Recitation Problems for Week 2, Tuesday

2.C11. A bug is hovering over a highway when it is struck by the windshield of a moving car. (a) Considering the Earth, the bug and the car as relevant objects, in which systems is the change of momentum zero? (b) How does the change in momentum of the bug compare to that of the car? (c) How does the change in speed of the bug compare to that of the car?

1.S57. A mass is observed falling past a window that is $2.2\,m$ tall. This event is caught on a 100 frame-per-second video which upon close examininaton shows the mass traversing 85% of the window in six frames. (a) How far up could the mass have been dropped from? (b) What assumptions were necessary for you to reach this conclusion? (c) Looking more carefully at the video, it appears that the mass is moving at constant speed as it goes past the window. Can you conclude anything about the height from which it fell?

2.S43 (a) What is the gravitational force that a pair of electrons separated by a typical atomic distance (10^{-10} m) exert on each other? (b) What is the electric force that the two electrons exert on each other? (c) What is the ratio of the electric to the gravitational force? (d) If the two electrons are initially at rest, will they start to move towards each other or away from each other? (e) How would your answers to parts (c) and (d) change if the electrons were 1 m apart?

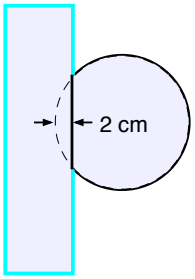

Figure 1: The diagram for problem S59 where a tennis ball deforms when hitting a wall.

1.S59. A professional tennis player can hit a tennis ball hard enough such that its speed is about 50 m/s. The ball strikes a wall, deforms, then bounces back with the same speed of 50 m/s. The deformed ball is shown in Figure 1 where the ball has its maximum deformation of about 2 cm. Taking the mass of the tennis ball to be 0.057 kg, model the collision of the ball with the wall as a constant force. (a) In this approximation, what is the magnitude of the force? (b) In this approximation, how long is the collision?

2.S44 Assume that we collected all the people in the Earth (about six billion) into a single city and all of them jumped straight up at the same time. Estimate the recoil speed of Earth.