

Homework #13

Donald Aingworth IV

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Problem 1

Figure 10-35 shows three 0.0100 kg particles that have been glued to a rod of length $L = 6.00$ cm and negligible mass. The assembly can rotate around a perpendicular axis through point O at the left end. If we remove one particle (that is, 33rotational inertia of the assembly around the rotation axis decrease when that removed particle is (a) the innermost one and (b) the outermost one?

Solution

Problem 2

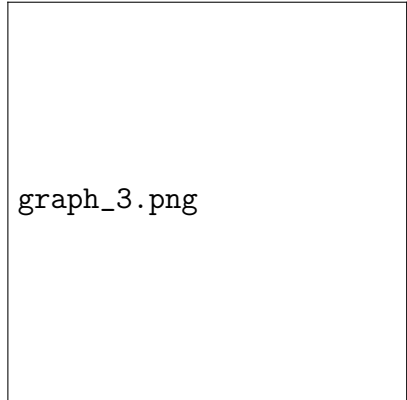
Find the center of mass of a rod of length L whose mass density changes from one end to the other quadratically. That is, if the rod is laid out along the x -axis with one end at the origin and the other end at $x = L$, the density is given by $\rho(x) = \rho_0 + (\rho_1 - \rho_0) \left(\frac{x}{L}\right)^2$, where ρ_0 and ρ_1 are constant values.

Solution

Problem 3

A cube of side a is cut out of another cube of side b as shown in the figure below. Find the location of the center of mass of the structure. (Hint: Think of the missing part as a negative mass overlapping a positive mass.)

Solution



graph_3.png

Problem 4

Two skaters, one with mass 65 kg and the other with mass 40 kg, stand on an ice rink holding a pole of length 10 m and negligible mass. Starting from the ends of the pole, the skaters pull themselves along the pole until they meet. How far does the 40 kg skater move?

Solution

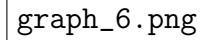
Problem 5

What is the average momentum of an avalanche that moves a 40-cm-thick layer of snow over an area of 100 m by 500 m over a distance of 1 km down a hill in 5.5 s? Assume a density of 350 kg/m³ for the snow.

Solution

Problem 6

A 75.0-kg person is riding in a car moving at 20.0 m/s when the car runs into a bridge abutment (see the following figure). a. Calculate the average force on the person if he is stopped by a padded dashboard that compresses an average of 1.00 cm. Calculate the average force on the person if he is stopped by an air bag that compresses an average of 15.0 cm.

A rectangular box containing the text 'graph_6.png', which likely refers to a figure showing the car's motion or the forces involved in the collision.

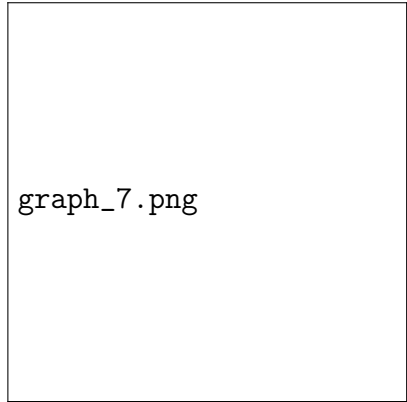
Solution

Problem 7

The x-component of a force on a 46-g golf ball by a 7-iron versus time is plotted in the following figure.

(a). Find the x-component of the impulse during the intervals i. $[0, 50 \text{ ms}]$, and ii. $[50 \text{ ms}, 100 \text{ ms}]$ (b) Find the change in the x-component of the momentum during the intervals iii. $[0, 50 \text{ ms}]$, and iv. $[50 \text{ ms}, 100 \text{ ms}]$

Solution



graph_7.png

Problem 8

The instantaneous positions and velocities of three particles are shown in the figure below. Find: (a) the position of the CM; (b) the velocity of the CM; (c) the position of the CM 3.00 s later if there is no external force acting.

graph_8.png

Solution