Physics 161, Homework 8

Due 12:00 pm, Friday, April 25; No Exceptions

Lubna Rana, Sections 0201-0206

Read Chapter 9, Sections 9.1-9.7 Make sure you do all the example problems in the chapter.

Short Answer Questions S1, S2, S3 ; Problems P1 = S & B Ch 9, Problem 6; , P2 = S & B Ch 9 P58; P3 = S & B Ch 9, Problem 60; P4, P5, P6

Special Note: Please always:

1). PRINT your name and SECTION NUMBER CLEARLY on the front page of your HW. Failure to do so will now cost you points.

2). STAPLE all your pages. It is your responsibility to make sure that your hw gets submitted in one piece.

3). DO ALL THE PROBLEMS IN ORDER.

4). Show complete work and write logically consistent explanations for all questions and problems to receive credit.

5). Write units next to all dimensionful quantities.

Short Answer Questions:

S1). Fig (S1) shows an overhead view of a golf ball bouncing off a tree trunk with no change in its speed. During the collision, the force **F** on the ball by the trunk causes a change $\Delta\mathbf{p}$ in the linear momentum of the ball. If the angle θ is increased (and assuming that the duration of the collision is unchanged), do the following increase, decrease, or remain the same: (a) Δp_x, (b) Δp_y, (c) magnitude of $\Delta\mathbf{p}$, (d) F_x, (e) F_y, and (f) magnitude of **F**?

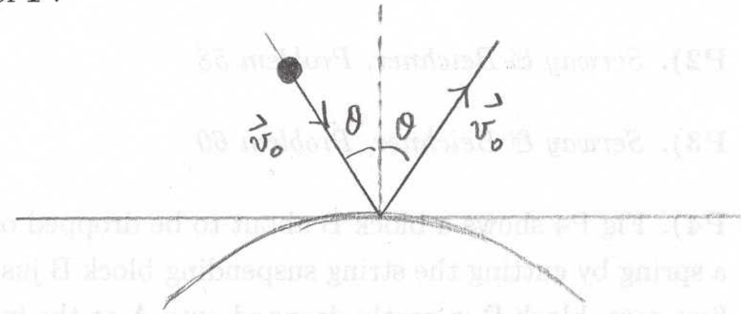


Fig S1.

S2). Fig (S2) shows, for four situations, three identical blocks that undergo elastic collisions on a frictionless surface. In situations 1 and 2, two of the blocks are glued together. In all four situations, the initially moving blocks have the same velocity **v**.

Rank the situations according to (a) total linear momentum of the blocks after the collision and (b) the speed of the rightmost block after the collisions, greatest first.

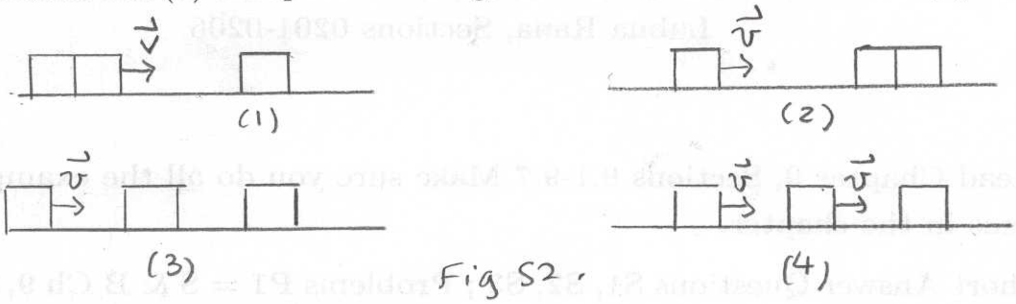


Fig S2.

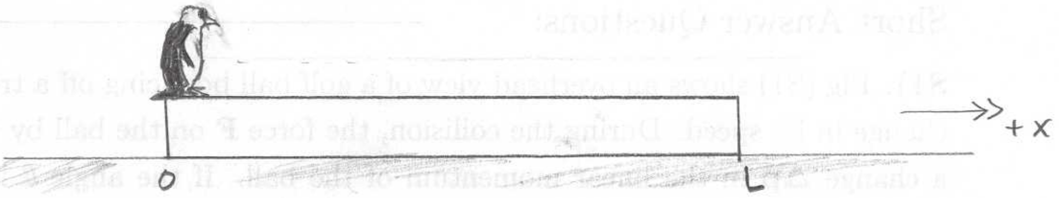
S3). A penguin stands at the left edge of a uniform plank of length L. The sled and the penguin have equal mass M. a). Where is the center of mass of the plank-penguin system?

