MECH230 - Fall 2024
Recommended Problems - Set 20

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December 10, 2024

The linear impulse - linear momentum equation is

$$\int_{t_A}^{t^B} \mathbf{F} dt = \mathbf{G}(t_B)_{\mathbf{G}}(t_A). \tag{1}$$

The angular impulse - angular momentum equations are equivalently

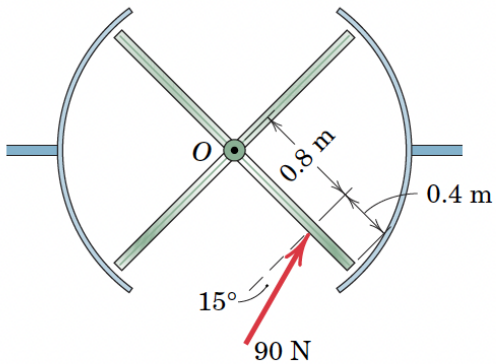
$$\int_{t_A}^{t_B} \mathbf{M}^C dt = \mathbf{H}^C(t_B) - \mathbf{H}^C(t_A) \quad \text{where } C \text{ is the center of mass,} \tag{2}$$

$$\int_{t_A}^{t_B} \mathbf{M}^O dt = \mathbf{H}^O(t_B) - \mathbf{H}^C(t_A) \quad \text{if there is a fixed point } O. \tag{3}$$

These problems are taken from J. L. Meriam, L. G. Kraige, and J. N. Bolton (MKB), Engineering Mechanics: Dynamics, Ninth Edition, Wiley, New York, 2018.

1. [MKB 06-136]

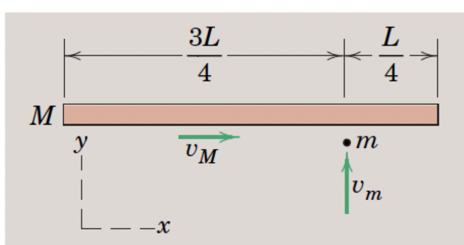
6/136 A person who walks through the revolving door exerts a 90-N horizontal force on one of the four door panels and keeps the 15° angle constant relative to a line which is normal to the panel. If each panel is modeled by a 60-kg uniform rectangular plate which is 1.2 m in length as viewed from above, determine the final angular velocity ω of the door if the person exerts the force for 3 seconds. The door is initially at rest and friction may be neglected.



PROBLEM 6/136

2. [MKB 06-142]

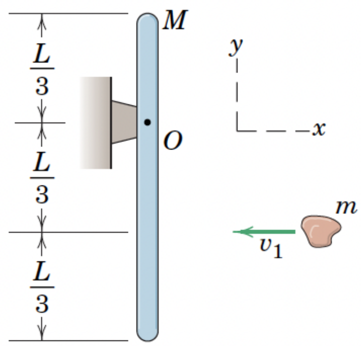
6/142 A uniform slender bar of mass M and length L is translating on the smooth horizontal x-y plane with a velocity v_M when a particle of mass m traveling with a velocity v_m as shown strikes and becomes embedded in the bar. Determine the final linear and angular velocities of the bar with its embedded particle.



PROBLEM 6/142

3. [06-145]

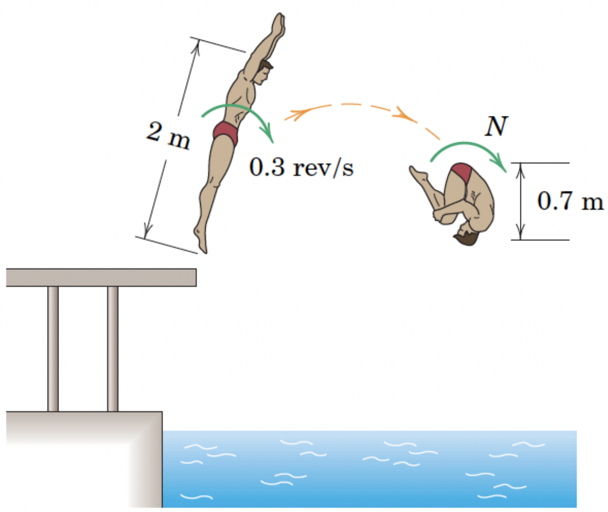
6/145 The wad of clay of mass m is initially moving with a horizontal velocity v_1 when it strikes and sticks to the initially stationary uniform slender bar of mass M and length L. Determine the final angular velocity of the combined body and the x-component of the linear impulse applied to the body by the pivot O during the impact.



PROBLEM 6/145

4. [06-146]

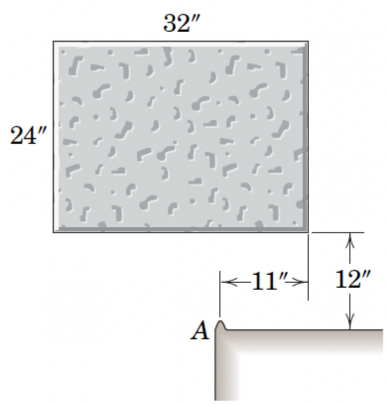
6/146 Just after leaving the platform, the diver's fully extended 80-kg body has a rotational speed of 0.3 rev/s about an axis normal to the plane of the trajectory. Estimate the angular velocity N later in the dive when the diver has assumed the tuck position. Make reasonable assumptions concerning the mass moment of inertia of the body in each configuration.



PROBLEM 6/146

5. [06-148]

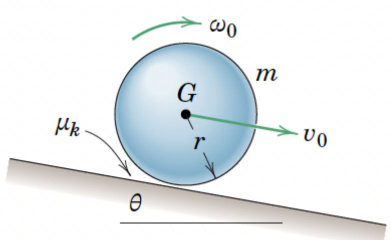
6/148 The uniform concrete block, which weighs 171 lb and falls from rest in the horizontal position shown, strikes the fixed corner A, and pivots around it with no rebound. Calculate the angular velocity ω of the block immediately after it hits the corner and the percentage loss n of energy due to the impact.



PROBLEM 6/148

6. [06-155]

6/155 The homogeneous sphere of mass m and radius r is projected along the incline of angle θ with an initial speed v_0 and no angular velocity ($\omega_0 = 0$). If the coefficient of kinetic friction is μ_k, determine the time duration t of the period of slipping. In addition, state the velocity v of the mass center G and the angular velocity ω at the end of the period of slipping.



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