

Section 1: The moment of a force

Solutions to Exercise level 1

1. (i) Moment = $4 \times 2 = 8$ Nm anticlockwise

(ii) Moment = $8 \times 3 = 24$ Nm clockwise

(iii) Measuring clockwise, total moment = $5 \times 3 - 2 \times 1 = 15 - 2 = 13$
so moment = 13 Nm clockwise

(iv) Measuring clockwise, total moment = $7 \times 4 - 5 \times 3 - 3 \times 5$
 $= 28 - 15 - 15 = -2$
so moment = 2 Nm anticlockwise.

2. (i) Taking moments about left end: $40 \times 2 - T_2 \times 3 = 0$

$$3T_2 = 80$$

$$T_2 = \frac{80}{3} \text{ N}$$

Resolving vertically: $T_1 + \frac{80}{3} = 40$

$$T_1 = \frac{40}{3} \text{ N}$$

(ii) Taking moments about left end: $40 \times 2 + 20 \times 3 - T_2 \times 4 = 0$

$$4T_2 = 140$$

$$T_2 = 35 \text{ N}$$

Resolving vertically: $T_1 + 35 = 40 + 20$

$$T_1 = 25 \text{ N}$$

(iii) Taking moments about right end: $80 \times 5.5 + 40 \times 3 - T_1 \times 3.5 = 0$

$$3.5T_1 = 560$$

$$T_1 = 160 \text{ N}$$

Resolving vertically: $T_2 + 160 = 80 + 40$

$$T_2 = -40 \text{ N}$$

This means that the tension would have to act downwards, so the cable would need to be attached below the beam.

(iv) Taking moments about right end:

$$50 \times 4.4 + 40 \times 2.2 + 30 \times 1.2 - T_1 \times 4 = 0$$

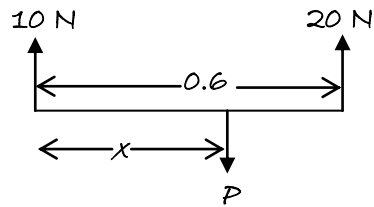
$$4T_1 = 344$$

$$T_1 = 86 \text{ N}$$

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Resolving vertically: $T_2 + 86 = 50 + 40 + 30$
 $T_2 = 34 \text{ N}$

3. (i)



Resolving vertically: $10 + 20 - P = 0$

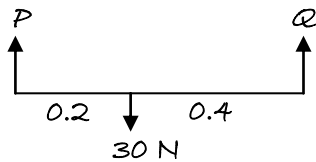
$$P = 30 \text{ N}$$

Taking moments about left-hand end: $20 \times 0.6 - Px = 0$

$$30x = 12$$

$$x = 0.4 \text{ m}$$

(ii)



Taking moments about left-hand end: $0.6Q - 0.2 \times 30 = 0$

$$0.6Q = 6$$

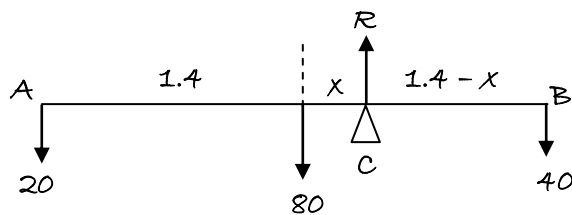
$$Q = 10 \text{ N}$$

Resolving vertically: $P + Q - 30 = 0$

$$P + 10 = 30$$

$$P = 20 \text{ N}$$

4.



Taking moments about C: $20(1.4 + x) + 80x - 40(1.4 - x) = 0$

$$28 + 20x + 80x - 56 + 40x = 0$$

$$140x = 28$$

$$x = 0.2$$

Distance of C from A = 1.6 m.