



# EXERCISE 11

## MECHANICS

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1. The moment of a force is the turning effect of a force around a specific point or axis.

2.  $\tau$  is the moment of a force in N·m.

F is the magnitude of the force in N.

$r_{\perp}$  is the perpendicular distance from the fulcrum to the straight line in which the force acts, measured in m.





3. Choose clockwise as positive. (Tightening is clockwise, loosening is anticlockwise.)

$$\tau = F \cdot r_{\perp}$$

$$\tau = -50(0,4)$$

$$= -20 \text{ N}\cdot\text{m}$$

$\therefore \tau = 20 \text{ N}\cdot\text{m}$  anticlockwise





## 4.1 The axis of the wheel

## 4.2 Choose clockwise as positive.

$$\tau = F \cdot r_{\perp}$$

$$\tau = (75 \times 9,8)(0,3)$$

$$\tau = 220,5 \text{ N}\cdot\text{m clockwise}$$





$$4.3 \quad \tau = F \cdot r_{\perp}$$

$$-220,5 = F \cdot 1,5$$

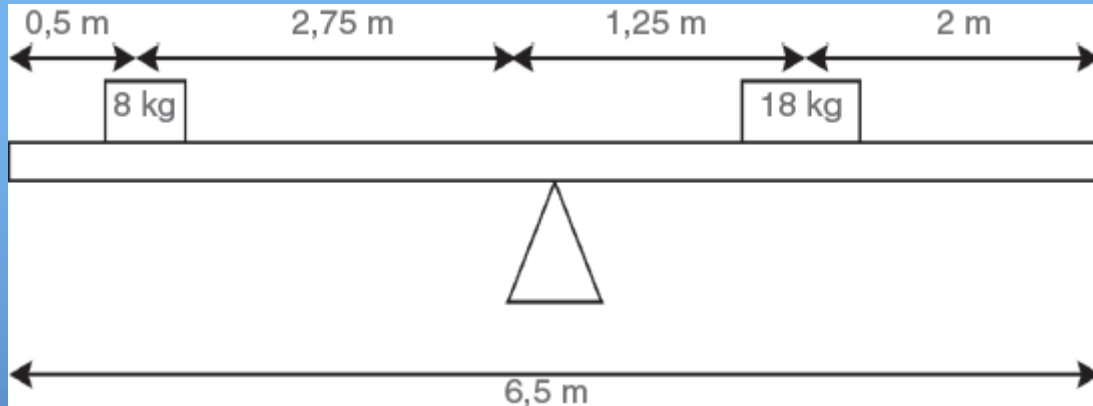
$$F = -147 \text{ N}\cdot\text{m}$$

The force of the builder must be a minimum of 147 N anticlockwise.





5. First, draw a rough sketch.



Choose clockwise as positive.

$$\Sigma\tau = \tau_8 + \tau_{18}$$

$$\Sigma\tau = F \cdot r_{\perp} + F \cdot r_{\perp}$$

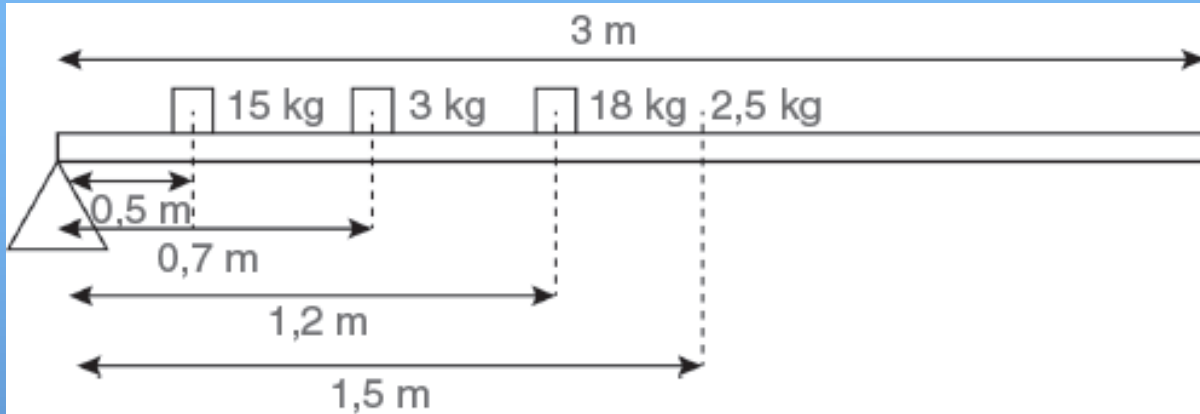
$$\Sigma\tau = (-8 \times 9,8)(2,75) + (18 \times 9,8)(1,25)$$

