

Phy 113: Physics of Sports
Homework Problems
Set #8: Due Wednesday, November 5, 2008

Note: Students are encouraged to work together and discuss the problems. However, each student must arrive at her/his own final answers. Show all your work. Simply copied homework will result in zero.

1. (10 points) (a) What is the momentum of a 0.4 kg football thrown by Eli Manning at 50 mph? (b) If the ball is caught by Amani Toomer during a 0.02 s period, what is the force exerted on the ball by Amani?
2. (15 points) Prof. Jung drops an egg from 0.4 m above a table. (a) What is the impulse when the egg hits the table? The mass of the egg is 57 g (2 oz). (b) If the time of contact between the egg and the table top is 0.4 ms, what is the force exerted on the egg by the table? (c) If the egg is dropped on to a sponge and thereby the contact time is lengthened to 8 ms, what is the force exerted on the egg by the sponge and the table?
3. (10 points) A bullet with a mass of 25 g is shot by a rifle and the recoil velocity of the rifle is measured to be 3 m/s. What is the velocity of the bullet as it is fired? Assume the mass of the rifle is 2.5 kg.
4. (10 points) During a short track speed-skating relay race, Apollo Ono pushes his teammate from behind to give him a boost as they relay the race. Just before the push Ono is skating at a speed of 10 m/s and his teammate is skating at a speed of 4 m/s. After the push his teammate's speed is 9 m/s. If Ono has a mass of 60 kg, and his teammate has a mass of 65 kg, what is Ono's speed after he pushed his teammate?
5. (15 points) At a Super bowl football game, in the 4th quarter as the time ran out with 5 points behind, a running back with a mass of 240 lbs jumped over his offensive line. While traveling at 8 m/s horizontally in the air at the 1-yard ball position toward the goal line, he was viciously hit by an opposing linebacker with a mass of 280 lbs, who also jumped in the air to stop the running back, and was traveling 5 m/s horizontally in the opposite direction before the collision. Right after the tackle the two got stuck together. (a) What were the speed and direction of the players after the tackle? (b) What was the impulse applied to the running back by the linebacker. (c) If the players were in the air for 0.3 s after the collision before they hit the ground, was the running back able to score a Super Bowl winning touchdown? Assume the ball position relative to the running back was the same before and after the collision/tackle.