Note that for linear dielectrics the following relations are valid:

$$\vec{P} = \chi_e \varepsilon_o \vec{E} \qquad\qquad \vec{D} = (1 + \chi_e)\varepsilon_o \vec{E} = \varepsilon_r \varepsilon_o \vec{E} = \kappa \varepsilon_o \vec{E} = \varepsilon \vec{E}$$

Sp the polarization is liner proportional to the applied electric field. χ_e is called the electric susceptibility. ε_r is called the relative permittivity or dielectric constant so ε_r of Griffith is the same as the κ of Halliday and Resnick. It is a dimensionless quantity. The ε without subscript is the permittivity of the material and includes both ε_o and ε_r (κ).

Polarization, read field induced electric dipole moment volume density, leads to bound volume and surface charge densities, i.e.

$$\rho_B = -\nabla \bullet \vec{P} \qquad\qquad \sigma_B = \vec{P} \bullet \hat{n}$$

Maxwell's equations for electrostatics in vacuum, i.e.

$$\nabla \bullet \vec{E} = \frac{\rho_{all}}{\varepsilon_o}$$

$$\nabla \times \vec{E} = 0$$

Turn into the following equations for a material:

$$\nabla \bullet \vec{D} = \rho_{free}$$

$$\nabla \times \vec{D} = \nabla \times \vec{P}$$

Only for special cases where the polarization is curl-less these equation simplify to:

$$\nabla \bullet \vec{D} = \rho_{free}$$

$$\nabla \times \vec{D} = 0$$

ONLY for the case where the polarization is curl-less we can write **D** as an integral over all free charges, i.e.

$$\vec{D} \overset{\nabla \times \vec{P} = 0}{=} \frac{1}{4\pi} \iiint_V \frac{\hat{r}_s}{r_s^2} \rho(\vec{r}')d\tau'$$

Which looks like Coulombs law and which tells us that the free charges are the sources of the electric displacement. If P is unequal to zero, D also has other contributions, and we no longer have a Coulomb's law equivalent. This makes the interpretation of D difficult.

The boundary conditions are listed on page 185 in the book. Please memorize them. Note that this chapter has quite a bit of new lingo, so please make sure you take ownership of the new symbols and their physical meaning.

Work problem 4.18 in the text.

Work problem 4. 21 in the test.

Rework example 4.7 in the text.

Work problem 4.26 in the text.