1) From a current weather chart (http://www.iges.org/pix/analyses.html) estimate a horizontal scale for the surface winds, an estimate of surface velocity, and come up with an estimate of the Rossby Number (U/fL). Do the same thing for the Jet Stream. From the satellite images available here (http://rs.gso.uri.edu/amy/avhrr.html) try to come up with similar scale estimates for the Gulf Stream (assume the currents are 1 m/s). For which fluid is the geostrophic approximation most useful?

2) Show cos(mx) can be expressed as the sum of two exponentials with imaginary exponents.

3) Express the ‘tophat’ function (φ(x) = 1 for -1/2<x<1/2, otherwise φ(x) = 0, in the domain -10<x<10) as an infinite set of cosine functions.

4) Many wave-type problems are governed by an equation like

$$\frac{\partial^2 \phi}{\partial t^2} - c^2 \frac{\partial^2 \phi}{\partial x^2} = 0$$

where c is a real constant. For an initial value of φ(x, t = 0) = f(x) find a general solution. Show that it consists of two sets of waves, one set moving towards positive values of x, and the other moving towards negative values of x.