Dimensions & Units

- Dimension: the type of a physical quantity, e.g. Length, Time, Temperature

- We use the SI system:
  - 6 fundamental dimensions
    - kind of arbitrarily defined
  - Time & current are among them
  - So, Charge = Current x Time is derived.
  - You could define charge & time as fundamental then current = charge/time can be derived.

- In physics & engineering, always check dimension & units; although this sanity check doesn't guarantee correctness.

\[ E = \frac{q}{4\pi \varepsilon_r \varepsilon_0 R^2} \]

\[ q = C; \quad \varepsilon_0 = \frac{F}{m} = \frac{C}{Vm} ; \quad R - m \]

\[ \frac{C}{Vm} = \frac{V}{m} \]

On the other hand, another charge \( q' \) in this field:

\[ F = q'E \Rightarrow E = \frac{F}{q'} \]

Show that \[ \frac{N}{C} = \frac{V}{m} \]

Joule

\[ W = F\cdot l \]
\[ J = Nm \]

If the force's electric \( W_{\text{electric}} = Q \cdot V \)
\[ J = CV \]

\[ Nm = CV \]