



EXERCISE 14

MECHANICS

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1 Give the definition of a lever.

A lever is a simple machine consisting of a rigid bar that pivots on a fixed support, or fulcrum, and is used to transmit torque.



2.

Type	One	Two	Three
Words	load effort	load effort	effort load
Simple sketch			



3. Define mechanical advantage of a lever.

The mechanical advantage is defined as the ratio of the load to the effort.



4 A worker uses a long plank and a round log to move a heavy rock out of the way. The worker exerts a force of 355 N on the plank.

4.1 If the part of the plank between the worker and the log is 2,8 m in length and the part between the log and the rock is 30 cm, calculate the mechanical advantage of the lever.



$$MA = \frac{e}{\ell}$$

$$MA = \frac{2,8}{0,3}$$

$$MA = 9,33$$



4.2 Calculate the maximum mass of the rock that he could move with the lever.



$$MA = \frac{L}{E}$$

$$9,33 = \frac{L}{355}$$

$$L = 3\,313,33 \text{ N}$$

$$m = \frac{L}{9,8}$$

$$= \frac{3\,313,33}{9,8}$$

$$= 338,09 \text{ kg}$$





5. A crate with mass 70 kg is lifted by a 60 N force with the aid of a lever. What is the mechanical advantage of the lever that is used?



$$MA = \frac{L}{E}$$
$$MA = \frac{70 \times 9,8}{60}$$
$$MA = 11,43$$

6. A broom is held in such a way while sweeping that the distance between the floor and the worker's bottom hand is 1,05 m.



If the mechanical advantage of the broom lever is 0,3, calculate the distance between the worker's two hands.

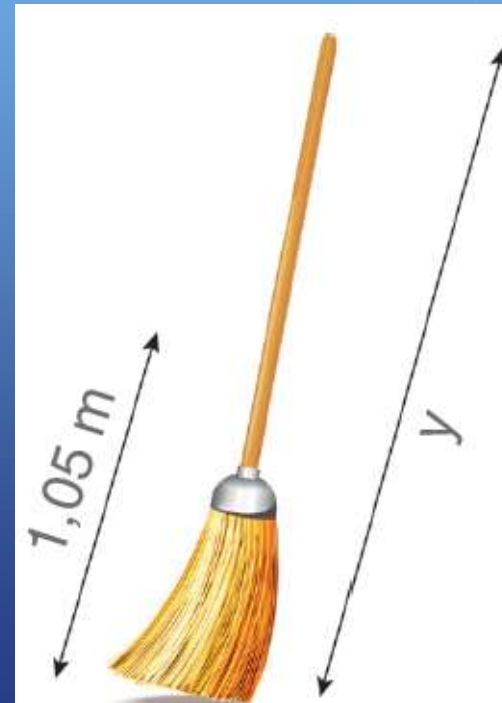
Take the distance between the floor and the top hand as y .

$$MA = \frac{m}{\ell}$$

$$0,3 = \frac{y - 1,05}{y}$$

$$0,3y = y - 1,05$$

$$y = 1,5 \text{ m}$$





7. A lever with a mechanical advantage of 4,8 is used to lift a weight of 45 N to a height of 3 m. Calculate the applied force.



