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).

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

q — C ; ε_0 — F/m = $\frac{C}{Vm}$; R — m

farad

coulomb meter volt

$$\frac{C}{\frac{C}{Vm}\cdot m^2} = \frac{V}{m}$$

Field is the gradient of potential, therefore V/m.

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farad, coulomb, meter, volt

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Field is the gradient of potential, therefore V/m.

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

$$F = q'E \quad \Rightarrow \quad E = \frac{F}{q'}$$

$\frac{N}{C}$ — newton, coulomb

Can you prove that N/C = V/m?

joule

Recall that $W = F \cdot l$ $\quad J = Nm$

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

$W = Q \cdot V$ $\quad J = CV$

coulomb, volt

You do the rest.

Review textbook Section 1-2.