Homefun 1
Terminal Velocity, or Why We Don't Play Tennis While Skydiving

MATH 150
15 points

Directions: Work in groups of 2 to 4 in class and then finish outside of class. Each group should submit **ONE** solution page for the group. (Be sure everyone's name is on it!)

The air resistance $D(v)$ on an object moving with velocity v is given[1] by

$$D(v) = \frac{\rho A C_d}{2} v^2 = kv^2,$$

where C_d is the drag coefficient (more or less determined by the shape of the object), ρ is the density of the air, and A is the frontal area ("reference area") of the object (and k is a constant that absorbs all of those). The reference area is the area that would be projected onto a flat surface in front of the object; in the case of a sphere, it is the same as the cross-sectional area. (For more complicated objects, it may not be.) Below, be sure to use SI units throughout (kg, m).

1. Look up the drag coefficient for a sphere.
2. Look up the density of air at roughly sea level.
3. Look up the radius of a tennis ball. Get the mass m while you're at it.
4. Compute the value of k for a tennis ball. (k is really just all that stuff in front of the v^2, so this is a matter of plugging in the values you found.)
5. From physics, we know that a falling tennis ball will reach terminal velocity when the drag equals the gravitational force, which is given by $9.8m$ (where m is the mass you found for a tennis ball). Calculate the terminal velocity of a tennis ball.
6. Look up the terminal velocity of a tennis ball and compare to what you found. Can you explain any discrepancy?

[1] https://www.grc.nasa.gov/WWW/K-12/airplane/falling.html