PH 223 Week 1

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Activity 1 is borrowed/adapted from Chapter 22 of *Physics for Scientists and Engineers*.

Activity 1

What mass of aluminum has a total nuclear charge of 1.0 C? Aluminum has atomic number 13 and molar mass 26.98 g/mol.

Activity 2

You dip a candy bar into chocolate and pull it out slowly so that more and more chocolate accumulates on the bar. When the chocolate has cooled, you measure the mass density at one end to be $\lambda = 0$ and the density at the other end to be $\lambda = \alpha L$, where L is the length of the bar and α is a constant, and you assume the mass density is linearly proportional to distance along the candy bar.

1. How are λ, mass, and length related?
2. Can you represent this relationship as a derivative?
3. Determine the total mass of chocolate on the candy bar.
4. The expression for center of mass is

$$x_{cm} = \frac{1}{m_i} \int_{x_i}^{x_f} x dm \tag{1}$$

   Use this expression to find the center of mass of the chocolate bar.

Activity 3

For each of the following charge density distributions, determine the units of the constant of proportionality (α, β, γ) and the total charge:

1. A rod of length L oriented along the x-axis with charge distribution $\lambda(x) = \alpha x^{1/3}$.
2. A rod of length L oriented along the y-axis with charge distribution $\lambda(y) = \beta y^5$
3. A disk of radius R with charge distribution $\sigma(x, y) = \gamma xy$