

## Physics 542 - Test 1

### Possible Derivations

- 1) Reason for definition of  $(\mathbf{H} = \mathbf{B}/\mu_0 - \mathbf{M})$
- 2) Displacement current. Why necessary? Why  $J_d = \frac{\partial D}{\partial t}$  ?

Adjustment to Ampere's Law:  $\nabla \wedge \mathbf{H} = \mathbf{J}_f + \frac{\partial \mathbf{D}}{\partial t}$

- 3) Poynting's Theorem. Derivation and interpretation leading to definition of the Poynting vector,  $\mathbf{S}$ .
- 4) Change necessary to definition of  $\phi$  when time dependent fields are allowed,

$$\mathbf{E} = -\nabla\phi - \frac{\partial \mathbf{A}}{\partial t}$$

- 5) Gauge transformations:

$$\mathbf{A}' \rightarrow \mathbf{A} + \nabla\chi \quad ; \quad \phi' \rightarrow \phi - \frac{\partial \chi}{\partial t}$$

why do they work and show that Lorentz condition demands that

$$\nabla^2 \chi - \mu\epsilon \frac{\partial^2 \chi}{\partial t^2} = 0$$