

## Maxwell's Equations in Materials

1. A parallel plate capacitor consists of two circular plates of area  $S$  with vacuum between them. It is connected to a battery of constant *emf*  $\Delta V$ . The plates are then *slowly* oscillated so that they remain parallel but the separation  $d$  between them is varied as  $d = d_o + d_1 \sin \omega t$ .
  - (a) Why is it important to specify that the plates are *slowly* oscillated?
  - (b) Determine the field  $\vec{H}$  between the plates.
  - (c) Similarly, find  $\vec{H}$  if the capacitor is first disconnected from the battery and then the plates are oscillated in the same manner.
2. In class we expressed Maxwell's equations in materials in terms of four vectors  $\vec{E}, \vec{D}, \vec{B}, \vec{H}$  as well as the sources  $\rho_f$  and  $\vec{J}_f$ . Instead, express the general form of Maxwell's equations completely in terms of each of the following pairs:  $(\vec{E}, \vec{H}), (\vec{D}, \vec{B}), (\vec{D}, \vec{H})$ .
3. Express the general boundary conditions (normal and tangential components) completely in terms of the following pairs for a l.i.h material  $(\vec{E}, \vec{H}), (\vec{D}, \vec{B}), (\vec{D}, \vec{H})$ .