

Local conservation of electric charge is expressed mathematically by:

$$\frac{\partial \rho}{\partial t} = -\nabla \cdot \vec{\mathbf{J}} \quad \text{where } \mathbf{J} \text{ is "current density"}$$

$\mathbf{J} = \rho \mathbf{v}$ has units of (charge/sec)/m²

We are trying to come up with a “conservation of energy” expression:

$$\frac{\partial(\text{energy density})}{\partial t} = -\nabla \cdot (\textit{something})$$

What sort of beast is this “something” ?

- Is it a scalar, vector, something else?
- How would you interpret it, what words would you use to try to describe it?
- What are its UNITS?

