Dimensions & Units

Dimension: The type of a physical quantity, e.g. length, time, temperature.

We use the SI system, in which there are 6 fundamental dimensions.

Kind of arbitrarily defined.

Time and current are among them.

Therefore, charge = current × time is “derived”.

If time and charge had been defined fundamental, then current = charge / time would be derived.

A number and a unit together make the value of a physical quantity.

In physics and engineering, we should always check units (although this sanity check does not guarantee an equation’s correctness).

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

\[ \frac{C}{m^2} = \frac{V}{m} \]

Field is the gradient of potential, therefore V/m.
Field is the gradient of potential, therefore \( \frac{V}{m} \).

On the other hand, if we place a probe charge \( q' \) in this field, \( q' \) will feel a force

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

Can you prove that \( \frac{N}{C} = \frac{V}{m} \)?

Recall that

\[
W = F \cdot l
\]

\[
J = Nm
\]

If the force is an electrostatic one moving a charge \( Q \), and the potential difference over \( l \) is \( V \), then

\[
W = Q \cdot V
\]

\[
J = CV
\]

You do the rest.

Review textbook Section 1-2.