MECH230 - Fall 2024
Recommended Problems - Set 11

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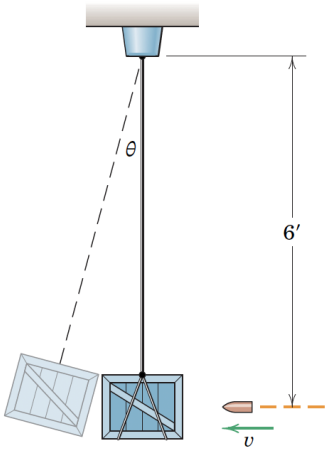
The problems are taken from J. L. Meriam, L. G. Kraige, and J. N. Bolton (MKB), Engineering Mechanics: Dynamics, Ninth Edition, Wiley, New York, 2018.

1. [MKB 03-168] Take the origin to be at the fixed point where the pendulum is suspended. In this problem, show that during collision (which takes up a very small time interval), the angular momentum of combined system of the pendulum and the bullet are conserved.

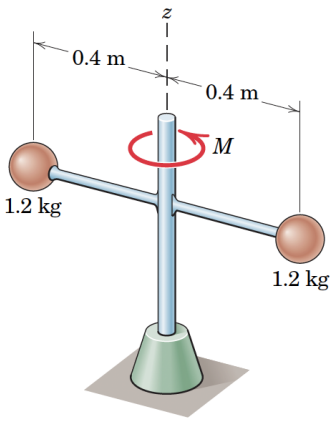
3/168 The ballistic pendulum is a simple device to measure projectile velocity v by observing the maximum angle θ to which the box of sand with embedded projectile swings. Calculate the angle θ if the 2-oz projectile is fired horizontally into the suspended 50-lb box of sand with a velocity $v = 2000$ ft/sec. Also find the percentage of energy lost during impact.



PROBLEM 3/168

2. [MKB 03-178] In this problem, you will use the integral form of the balance of angular momentum. Choose your system appropriately and take the origin to be at the green base.

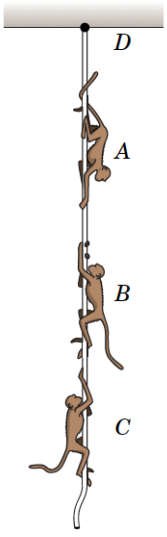
3/178 The rigid assembly which consists of light rods and two 1.2-kg spheres rotates freely about a vertical axis. The assembly is initially at rest and then a constant couple $M = 2$ N·m is applied for 5 s. Determine the final angular velocity of the assembly. Treat the small spheres as particles.



PROBLEM 3/178

4. [04-008] Take appropriate cuts in the rope to find the desired quantities.

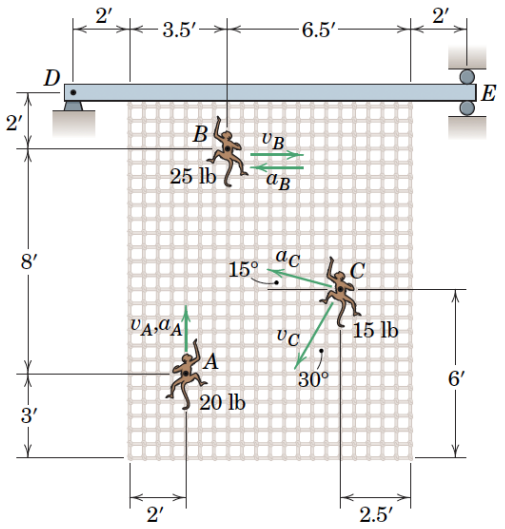
4/8 Three monkeys A, B, and C weighing 20, 25, and 15 lb, respectively, are climbing up and down the rope suspended from D. At the instant represented, A is descending the rope with an acceleration of 5 ft/sec^2, and C is pulling himself up with an acceleration of 3 ft/sec^2. Monkey B is climbing up with a constant speed of 2 ft/sec. Treat the rope and monkeys as a complete system and calculate the tension T in the rope at D.



PROBLEM 4/8

5. [04-009]

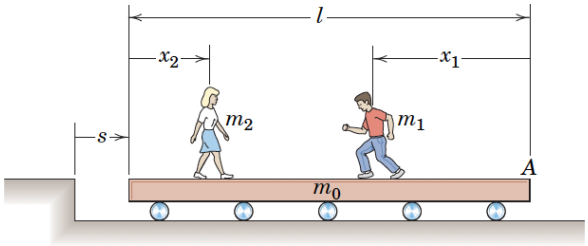
4/9 The monkeys of Prob. 4/8 are now climbing along the heavy rope wall suspended from the uniform beam. If monkeys A, B, and C have velocities of 5, 3, and 2 ft/sec, and accelerations of 1.5, 0.5, and 2 ft/sec^2, respectively, determine the changes in the reactions at D and E caused by the motion and weight of the monkeys. The support at E makes contact with only one side of the beam at a time. Assume for this analysis that the rope wall remains rigid.



PROBLEM 4/9

6. [04-019] In this problem, identify a direction of conservation of linear momentum. On your way to the answer, you will notice that the velocity of the center of mass of the system will remain zero, so the center of mass will remain stationary.

4/19 The man of mass m_1 and the woman of mass m_2 are standing on opposite ends of the platform of mass m_0 which moves with negligible friction and is initially at rest with $s = 0$. The man and woman begin to approach each other. Derive an expression for the displacement s of the platform when the two meet in terms of the displacement x_1 of the man relative to the platform.



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