According to the National Oceanic and Atmospheric Administration, hail is showery precipitation in the form of irregular pellets or balls of ice more than 0.2 inches in diameter. Severe hail is defined to consist of hailstones with diameter 0.75 inches or larger. Giant hailstones (sometimes produced in supercell thunderstorms) are defined to be hailstones larger than 2 inches in diameter. In this problem, we will estimate the relative potential to do damage of the various types of hail. (Photo credits: left (normal hail) courtesy of Wikimedia Commons; center (severe hail) and right (giant hail) courtesy NOAA Photo Library.)

a.) For the purposes of this problem, let us assume that hail reaches the ground falling at its terminal velocity. (The high winds produced during thunderstorms can make this a poor assumption.) Assume that the drag force on a hailstone is given by the formula $F_D = \frac{1}{4} \rho_{air} A v^2$ where A is the cross-sectional area (not the full surface area) of the hailstone. Assuming that the density of air is about 1.3 kg/m^3 and that the density of ice is about 920 kg/m^3 estimate the terminal velocity of spherical hail with diameter 0.2 inches, 0.75 inches and 2 inches. Give your answers in miles per hour.

b.) Calculate the kinetic energy of hailstones with diameter 0.2 inches, 0.75 inches and 2 inches reaching the ground at terminal velocity.

c.) Calculate the heights from which you would have to drop a 5 kg mass to give it the same kinetic energy as the 0.2 inch, 0.75 inch and 2 inch hailstones moving at terminal velocity. (Ignore the action of air resistance on the 5 kg mass.) Give your answers in centimeters.