Homework 1a: **Dimensional Analysis**

Course: Physics 231, *Methods of Theoretical Physics* (2019)
Instructor: Professor Flip Tanedo (flip.tanedo@ucr.edu)
Due by: **Fri**, October 4

1 Identifying Dimensions

As a warm up, write out the dimensions of the following quantities in the form $[Q] = L^\alpha, M^\beta T^\gamma$, that is: write out the length, mass, and time dimensions.

(a) Electric charge, e. (In lecture we wrote out the answer; derive it.)

(b) Action ($S = \int dt L$, where L is the Lagrangian)

(c) Magnetic field, B

(d) Energy.

Extra Credit

These problems are not graded and are for your edification. You are strongly encouraged to explore and discuss these topics, especially if they are in a field of interest to you.

1 Allometry

These two problems come from *Mathematical Methods in Classical Mechanics* by the eminent mathematician V.I. Arnold.

(a) A desert animal has to cover great distance between sources of water. How does the maximal time the animal can run depend on the size L of the animal?

(b) How does the height of an animal's jump depend on its size? Use the fact that the force applied by muscles is proportional to the strength of bones, which is itself is proportional to their cross section.