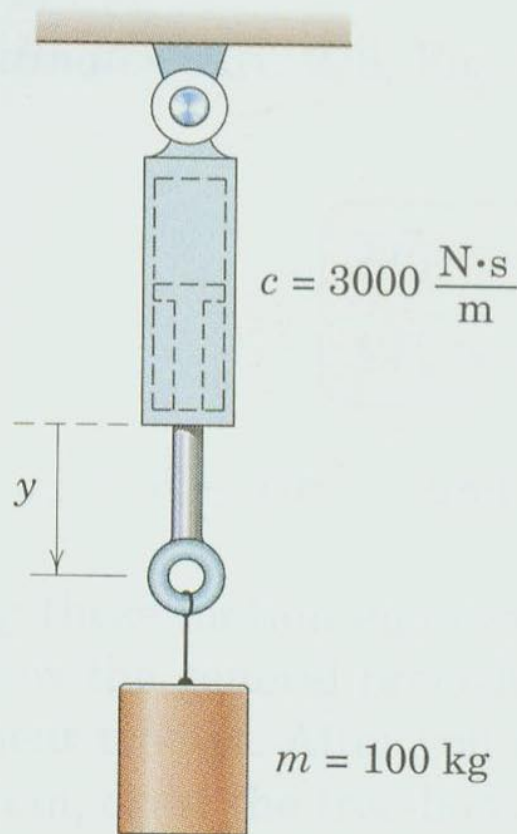


Dynamics PhD Qualifying Exam, Spring 2005

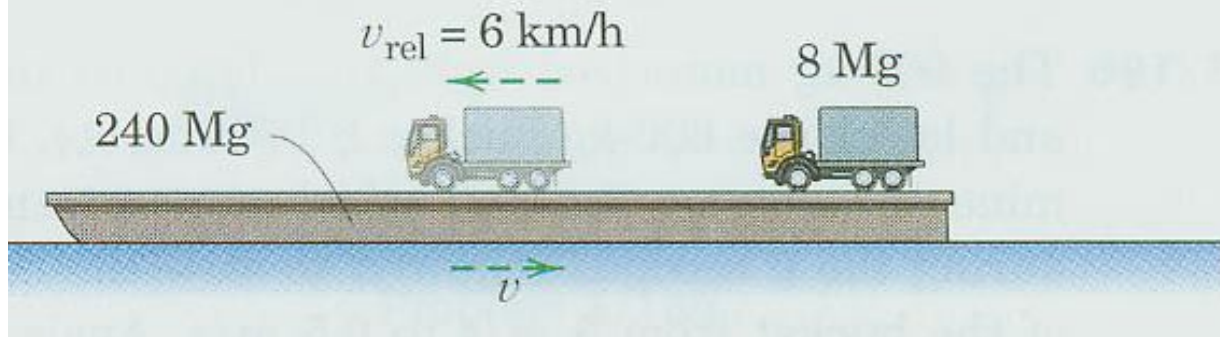
Prob1

A shock absorber is a mechanical device which provides resistance to compression or extension given by $R = cv$, where c is a constant and v is the time rate of change of the length of the absorber. An absorber of constant $c = 3000 \text{ N}\cdot\text{s}/\text{m}$ is shown being tested with a 100-kg cylinder suspended from it. The system is released with the cable taut at $y = 0$ and allowed to extend. Determine (a) the steady-state velocity v_s of the lower end of the absorber and (b) the time t and displacement y of the lower end when the cylinder has reached 90 percent of its steady-state speed. Neglect the mass of the piston and attached rod.



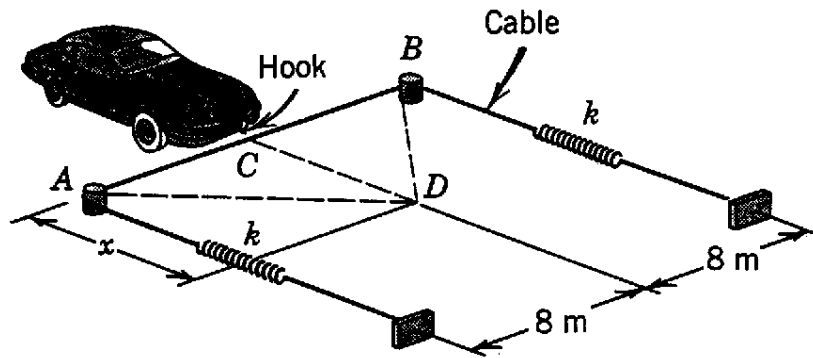
Prob2

An 8-Mg truck is resting on the deck of a barge which displaces 240 Mg and is at rest in still water. If the truck starts and drives toward the bow at a speed relative to the barge $v_{\text{rel}} = 6 \text{ km/h}$, calculate the speed v of the barge. The resistance to the motion of the barge through the water is negligible at low speeds.



Prob3

The arresting gear slows an automobile in a crash test by catching the hook at midpoint C on the cable. The cable carries a tension of 15 kN when the hook is not engaged, and each spring has a stiffness of 30 kN/m. A 1200 kg automobile engages the cable at a speed of 50 km/hr. Determine the distance x locating the position D of the hook when the automobile comes to rest. The vehicle rolls freely.



Prob4

Three blocks A, B, and C, of mass $m_A = 70$ kg, $m_B = 30$ kg, and $m_C = 40$ kg, are connected by inextensible cords of negligible weight. Find the accelerations of the blocks and the tensions in the cords. Neglect the weight and friction of the two pulleys. Note that x_1 , x_2 , and x_3 are measured from the center of the pulleys, not necessarily from an inertial reference.