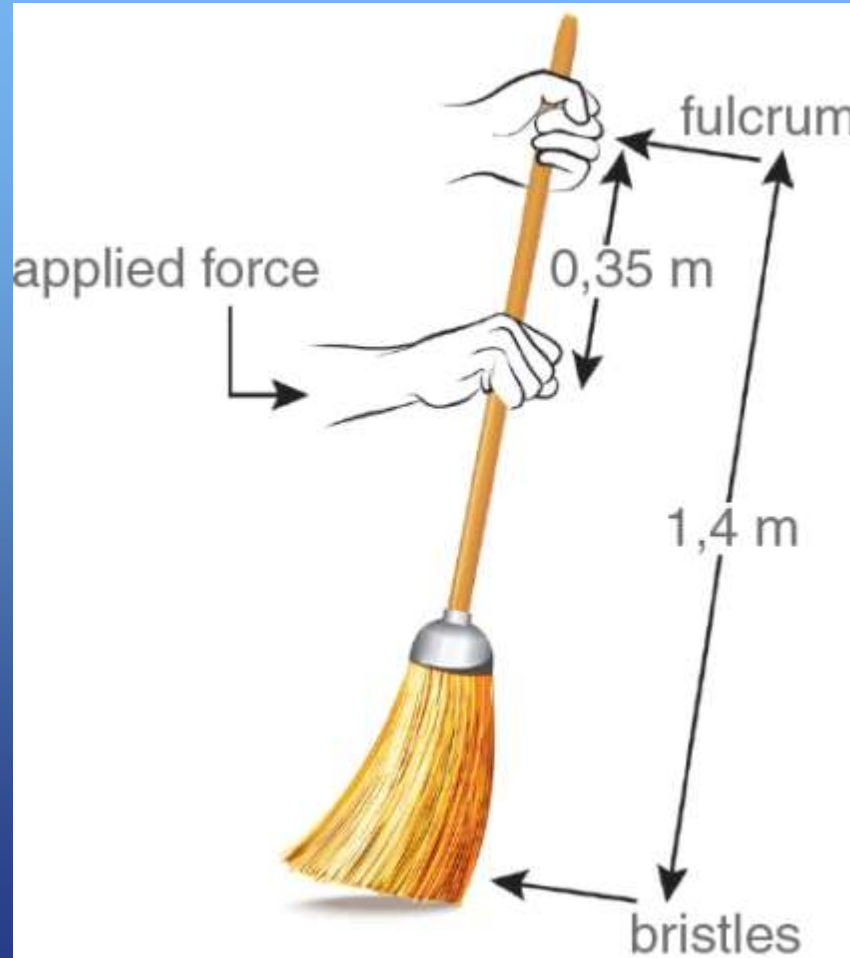
$$MA = \frac{L}{E}$$

$$4,8 = \frac{45}{E}$$

$$MA = 9,38 \text{ N}$$



8. The diagram shows a broom being used to sweep the floor:





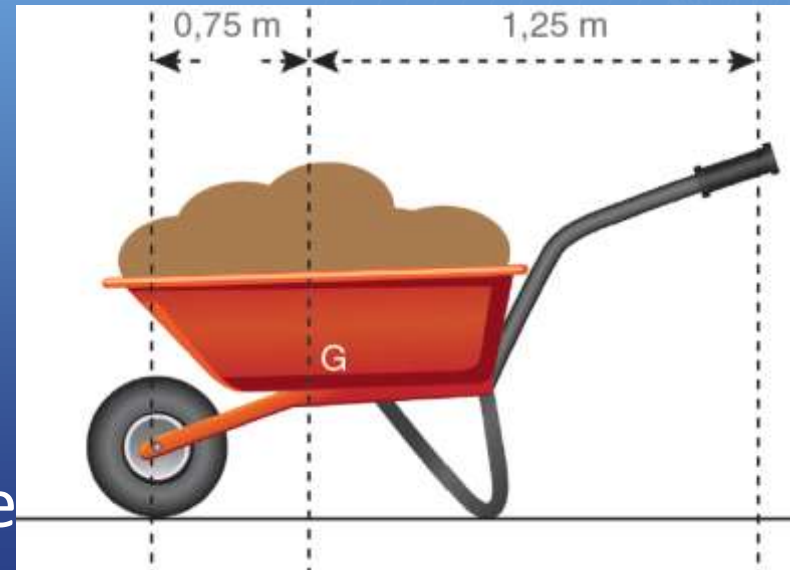
Calculate the mechanical advantage of the broom.

$$MA = \frac{e}{\ell}$$

$$MA = \frac{0,35}{0,25}$$

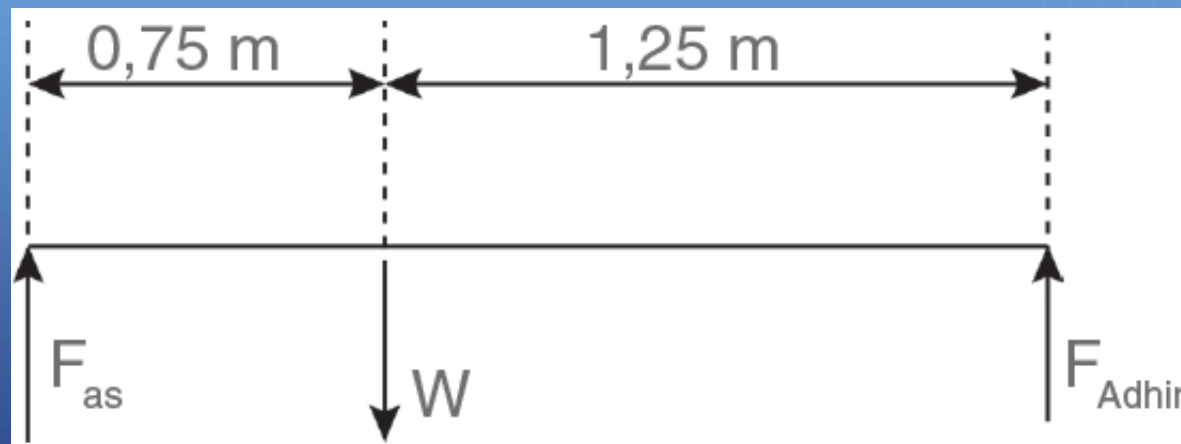
$$MA = 1,4$$

- 9 Adhir works in his garden. He pushes a wheelbarrow, with mass 25 kg, which is loaded with a cargo of 50 kg. G is the centre of mass of the loaded wheelbarrow.





9.1 Name and draw all the following forces on the wheelbarrow: weight, force of axle on wheelbarrow, force of Adhir on handles. Represent the wheelbarrow as a horizontal rod.





9.2 Calculate the force that he must exert on the handles so he can lift the wheelbarrow with its load. Show all calculations.

Choose clockwise as positive.

Also choose upward and to the right as positive.

$$\Sigma \tau_{\text{clockwise}} = \Sigma \tau_{\text{anticlockwise}}$$

$$\tau_w = \tau_{\text{Adhir}}$$

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

$$(75 \times 9,8) \times 0,75 = F_{\text{Adhir}} \times 2$$

$$551,25$$

$$F_{\text{Adhir}} = 2$$

$$F_{\text{Adhir}} = 275,63 \text{ N upwards}$$





9.3 Calculate the mechanical advantage of the wheelbarrow.

$$MA = \frac{e}{\ell}$$

$$MA = \frac{2}{0,75}$$

$$MA = 2,67$$

OR

$$MA = \frac{L}{E}$$

$$MA = \frac{75 \times 9,8}{275,63}$$

$$MA = 2,67$$

