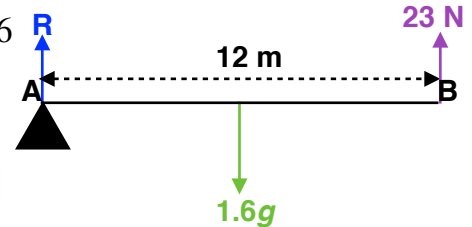


Equilibrium

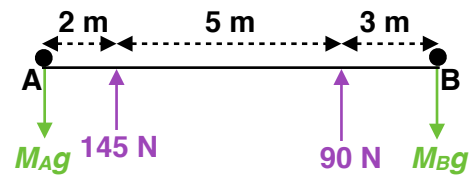
Starter

1. **(Review of last lesson)** A horizontal uniform rod AB of length 12 m and mass 1.6 kg is acted upon by an upward vertical force of 23 N at B . Find the sum of the moments about A .

Working: Sum of moments = $23 \times 12 - 1.6g \times 6$
 $= 181.92 \text{ Nm}$



- E.g. 1** The diagram shows a light rod AB of length 10 m. Given that the rod is in equilibrium, find M_A and M_B .



Working: An unknown force acts through A so take moments about A .

$$\begin{aligned} \curvearrowright \text{ about } A: \quad M_B g \times 3 &= 145 \times 2 + 90 \times 7 \\ M_B &= \frac{145 \times 2 + 90 \times 7}{3g} \\ M_B &= 9.39 \text{ kg} \end{aligned}$$

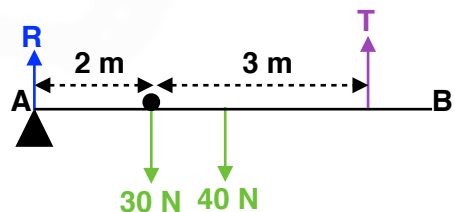
$$\begin{aligned} R(\uparrow): \quad M_A g + M_B g &= 145 + 90 \\ M_A g + 9.39g &= 145 + 90 \\ M_A g &= \frac{145 + 90 - 9.39g}{g} \\ M_A &= 14.6 \text{ kg} \end{aligned}$$

- E.g. 2** A 6 m long uniform beam AB of weight 40 N is supported at A by a vertical reaction R . AB is held horizontal by a vertical wire attached 1 m from the other end. A particle of weight of 30 N is placed 2 m from the support A . Find the tension T in the wire and the force R .

Working: An unknown force acts through A so take moments about A .

$$\begin{aligned} \curvearrowright \text{ about } A: \quad 5T &= 30 \times 2 + 40 \times 3 \\ 5T &= 180 \\ T &= 36 \text{ N} \end{aligned}$$

$$\begin{aligned} R(\uparrow): \quad R + T &= 30 + 40 \\ R + 36 &= 70 \\ R &= 34 \text{ N} \end{aligned}$$



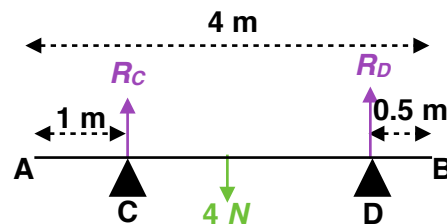
E.g. 3 A light rod AB , of length 4 m, supports an object of weight 4 N at its midpoint. It rests in equilibrium in a horizontal position on vertical supports at C and D , where $AC = 1$ m and $AD = 3.5$ m. Find the magnitude of the reaction forces at C and D .

Working: An unknown force acts through C so take moments about C .

$$\begin{aligned} \curvearrowright \text{ about } C: \quad R_D \times 2.5 &= 4 \times 1 \\ R_D &= 1.6 \text{ N} \end{aligned}$$

$$\begin{aligned} R(\uparrow): \quad R_C + R_D &= 4 \\ R_C + 1.6 &= 4 \\ R_C &= 2.4 \text{ N} \end{aligned}$$

The reaction forces at C and D are 1.6 and 2.4 N respectively



Video: [Horizontal beam in equilibrium](#)

[Horizontal beam in equilibrium EQ](#)

[Solutions to Starter and E.g.s](#)

Exercise

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