MEI A level Maths Moments

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, to the cable would need to be attached below the beam.

    (iv) Taking moments about right end:
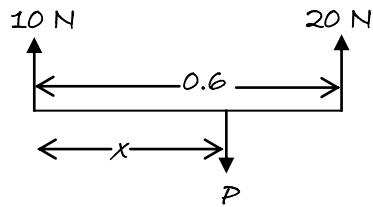 $$50 \times 4.4 + 40 \times 2.2 + 30 \times 1.2 - T_1 \times 4 = 0$$
    $$4T_1 = 344$$
    $$T_1 = 86 \text{ N}$$

Resolving vertically: $\qquad$ $T_2 + 86 = 50 + 40 + 30$

$$T_2 = 34 \text{ N}$$

3. (i)

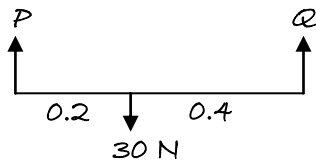Resolving vertically: $10 + 20 - P = 0$

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

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

$$30x = 12$$

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

(ii)

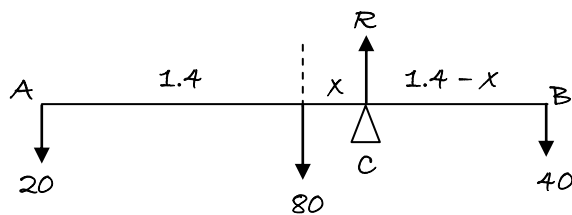Taking moments about left-hand end: $0.6Q - 0.2 \times 30 = 0$

$$0.6Q = 6$$

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

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.