The penguin then waddles to the to the right edge of the sled and the sled slides on the ice.

b). Does the center of mass of the sled-penguin system move leftward, rightward or not at all. Explain briefly.

c). Now how far and in what direction is the center of the *sled* from the center of mass of the plank-penguin system.

d). Relative to the center of mass of the plank-penguin system, how far does the penguin move?



Problems:

P1). *Serway & Beichner, Problem 6*

P2). *Serway & Beichner, Problem 58*

P3). *Serway & Beichner, Problem 60*

P4). Fig P4 shows a block B about to be dropped onto a moving cart A attached to a spring by cutting the string suspending block B just as A passes underneath. In the first case, block B is gently dropped onto A at the instant the cart passes through its equilibrium position. Let the masses of blocks A and B be m_A and m_B respectively, and let k be the spring constant. Assume the mass of the spring to be negligible.

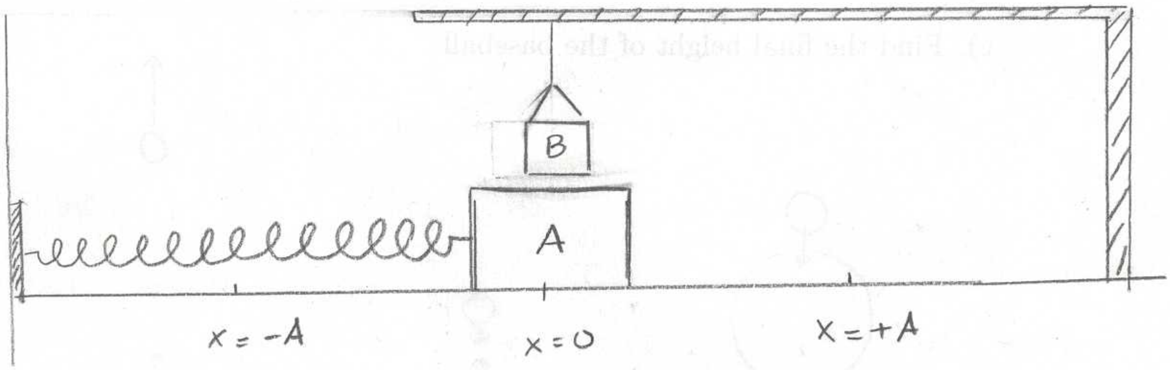
a). What would be the velocity of the combination of blocks B and A after the collision?

b). Let's focus on the system consisting of block A + block B + the spring. Is this an elastic or an inelastic collision? Calculate the kinetic energy of the system shortly before and shortly after the collision. (*Assume that the velocity of cart B is essentially zero before the collision.*)

c) Draw a free body diagram of each block. What role does friction play in this situation? What would happen if the interface between the block and the cart were frictionless?

d). What now is the maximum extension of the cart-block-spring system, assuming the block stays put on top of the cart?

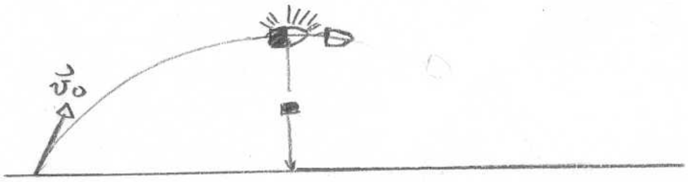
e). Now suppose that block B is dropped onto the cart at the instant the cart-spring system is at its maximum extension. How do your answers to parts (a) through (d) change in this case, if at all? What accounts for the differences, if any?



P5). A shell is fired from a gun with a muzzle velocity of $20 m/s$ at an angle of 60^o with the horizontal. At the top of the trajectory, the shell explodes into two fragments of equal mass. One fragment, whose speed immediately after the explosion is zero, falls vertically.

(a). Draw the complete trajectory of the center of mass of the shell.

(b). Use the insight given by your diagram for part (a) to find out how far from the gun the other fragment lands.



P6). Basketball & Baseball Collision Suppose that you align a baseball above a basketball (with a small separation) as shown in Fig P6 and drop them simultaneously from a height h. In answering the following questions, make the following assumptions:

Assumption 1). The mass of the basketball M is three times the mass of the baseball m i.e., $M = 3m$; and

Assumption 2). The diameter of the basketball and the baseball are very small compared to the initial height from which they are dropped. So you can treat them essentially as point particles.

Assumption 3). All collisions are elastic.

a). Find the velocity of each ball just before they collide. Note that due to their initial separation, the baseball will still be moving downwards and the basketball will be moving upwards after having bounced off the floor.

b). Find the velocity of each ball shortly after they collide with each other.

c). Find the final height of the baseball.