MATH-UA.251.001: Introduction to Mathematical Modeling
Homework 3

1. Recall the model for vehicular stopping distance we derived: Total stopping distance, D, is equal to reaction distance, D_R, plus the breaking distance, D_B. Use the method of dimensional analysis to confirm the validity of the models we derived for D_R and D_B.

2. Consider Keplar's Third Law: The square of the orbital period of a planet, T, is proportional to the cube of the semi-major axis (the longer diameter of the elliptical path traced out), R, of orbit.

   (a) Using dimensional analysis, determine the relevant variables and how they effect orbital period, T. One of these variables should be F_G, the force due to gravity.

   (b) From experimental data, it has been determined that

   $$T = 2\pi\sqrt{\frac{R^3}{G}}$$

   where G is Earth's associated gravitational constant. What is the relationship between this model from experimental data and the model you derived from dimensional analysis? **Hint:** It should look like a physical law that we already know!

3. In many systems, we must consider the **drag force** (or damping force or frictional force) acting on an object, or how surrounding particles act to reduce the velocity of objects considered. Using dimensional analysis, determine the relevant variables and how the effect the drag force of a general system. How might we confirm this model experimentally?