Work your choice of two of the following four problems. Hand in your solutions at the end of the hour, or the start of class tomorrow morning.

1. A 5800 kg open railroad car coasts along with a constant speed of 8.6 m/s on a level track. Snow begins to fall vertically and fills the car at a rate of 3.5 kg per minute. Ignoring friction with the tracks, what is the speed of the car after 90 minutes?

2. An astronaut of mass M (including space suit) acquires a speed of V by pushing off with his legs from a space capsule of mass 15M. What is the change in speed of the space capsule? If the push lasts a time T, what is the average force exerted by each on the other?

3. A rifle bullet of mass M traveling at a speed V buries itself inside a pendulum of mass 200M hanging from a string of length L. The pendulum/bullet system swings upward in an arc. Determine the horizontal component of the pendulum’s maximum displacement.

4. From what maximum height can a 75 kg person jump without breaking the lower bone in either leg? Ignore air resistance and assume the center of mass of the person moves a distance of 0.6 m from the initial upright contact position to the final position when he ceases moving. The breaking strength (in terms of force per unit area) of bone is $170 \times 10^6$ N/m$^2$, and the smallest cross-sectional area of a typical leg bone is $2.5 \times 10^{-4}$ m$^2$. 