

Assignment #3 HK 376 - Biomechanics October 9th 2018

1. A 1.4 kg shot put is moving with a velocity of -6.2 m/s.
 - a. What is the momentum of the shot put? (1)
 - b. What impulse must act on the shot put to cut its velocity in half? (1)
2. Samurai pizza cats love to fight and make pizza. One of the pizza cats, Guido Anchovy (4.5 kg), was attempting a flying leg kick through a wall. Sadly, the wall was tougher than Guido initially anticipated. What impulse did the wall exert on Guido to accelerate him from 6 m/s to -1.5 m/s? (1)
3. Jeff was speeding down the ice during a hockey game at -7m/s when all of the sudden he spontaneously sprained his ankle again. Now all Jeff can do is glide to the bench at his current velocity all of the while brushing back tears and sobbing to himself. Assuming Jeff is a lean, mean 75 kg:
 - a. What is Jeff's momentum? (1)
 - b. What impulse must act on Jeff to change his velocity by 6 m/s? (1)
 - c. After the impulse in b. acts on Jeff, what will his momentum be? (1)
4. October 4th is Jeff and his cars' third year anniversary! Since his car is only three years old, it is equipped with driver and passenger side airbags. The passenger seat has a sensor that turns on the passenger side airbag when there enough weight on the seat. This insures that the airbag will be on when an adult passenger is present. The passenger is now less likely to be injured because (1)
 - a. Airbags reduce the impulse imparted to the passenger
 - b. Dashboards/windshields decrease the time of contact thereby increasing the peak force
 - c. Passengers undergo more change in momentum when they hit an airbag
 - d. Airbags increase the time of contact thereby decreasing the peak force
 - e. Both b and d
 - f. None of the above appeal to me that much but Jeff's car is a lot cooler than Sasho's car
5. Suppose a 60 kg centerfielder is running East at 4 m/s collides with a 52 kg shortstop at 7.5 m/s West. Match the following quantities of the centerfielder with how they would compare to the same quantities for the shortstop. Greater than, Less than, or the same (6)
 - a. Impulse during contact
 - b. Peak force during contact
 - c. Change in velocity
 - d. Change in momentum
 - e. Peak acceleration
6. Collin and Matt are having a rock pushing competition. Collin pushes on a 150 kg boulder for 10 seconds with an average force of 300 N. Matt pushes on a 160 kg boulder for 25 seconds with an average force of 120 N.
 - a. Who exerts the smaller impulse on their respective boulder if neither boulder moves? Explain (1)
 - b. Which boulder experiences a greater resultant impulse if neither moves? (1)

7. On the advice of X-men Hockey team coach Brad Peddle, assistant coach Zach MacQueen has taken up ballet in order to become more agile on the ice. Not wanting anyone to see him in his pink leotard, Zach practices alone in his office. To ensure that he has enough room to chassé and plié, Zach must move his filing cabinet. Assume he applied a horizontal force of 450 N, directed to the left for 0.3 seconds on a 45 kg filing cabinet which was initially at rest. The coefficient of friction between the cabinet and the surface on which it is sliding is 0.8.
 - a. What will the momentum of the bookcase be immediately after the 0.3 seconds? (1)
 - b. What impulse was exerted on the cabinet by Zack? (1)
 - c. What impulse was exerted on the cabinet by the force of friction? (1)
 - d. After 0.3 seconds, the 450 N horizontal force no longer acts on the cabinet. How far (in meters) will the cabinet continue to slide before coming to rest? (2)

8. A maximum **net** vertical force of 3000 N and a maximum **net** horizontal force of 1200 N act at the same time on the foot of a 90 kg football player. Ignoring air resistance,
 - a. What is the resultant **force from the ground** acting on the football player? (2)
 - b. What is the football player's resultant acceleration? (1)
 - c. Assume that the average vertical and horizontal forces applied by the ground over the entire time of foot contact were 55% of these peak magnitudes. If these average forces acted for 0.6 seconds. What impulse did the ground exert on the football player? (1)

9. A 75.0 kg man is trying to walk across a frozen river. He is walking into a head wind that is producing a 97 N force. If the coefficient of friction between the ice and his boots is 0.1, can he make it across? Your work should support your answer. (1)

10. Jamie McCarron has some serious ups. If an average vertical ground reaction force of 2300 N acted on Jamie's foot for 0.2 s during the upward phase of her jump, and Jamie's mass is 69 kg, what would her take-off velocity be? (2)

11. Lindsay and Deb collide in midair while trying to catch a wedding bouquet. If Lindsay undergoes a 40 kg*m/s change in momentum, what is Deb's change in velocity if she has a mass of 60 kg? (1)

12. Before the impact of two croquet balls, their combined linear momentum was 3 kg*m/s. If the first ball comes to a complete stop after the collision, with what velocity does the 0.3 kg second ball leave the collision? (1)

13. A pitcher throws a baseball with a velocity of +36m/s. The batter swings so that the "sweet spot" on the bat has a linear velocity of -21 m/s
 - a. What is the velocity of the ball relative to the sweet spot on the bat? (1)
 - b. What is the velocity of the sweet spot on the bat relative to the ball? (1)

Due: Tuesday October 16th at the start of class. 25% deduction of mark/day. Please YOU'RE YOUR answers. Please show all your work...clearly! Once again, please only write on the front of each sheet of paper and staple the assignment prior to submission. Remember that vectors need direction!!