1 Dimensions

(2, 2 pts)

When physicists calculate the value of a physical quantity from an equation, they pay particular attention to the units involved. A force of 2 is ill-defined, a force of 2 Newtons is clear. Units tell you both what **type** and **how much**.

However, when physicists want to check the plausibility of an equation, without worrying exactly about "how much" and which set of units will be used (e.g. Newtons vs. pounds vs. dynes), they often look at the "dimensions" of the physical quantities involved. **Dimensions** are the powers of the fundamental physical quantities: length (L), time (T), mass (M), and charge (Q), that make up the physical quantity. They only tell you what **type** of quantity and not "how much". For example, since force is mass times acceleration,the dimensions of force are ML/T^2. A common notation for the dimensions of a quantity is to put the quantity in square brackets, for example:

$$[Force] = \frac{ML}{T^2}$$

Find the dimensions of electrostatic potential energy. Also, find the dimensions of electrostatic potential.

2 Total Charge (HW)

(4, 4 pts)

For each case below, find the total charge.

(a) A positively charged (dielectric) spherical shell of inner radius a and outer radius b with a spherically symmetric internal charge density

$$\rho(\vec{r}) = 3\alpha\, e^{(kr)^3}$$

(b) A positively charged (dielectric) cylindrical shell of inner radius a and outer radius b with a cylindrically symmetric internal charge density

$$\rho(\vec{r}) = \alpha\, \frac{1}{s}\, e^{ks}$$