**University of Kentucky, Physics 520**
**Homework #2, Rev. B, due Friday, 2015-09-09**

**0.** Griffiths [2ed] Ch. 1 #11, #12, #13.

**1. Bohr's Oscillator.** A 3-dimensional ideal frictionless harmonic oscillator of mass $m$ and natural angular frequency $\omega$ is similar to a hydrogen atom, except instead of $F = Ze^2/4\pi\epsilon_0 r^2$, the central force is $F = kr$ with spring constant $k = m\omega^2$.

**a)** In the same way that Bohr quantized the hydrogen atom, use quantization of angular momentum $L = \hbar n$ to calculate the radius $r_n$, velocity $v_n$, and energy levels $E_n$ of the stationary orbits (states) of the harmonic oscillator.

**b)** Calculate spectrum of emitted wavelengths.

**c)** Show that Bohr's correspondence principle holds for this system.

**2. Surface optics.** Use the principle of constructive interference to show that one single formula $\Delta(nd\sin\theta) \equiv (n_2\sin\theta_2 - n_1\sin\theta_1)d = m\lambda$ applies to reflection, refraction, and diffraction at the interface between two media with indices of refraction $n_1$ and $n_2$. $\theta_{1,2}$ are the angles of the incident and outgoing waves, respectively, measure from the normal. $d$ is the spacing between individual rules of the diffraction grating, which are perpendicular to the plane of incidence, and $m$ is the order of diffraction. Note that diffraction can be either reflective or transmissive, with the $0^{\text{th}}$ order diffraction peak corresponding to reflection or refraction, respectively, in which case $d$ is irrelevant.