University of Kentucky, Physics 520
Homework #8, Rev. A, due Friday, 2016-10-28

0. Griffiths [2ed] Ch. 2 #52, #53.

1. The **step potential** $V(x) = V_0\theta(x) = \{V_0 \text{ if } x > 0, \text{ or } 0 \text{ if } x < 0\}$ is the quantum mechanical analog of a wave on a string crossing over the junction of two strings of characteristic impedance Z_1 and Z_2 connected at $x = 0$.

a) Calculate the transfer matrix for this potential.

b) Calculate the scattering matrix from the transfer matrix of part a).

c) Calculate the forward (coming in from the left) and backward (coming in from the right) probabilities of reflection and transmission for a particle of energy $E > 0$ using the elements of the scattering matrix of part b). *Hint: the forward transmission probability must take into account the difference of incoming and outgoing velocities:*

$$T_\ell = \left.\frac{j_F}{j_A}\right|_{G=0} = \left.\frac{k_2|F|^2}{k_1|A|^2}\right|_{G=0} = \frac{k_2}{k_1}|S_{21}|^2.$$

d) Show that the forward reflection coefficient is $R = 1$ if $E < V_0$, similar to total internal reflection of a light wave in a fibre optic cable.

e) [bonus] What are the quantum mechanical analogs of the velocity v and impedance Z of a classical wave medium?