2/8/2005. **Due:** Tuesday, February 15, 2005 (in class).

Physics 302/572: Electromagnetic Theory II

Read: Griffiths chapter 9.1, 9.2

"**G**" refers to Griffiths' book.
Problems with stars are not for credit and will NOT be graded.

Homework 2

Exercise 1 (G 9.2)

Show that the **standing wave** $f(z,t) = A\sin(kz)\cos(kvt)$ satisfies the one-dimensional wave equation, and express it as the sum of a wave traveling to the left and a wave traveling to the right.

Exercise 2 (G 9.6)

Consider two strings under tension T joined by a knot of mass m. Wave velocities for these strings are v_1 and v_2.

a) Formulate an appropriate boundary condition on the transversal displacement $f(z,t)$ of strings at the joint.

*b) Find the amplitude and phase of the reflected and transmitted waves for the case where the knot has a mass m and the second string is massless.

Exercise 3

Find the solution $f(z,t)$ of the one-dimensional wave equation $f_z^2 = f_t^2/v^2$ subject to the initial condition

$$\begin{aligned} f(z,0) &= \frac{a^2}{z^2+b^2}, \\ f_t(z,0) &= 0. \end{aligned}$$

Exercise 4 (G 9.8, partial)

a) Using complex notations write down the solution of a one-dimensional wave equation corresponding to a **left circular polarization**.

b) Show that it can be decomposed into two linearly polarized solutions. What is the phase difference between the linearly polarized solutions?

c) Sketch the string at time $t = 0$.

d) How would you shake the string in order to produce a circularly polarized wave?

*Exercise 5 (G 9.9)

Write down the (real) electric and magnetic fields for a monochromatic plane wave of amplitude E_0, frequency ω, and phase angle zero that is

(a) traveling in the negative x direction and polarized in the z direction;

(b) traveling in the direction from the origin to the point $(1, 1, 1)$ with polarization parallel to the xz plane.

In each case, sketch the wave, and give the explicit Cartesian components of $\mathbf{k}$ and $\hat{\mathbf{n}}$.