$$\Sigma\tau = -215,6 + 220,5$$

$$\Sigma\tau = 4,9 \text{ N}\cdot\text{m clockwise}$$



6.1



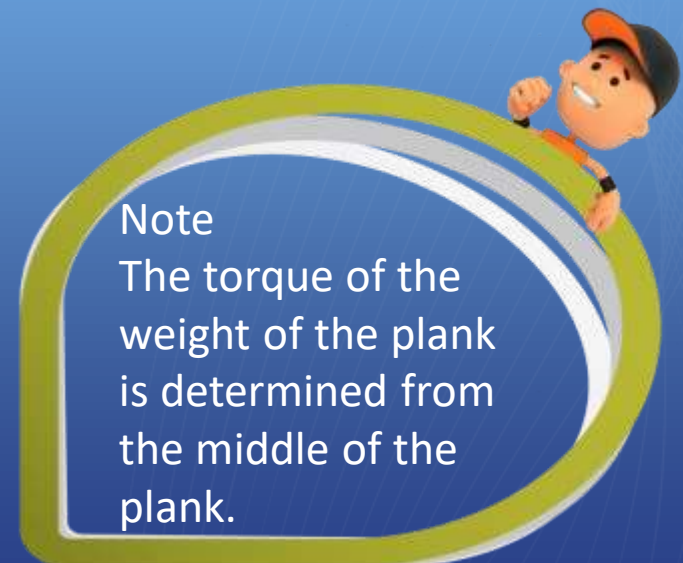
6.2 Choose clockwise as positive.

$$\Sigma\tau = \tau_{15} + \tau_3 + \tau_{18} + \tau_w$$

$$\Sigma\tau = F \cdot r_{\perp} + F \cdot r_{\perp} + F \cdot r_{\perp} + F \cdot r_{\perp}$$

$$\Sigma\tau = (15 \times 9,8)(0,5) + (3 \times 9,8)(0,7) + (18 \times 9,8)(1,2) + (2,5 \times 9,8)(1,5)$$

$$\Sigma\tau = 342,51 \text{ N}\cdot\text{m clockwise}$$



Note

The torque of the weight of the plank is determined from the middle of the plank.



7. Choose clockwise as positive.

$$\Sigma\tau = \tau_{50} + \tau_{20}$$

$$\Sigma\tau = F \cdot r_{\perp} + F \cdot r_{\perp}$$

$$\Sigma\tau = -(20 \times 9,8)(1) + (50 \times 9,8)(0,5)$$

$$\Sigma\tau = 49 \text{ N}\cdot\text{m clockwise}$$







## 8. Step 1:

Use a dotted line to draw a construction line that indicates the straight line in which the force acts by extending the force.



## Step 2:

Draw a perpendicular line through the fulcrum which cuts through the extended force line.



## Step 3:

Determine the distance  $r$  from the fulcrum to the extended force line.



Step 4:

Calculate the torque.

$$\tau = F \cdot r_{\perp}$$

$$\tau = 60 \times 0,2$$

$$\tau = 1,2 \text{ N}\cdot\text{m clockwise}$$

