TAM 212 – Extra Problems From Text

Basic Motions of Mass Centers of Bodies

2.35 The truck in Figure P2.35 is traveling at 45 mph. Find the minimum stopping distance such that the 250-lb crate will not slide. Assume the crate cannot tip over.

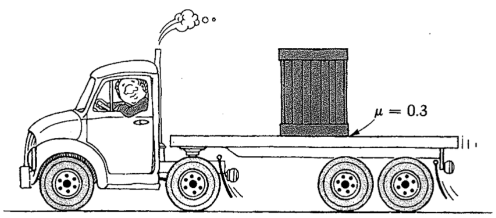


Figure P2.35

ans:

Figure P2.58

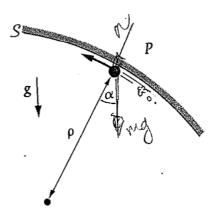


Figure P2.59

2.59 A particle P moves along a curved surface $\mathcal{S}$ as shown in Figure P2.59. Show that P will remain in contact with $\mathcal{S}$ provided that, at all times, $v \geq \sqrt{\rho g} \cos \alpha$.

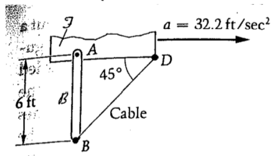
ans:

Linear Momentum

2.133 The astronaut in Figure P2.133 is finding it difficult to stop his forward momentum while jogging on the moon. Using a friction coefficient of $\mu = 0.3$ and a gravitational acceleration one-sixth that of earth's, illustrate the difficulty of stopping a forward momentum of mv = (5 slugs)(12 ft/sec). Specifically, use the principle of impulse and momentum to find the time it takes to stop on earth versus on the moon. eq. 2.28 $t^* = \frac{v_0}{\mu g}$ *ans:*

Euler's Second Law - Basic

2.166 The uniform rigid bar $\mathcal{B}$ in Figure P2.166 weighs 60 lb and is pinned at A (and fastened by the cable DB) to the frame $\mathcal{F}$. If the frame is given an acceleration $a = 32.2$ ft/sec^2 as shown, determine the tension T in



ans:

Rigid Bodies in Translation

4.13 A can $\mathcal{C}$ that may be considered a uniform solid cylinder (see Figure P4.13) is pushed along a surface $\mathcal{B}$ by a moving arm $\mathcal{A}$. If it is observed that $\mathcal{C}$ *translates* to the right with $\ddot{x}_C = g/10$, what must be the minimum coefficient of friction between $\mathcal{A}$ and $\mathcal{C}$? The coefficient of friction between $\mathcal{C}$ and $\mathcal{B}$ is μ.

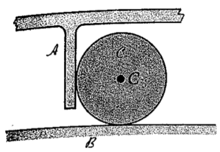


Figure P4.13

ans:

4.18 The 25-lb triangular plate is smoothly pinned at vertex A to a small, light wheel (see Figure P4.18). Find the value of force P so that the plate, in theory, will translate along the incline. Also find the acceleration.

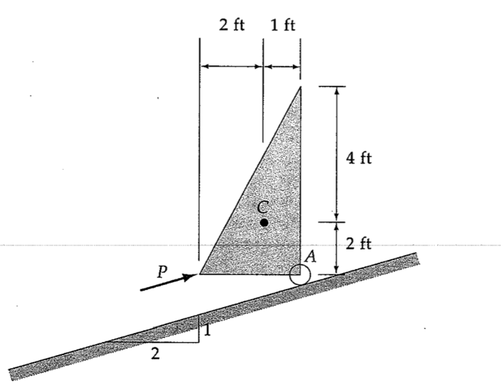


Figure P4.18

ans:

Moment of Momentum, Moment of Inertia, Parallel Axis Theorem

4.34 Find I_{xx}^{C} for a uniform thin plate in the form of a pie-shaped circular sector as shown in Figure P4.34.

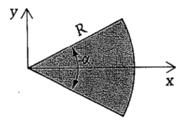


Figure P4.34

ans:

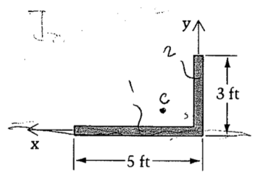


Figure P4.41

4.41 Two bars, each weighing 5 lb per foot, are welded together as shown in Figure P4.41. (a) Locate the center of mass of the body. (b) Find I_{zz}^{C}.

4.42 Find I_{xx} in Problem 4.41.

4.43 Use the result of the preceding problem, together with the transfer (parallel axis) theorem, to find I_{xx}^{C}.

ans:

Mass Center Form of Moment Equations

4.70 The uniform cylinder in Figure P4.70, of mass m and radius r, is at rest before it is subjected to a couple of moment M_o. The coefficient of friction between cylinder and floor is μ.

- **a.** Find the largest value of M_o for which there is no slip. $\frac{3}{2}\mu mgr$
- **b.** For M_o twice the value found in (a), find $\mathbf{a}_C$ and $\boldsymbol{\alpha}$.

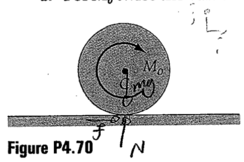


Figure P4.70

ans:

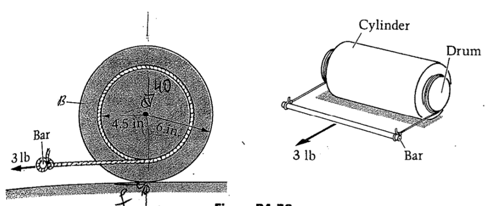


Figure P4.79

4.79 Two drums of radius 4.5 in. are mounted on each end of a cylinder of radius 6 in. to form a 40-lb rigid body $\mathcal{B}$ with radius of gyration $k_{zC} = 5$ in. (See Figure P4.79.) Ropes are wrapped around the drum and tied to a horizontal bar to which a 3-lb force is applied. As $\mathcal{B}$ rolls from rest, tell (a) the number of inches of rope wound or unwound (tell which) in three seconds and (b) the minimum friction coefficient needed for the rolling to take place.

ans:

4.92 Two cables are wrapped around the hub of the 40-kg spool shown in Figure P4.92, which has a radius of gyration of 500 mm with respect to its axis. A constant 40-N force is applied to the upper cable as shown. Find the mass center location 5 s after starting from rest if: (a) $\mu = 0.2$; (b) $\mu = 0.5$.

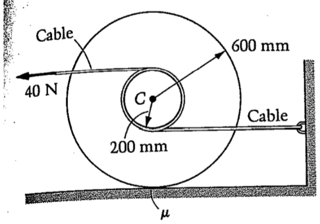


Figure P4.92

ans:

Moment Equations about Fixed Point

4.171 Body $\mathcal{B}$ is a slender bar bent into the shape of a quarter-circle (Figure P4.171). Find the tensions in strings OA and OB when the system is released from rest.

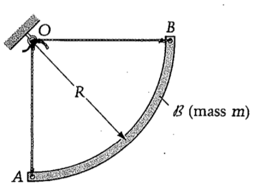


Figure P4.171

ans: