Phy 113: Physics of Sports
Homework Problems
Set #5: Due Monday, October 16, 2017

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) Odell Beckham Jr., a NY Giants wide receiver, starts on the hash mark on the right side of the field. When the ball is snapped, he runs 40 yards directly towards the goal and then runs a slant at an angle of 60 degrees with respect to the hash marks (i.e. 30 degrees with respect to the yard lines) towards the right sideline, where he makes a spectacular one-handed diving catch of the ball thrown by QB Eli Manning. What is Odell's displacement from the starting point when he makes his catch right at the sideline? (The hash marks are 70 feet, 9 inches from the sidelines.)

2. (10 points) A movie stunt woman (for Halle Barry in a James Bond movie) on a motorcycle speeds horizontally off a 11 m high cliff. How fast must she leave the cliff-top (in mph) if she is to land on the level ground below 28 m from the bottom edge of the cliff where the cameras are? (b) How far will she land if the cliff is 8 m high instead and the speed of the motorcycle is the same? (Comment: This problem is related to why taller shot-putters have advantage over shorter shot-putters.)

3. (7 points) The average distance of Aaron Judge’s home runs in 2017 is 413.4 feet, and his average launching angle of the ball is about 30 degrees. Ignoring air resistance, what is the average initial velocity (commonly known as “exit” velocity or “speed off bat”)? Compare your answer with the measured initial velocity of 107.3 mph. Which one is larger? Explain the difference.

4. (14 points) Maxi Moralez, a NYCFC midfielder, passed a soccer ball perfectly from the midfield over the Chicago Fire defenders to his teammate David Villa, a striker, who was streaking on the right side of the penalty box towards the goal 27 m away from Maxi. Assuming the initial velocity Maxi kicked the ball was 20 m/s, at what angle did he kick the ball? How long was the ball in the air (assuming no wind resistance)?

5. (25 points) The NY Jets place kicker, Chandler Catanzaro, kicks a football against Cleveland Browns at an angle \( \theta = 40.0^\circ \) with a velocity of 30.0 m/s. Calculate (a) the maximum height, (b) the hangtime, (c) how far away it hits the ground, (d) the velocity vector at the maximum height, and (e) the acceleration vector at the maximum height.

6. (5 point) Watch any sports events (at least one, preferably an MLB playoff game) during the week and identify any particular action you saw in the event to which you can apply what you have learned from the Phy113 course so far. Write down: (1) name of the event/game; (2) date of the event; (3) action of the event; and (4) brief explanation of the action relating to what you have learned from Phy113.