

Problem Set #3

Physics 131

7 September 2022

- The 2012 Lamborghini Aventador LP700-4 claims a 0 - 60 mph time of 2.9 s. For the sake of simplicity, assume the acceleration of the sports car is constant.
 - Give the acceleration in ft/s^2 and in terms of g .
 - How far did the sports car travel during the 2.9 s of acceleration?
- Inspired by dreams of one day owning a Lamborghini, you and a friend decide to measure the acceleration of your car. While driving through West Virginia, where the speed limit is 70 mph on the interstates, you leave a rest stop, enter the acceleration lane for a WV interstate, and slam on the gas. You tell your friend when your car is going 35 mph, at which time your friend starts a stopwatch. You then tell your friend when your car reaches 70 mph, at which time your friend stops the stopwatch. Your friend records a time of 12 s. So that you can get an estimate of your car's acceleration, assume its acceleration is constant.
 - Give your car's acceleration in ft/s^2 and in terms of g .
 - How far did your car travel during your friend's timing?
- Usain Bolt set a new Olympic 100-m sprint record at the 2012 London Olympics. His time of 9.63 s was just 0.05 s off the world-record time he set in Berlin in 2009. One of the athletes who was supposed to give Bolt a run for his money was fellow Jamaican Asafa Powell. Unfortunately for Powell, he suffered a hamstring pull during the final. What is remarkable about Powell's last-place time of 11.99 s is that that time would have been good enough for *first* place at the inaugural modern Olympic games in Athens, Greece in 1896. Thomas Burke of the US won gold with a time of 12.0 s.
 - What was Bolt's average speed in winning gold in 2012? Give your answer in the following units: ft/s, mph, m/s, and kph.
 - What was Burke's average speed in winning gold in 1896? Give your answer in the following units: ft/s, mph, m/s, and kph.
 - By what percentage was Bolt's average speed greater than Burke's?
 - Suppose the Thomas Burke of 1896 races against the Usain Bolt of 2012. If Burke and Bolt each run the identical race they ran to win their respective gold medals, how far behind Bolt would Burke be when Bolt crosses the finish line? Give your answer in both m and ft.
- Among the centers and power forwards at the 2013 NBA Combine, former Indiana Hoosiers star Cody Zeller had the greatest standing vertical jump. Zeller jumped 35.5 in.
 - Assuming that Zeller's center of mass was vertically displaced by 35.5 in, calculate Zeller's launch speed off the basketball court. Give the speed in the following units: ft/s, mph, m/s, and kph.
 - How long was Zeller off the basketball court during his jump?

5. A basketball of mass 600 g is dribbled on the sidewalk. Video analysis shows that the ball collides with the ground with a speed of 4.5 m/s, and then rebounds with a speed of 3.5 m/s. Those speeds are determined *immediately* before and *immediately* after making contact with the sidewalk. The rebound speed is less than the incoming speed because energy is lost during the collision. The basketball is in contact with the sidewalk for 20 ms. The figure shows the collision.



- (a) As a first approximation, take the acceleration of the basketball to be constant while it's in contact with the sidewalk. What is the magnitude of the acceleration experienced by the basketball while in contact with the sidewalk?
- (b) How many “gees” does the basketball experience during the collision? In other words, if a is your part (a) answer, what is a/g ?

Due date: **14 September 2022** (*beginning of class*)