Physics 373 Homework #10 Spring '18
Dr. Drake

Due on Thursday December 6.

1. Boas Chapter 13: 2.1, 2.14 (Hint: the boundary condition on the two sides is $\partial T/\partial x = 0$

2. Boas Chapter 13: 6.6 The book problem asked you to calculate only the energy levels but I want you to calculate the full time dependence $\psi(x, y, t)$ with initial conditions corresponding to the particle having equal probability of being anywhere in the domain. Choose the normalization of ψ so that the integrated probability of finding the particle is unity.
Hint: you will need two distince eigenvalues corresponding to the x and y directions.

3. Consider the oscillation of a circular membrane of radius R that is described by the wave equation with $\partial/\partial\phi = 0$. The oscillation amplitude $u(r, t)$ is zero at the boundary. The initial displacement at $t = 0$ is uniform, $u(r, t = 0) = u_0$ with $\dot{u}(r, t = 0) = 0$. Construct the basis functions $R_n(r)$ for the motion and determine the eigenfrequency ω_n for each value of n. Determine the full time dependence $u(r, t)$.

4. Consider the time-dependent Schroedinger equation in a box of length L with ψ equal to zero at $x = 0$ and $x = L$ and $V = 0$. The goal is to show that the form of the equation guarantees that the integrated probability of the particle being in the box is a constant in time. To demonstrate this consider the local probablilty $P(x, t) = \psi^*\psi$. Take the time derivative of P and use the Schroedinger equation to evaluate $\dot{\psi}$. The time derivative of ψ^* can be obtained by taking the complex conjugate of the Schroedinger equation. Integrate the equation for $\dot{P}$ over the entire domain and integrate by parts. You will then find that the integral of P is constant in time.