Phy 113: Physics of Sports
Homework Problems
Set #11: Due Monday, December 4, 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) How much work must Prof. Jung’s car produce to drive 55.9 miles (at a constant speed) from his home to Yankee Stadium to watch a NYCFC game if an average force of 3,300 N must be maintained to overcome friction? And how many gallons of gasoline are needed for this trip? (Hint: Use the information provided on the class hand-out sheets as well as the following conversions: 1 liter of gasoline = 0.737 kg, and 1 gallon = 3.79 liter)

2. (5 points) How much chocolate (in grams) do you need to consume in order to sit in a Prof. Jung’s Physics of Sports class that lasts 80 minutes? Assume that the chocolate is the only source of energy for this activity and you do not use any of the stored energy in your body. Also assume that you don’t fall asleep. (Hint: Use the information provided on the class handout sheets.)

3. (15 points) When a person jumps from some height to the ground, very large stresses are produced in the joints. If a NY Knicks rookie, Kristaps Porzingis, who weighs 240 lbs, lands on the floor after a dunk (0.8 m above the floor), calculate the force in the knee joints (a) if he lands stiffly and compresses the joint materials 0.20 cm; (b) if he cushions the shock by flexing his legs upon striking the ground and his body moves 0.5 m in stopping. (c) Compare these forces with the weight of Kristaps.

4. (10 points) It turns out that surprisingly little advantage is gained by getting a running start in a downhill ski race. To demonstrate this, calculate the final speed of Lindsey Vonn who skis down a hill 150-m-high with negligible friction (a) if her initial speed is zero; (b) If her initial speed is 6.0 m/s. [The final speed found in part (b) is larger than in part (a), but by far less than 6.0 m/s! Also the actual downhill courses have much higher vertical drop, as much as 1 km.]

5. (10 points) Suppose Michael Phelps, winner of 14 Olympic gold medals, uses mostly arm motion to pull himself along, exerting an average force of 220 N through a distance of 1.8 m in each stroke. (See figure below.) Assuming he does 120 strokes per minute, (a) calculate the work done in each stroke, and (b) calculate the useful power generated by his arm.

![Diagram showing a swimmer's stroke with a length of 1.8 m]