

Assignment Preview

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Homework 6

1. CJ6 7.P.004. [294506] A baseball ($m = 149$ g) approaches a bat horizontally at a speed of 43.0 m/s (96 mi/h) and is hit straight back at a speed of 46.7 m/s (104 mi/h). If the ball is in contact with the bat for a time of 1.10 ms, what is the average force exerted on the ball by the bat? Neglect the weight of the ball, since it is so much less than the force of the bat. Choose the direction of the incoming ball as the positive direction.

[-12200] N

2. CJ6 7.P.008. [239582] When jumping straight down, you can be seriously injured if you land stiff-legged. One way to avoid injury is to bend your knees upon landing to reduce the force of the impact. A 75 kg man just before contact with the ground has a speed of 6.5 m/s.

(a) In a stiff-legged landing he comes to a halt in 1.8 ms. Find the average net force that acts on him during this time.

[2.71e+05] N

(b) When he bends his knees, he comes to a halt in 0.10 s. Find the average force now.

[4880] N

(c) During the landing, the force of the ground on the man points upward, while the force due to gravity points downward. The average net force acting on the man includes both of these forces. Taking into account the directions of these forces, find the force of the ground on the man in parts (a) and (b).

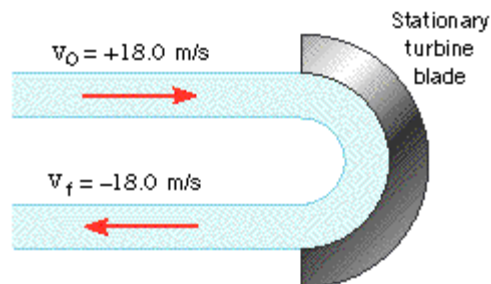
stiff legged landing

[2.72e+05] N

bent legged landing

[5610] N

A stream of water strikes a stationary turbine blade horizontally, as the drawing illustrates. The incident water stream has a velocity of $+18.0$ m/s, while the exiting water stream has a velocity of -18.0 m/s. The mass of water per second that strikes the blade is 47.0 kg/s. Find the magnitude of the average force exerted on the water by the blade.



[1690] N

4. CJ6 7.P.015. [239585] For tests using a *ballistocardiograph*, a patient lies on a horizontal platform that is supported on jets of air. Because of the air jets, the friction impeding the horizontal motion of the platform is negligible. Each time the heart beats, blood is pushed out of the heart in a direction that is nearly parallel to the platform. Since momentum must be conserved, the body and the platform recoil, and this recoil can be detected to provide information about the heart. For each beat, suppose that 0.050 kg of blood is pushed out of the heart with a velocity of $+0.25$ m/s and that the mass of the patient and the platform is 85 kg. Assuming that the patient does not

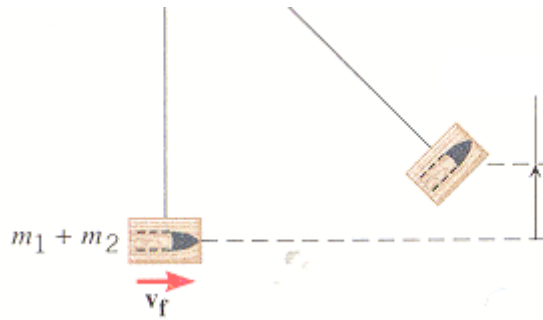


Figure 7.14

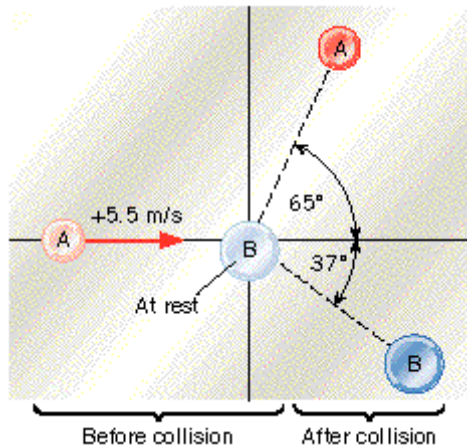
(a) Find the speed of the bullet/block combination immediately after the collision.

[4.19] m/s

(b) How high does the combination rise above its initial position?

[0.895] m

9. CJ6 7.P.030. [239589] The drawing shows a collision between two pucks on an air-hockey table. Puck A has a mass of 0.038 kg and is moving along the x axis with a velocity of +5.5 m/s. It makes a collision with puck B, which has a mass of 0.063 kg and is initially at rest. The collision is not head-on. After the collision, the two pucks fly apart with the angles shown in the drawing.



(a) Find the final speed of puck A.

[3.38] m/s

(b) Find the final speed of puck B.

[3.07] m/s

10. CJ6 7.P.042. [294558] Consider the two moving boxcars in Example 5. Car 1 has a mass of $m_1 = 65 \times 10^3$ kg and moves at a velocity of $v_{01} = +0.64$ m/s. Car 2, with a mass of $m_2 = 92 \times 10^3$ kg and a velocity of $v_{02} = +1.5$ m/s, overtakes car 1 and couples to it. Neglect the effects of friction in your answer.

(a) Determine the velocity of their center of mass before the collision

[1.14] m/s

(b) Determine the velocity of their center of mass after the collision

 [1.14] m/s

(c) Should your answer in part (b) be less than, greater than, or equal to the common velocity v_f of the two coupled cars after the collision?

- less than
 greater than
 equal to - **Correct!**

Justify your answer.

Key: Since the cars are coupled together the center of mass moves at the same speed as the cars do.

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