Set 12 – due 28 November

“The task is not to see what no one else has seen, but to think what no one else has thought, about that which everyone else has seen.” – Schrödinger

1) [20 points] Jackson 7.6 (a)–6, (b)–6, (c)–8.

2) [20 points] More about Jackson 7.2. You have already solved this problem to find the transmission and reflection coefficients. Now consider the case of an infinite planar dielectric medium of thickness \( d \) in the vacuum (i.e. \( n_3 = 1 \) in 7.2). Assume that there is an incident electromagnetic wave of energy density \( u_0 \) and frequency \( \omega \) directed normal to the surface of the plane, and compute the radiation pressure of the wave on the plane in two ways: (a) [7 points] Calculate the field momentum of the incident wave, \( \vec{p}_i \), the transmitted wave, \( \vec{p}_t \), and the reflected wave \( \vec{p}_r \). Then use momentum conservation to write \( \vec{p}_i = \vec{p}_t + \vec{p}_r \) momentum of plate. (b) [7 points] Evaluate the stress tensor to the left and to the right of the slab. (c) [6 points] For what values of thickness \( d \) is the pressure a maximum?

3) [10 points] Suppose that there is a magnetic field \( \vec{H}_0 \) parallel to, and at the surface of, a good conductor. Beginning with the expressions for \( \vec{E} \) and \( \vec{H} \) in conductors (in Jackson Sec. 8.1), (a) [5 points] show that the time-averaged power loss into the conductor per unit area is

\[
\frac{dP}{dA} = \frac{\mu_r \omega \delta}{4} |H_0|^2 = \frac{1}{2 \sigma \delta} |H_0|^2.
\]  

(b) [5 points] What is the time-averaged magnetic energy density (energy per unit area) stored in the conductor, in terms of \( \vec{H}_0 \)?