

Solutions

Each answer shows the steps, then the **result**.

2.1

- The net torque about any axis is zero

2.2

- the weight acts perpendicular to the arm:

$$\tau = rF = (0.4 \text{ m})(30 \text{ N})$$

- $\tau = \mathbf{12 \text{ N m}}$

2.3

- Net force zero ($\sum F = 0$) and net torque zero ($\sum \tau = 0$)

2.4

- 40 N m

3.1 B

- the net torque is zero

3.2 B

- the two torques are equal in size (and opposite in sense)

3.3

(a)

- the weight acts perpendicular to the beam:

$$\tau = rF = (0.6 \text{ m})(50 \text{ N})$$

- $\tau = \mathbf{30 \text{ N m}}$ (anticlockwise)

(b)

- balance: clockwise torque = anticlockwise torque:

$$(30 \text{ N})d = 30 \text{ N m} \quad \Rightarrow \quad d = \frac{30 \text{ N m}}{30 \text{ N}}$$

- $d = \mathbf{1.0 \text{ m}}$ right of the pivot

3.4

(a)

- At its centre, 1 m from each end

(b)

- the weight acts at the centre, $1.0 \text{ m} - 0.5 \text{ m} = 0.5 \text{ m}$ right of the pivot:

$$\tau = rF = (0.5 \text{ m})(60 \text{ N}) = 30 \text{ N m clockwise}$$

- nothing gives an anticlockwise torque to balance it, so the net torque is not zero and the plank tips clockwise