about *B*,

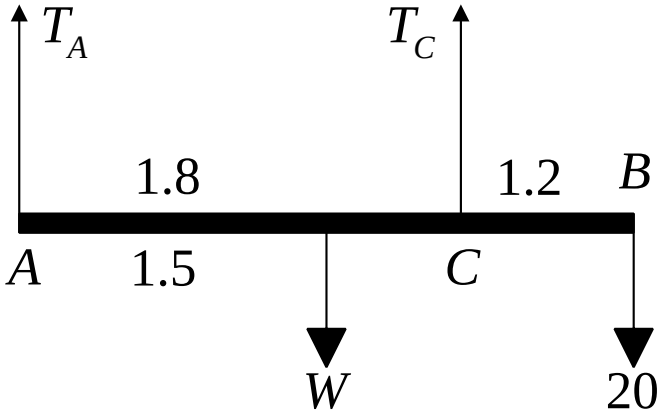
$$R_C \times 5 = 30 \times 9.8 \times (6 - x) + 20 \times 9.8 \times 3$$

$$1225 = 1764 - 294x + 588$$

$$294x = 1127$$

$$x = 3.83 \text{ metres}$$

Answer 5



(a) Take moments about A,

$$T_C \times 1.8 = W \times 1.5 + 20 \times 3$$

$$T_C = \frac{1.5\,W}{1.8} + \frac{60}{1.8}$$

$$= \frac{15}{18}\,W + \frac{600}{18}$$

$$= \frac{5}{6}\,W + \frac{100}{3} \qquad \square$$

(b) Balancing forces vertically,

$$T_A + T_C = W + 20$$

$$T_A = W + 20 - \frac{5}{6}\,W - \frac{100}{3}$$

$$= \frac{1}{6}\,W - \frac{40}{3}$$

(c)

$$T_C = 8\,T_A$$

$$\frac{5}{6}\,W + \frac{100}{3} = 8\left(\frac{1}{6}\,W - \frac{40}{3}\right)$$

Multiply through by 6

$$5W + 200 = 8\,(W - 80)$$

$$200 + 640 = 8W - 5W$$

$$3W = 840$$

$$W = 280 \text{ N}$$