A Level · OCR · Physics

11 mins 2 questions

Structured Questions

Moments

Moments / Couples & Torque / Centre of Mass / Equilibrium

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Total Marks **/11**

1 (a) A screw is used to hang a wooden sign on a wall. It is screwed into the wall using a screwdriver.

The width of the screwdriver blade is 5.0×10^{-3} m from end to end.

The ends of the blade exert equal and opposite forces on the screw.

The magnitude of each force is 350 N, as shown in Fig. 22.1.

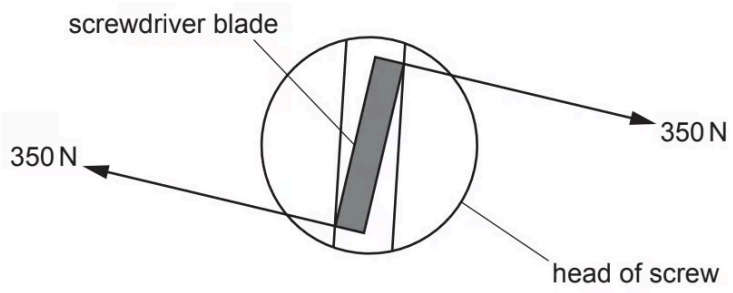


Fig. 22.1

Calculate the magnitude of the torque of the couple produced by the forces at each end of the screwdriver blade.

torque = ... Nm

.....

(1 mark)

(b) The wooden sign is then hung on the screw at point **A**.

The forces acting on the screw are shown in Fig. 22.2.

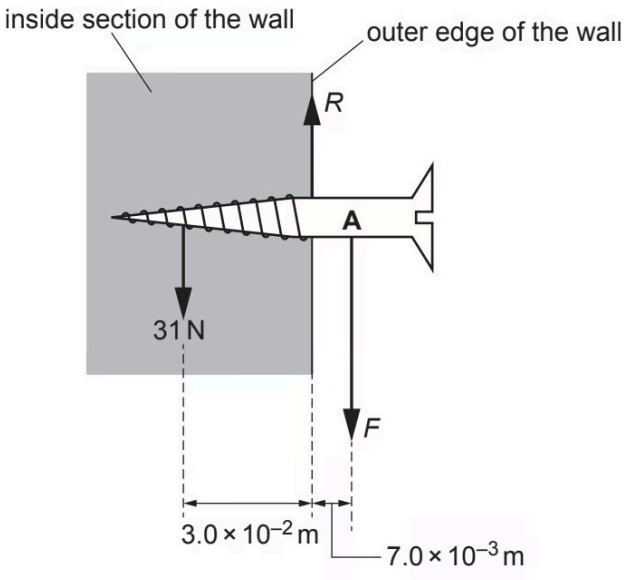


Fig. 22.2

The inside section of the wall exerts a maximum downwards force of 31 N at a distance of 3.0×10^{-2} m from the outer edge of the wall.

The hanging wooden sign exerts a force *F* at a distance 7.0×10^{-3} m from the outer edge of the wall.

There is a force *R* acting on the screw at the outer edge of the wall.

The mass of the screw is negligible.

Use the principle of moments to calculate the maximum mass of the wooden sign.

mass = ... kg

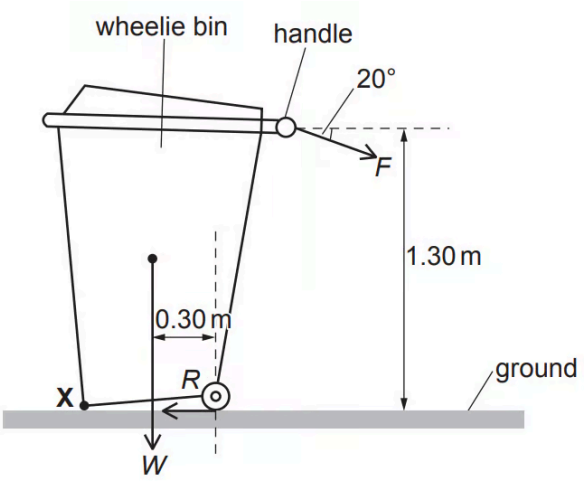
.....

.....

.....

(3 marks)

2 (a) A wheelie bin is tipped onto its wheels by applying two forces *F* and *R*.



F is applied to the handle. *F* is to the right at an angle 20° below the horizontal. The height of the handle above the ground is 1.30 m.

R is a horizontal force applied to the left to the wheels. The total weight of the wheelie bin and its contents is *W*.

The perpendicular distance between the line of action of the weight and the bottom of the wheels is 0.30 m. The wheelie bin and contents have a total mass of 40 kg.

State the **principle of moments.**

.....

(1 mark)

(b) i) Show that the magnitude of the minimum force *F* which lifts the front end of the wheelie bin (point **X**) off the ground is 96 N.

[3]

ii) Use your answer to **(b)(i)** to calculate the magnitude of the force *R* required to stop the wheelie bin from moving to the right.

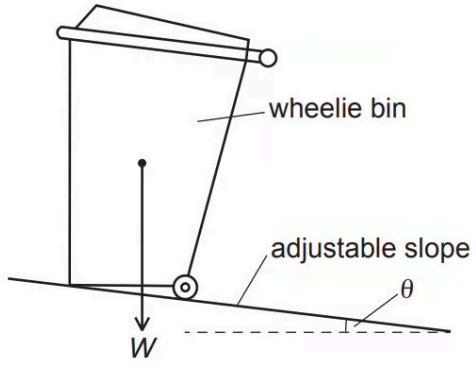
R = ... N **[2]**

.....

.....

(5 marks)

(c) The wheelie bin in now placed on an adjustable slope. The wheels are now fixed so they cannot move.



The angle θ made by the slope with the horizontal is steadily increased from zero.

Explain, without calculation, at what angle θ the wheelie bin starts to topple clockwise.

(1 mark)