

Workbook



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Torque

Torque

Questions

1) R Effective

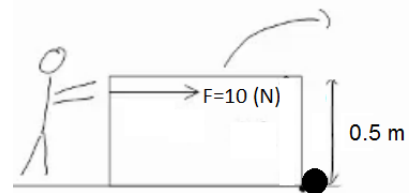
A man pushes a box of high 0.5m and exerts a force of F (see diagram).

There is no friction between the box and the ground.

The man pushes the box until it reaches a rock and the box flips over.

(The position of the rock becomes the axis of rotation)

What is the moment of force?

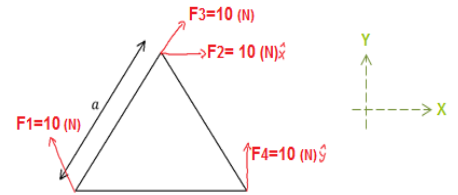


Torque Equation

2) Moments on a Triangle

An equilateral triangle is given with sides of length a .

- a. Calculate the torque of the forces in the diagram about the axis perpendicular to the page, which goes through the bottom left corner of the triangle.



- b. The mass of the triangle is M and the center of mass is located at $\left(\frac{1}{2}a, \frac{1}{2\sqrt{3}}a\right)$.

Work out of the gravity's moment of force.

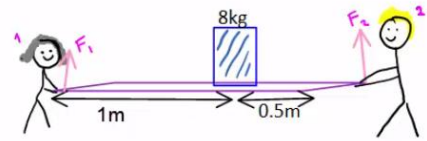
- c. Work out the moments about the center of mass of the triangle, again, and assume that the angle between F_1 and the side of the triangle is 60° .

3) Why does the gravitational force act on the center of mass?

Exercises

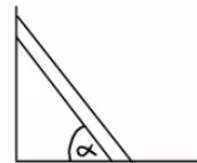
4) Two People Holding a Plank

Two people hold a wooden plank of mass 12 kg and of length 1.5m. On the plank, 0.5m from the person on the right, a box of mass 8 kg is placed. The people are stationary. What force does each person apply to the system?



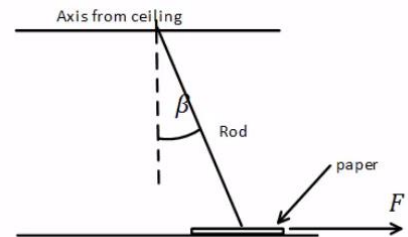
5) Ladder on a Wall

A ladder of mass m and length L is leaning on a smooth wall and rough floor. What forces are acting on the ladder?



6) Rod Resting on a Paper

A rod of length L and mass M is attached to the ceiling via an axis. The other end of the rod is resting on a sheet of paper that is resting on the floor. The angle between the rod and the axis is β , and the coefficient of static friction between the rod and the paper, and the paper and the floor are μ_s .



- a. The paper is pulled rightwards with a force F . What is the minimal force required in order to pull the paper from underneath the rod? Assume that the rod remains stationary.
- b. Redo part a, but this time when the force is acting leftwards.

Answer Key

1) $5Nm$

2) a. $\vec{\tau} = \vec{r} \times \vec{F}$, $|\vec{\tau}| = |\vec{r}| |\vec{F}| \sin \alpha$ b. $\bar{\tau}_g = Mg \frac{a}{2}$

c. $\bar{\tau}_1 = \frac{-109}{\sqrt{3}}$, $\bar{\tau}_2 = \frac{-10a}{\sqrt{3}}$, $\bar{\tau}_3 = \frac{-5a}{\sqrt{3}}$, $\bar{\tau}_4 = 5a$, $\bar{\tau}_g = 0$

3) Solution in the recording.

4) $F_1 = 86.6N$, $F_2 = 113.3N$

5) $f = \mu N$

6) a. $F_{\min} = \frac{\mu_s M_g \sin \beta}{\sin \beta + \mu_s \cos \beta}$ b. $F_{\min} = \frac{\mu_s M_g \sin \beta}{\sin \beta - \mu_s \cos \beta}$