

Homework 1: due 1/19/22

1. If $V(t) = V_0 \cos(\omega t + \phi)$, show that $\frac{\partial V(t)}{\partial t} = \text{Re}\{j\omega V_0 e^{j\phi} e^{j\omega t}\}$, which can be expressed as $j\omega V$ where V is the phasor representation of $V(t)$.
2. Show that $\langle \mathbf{A}(t) \times \mathbf{B}(t) \rangle = \frac{1}{2} \text{Re}\{\mathbf{A} \times \mathbf{B}^*\}$ where $\mathbf{A}(t) = \text{Re}\{\mathbf{A} e^{j\omega t}\}$, $\mathbf{B}(t) = \text{Re}\{\mathbf{B} e^{j\omega t}\}$ and $\langle \mathbf{V}(t) \rangle = \frac{1}{T} \int_0^T dt \mathbf{V}(t)$.
3. Can the magnetic field $\mathbf{B} = \hat{x} \sin(x) + \hat{y} \sin(y)$ exist in the region defined by $0 \leq x \leq 1$, and $0 \leq y \leq 1$?
4. If two opposite traveling waves are of the same frequency but with a phase difference, will a standing wave form?
5. Estimate the electric field on the electron in the ground state of a hydrogen atom.