Homework 3 (MATH 5490-01) **Name (Print):**
Due date: Thursday, March 7, 2013

Consider the instantaneous emission of a mass M = 0.1 kg from a point source at position y_0 = 10 m. The mean wind velocity in x direction is U = 10 m/s, and the diffusion coefficient is D = U y_0.

1. Develop a diffusion model that can be used for the simulation of the diffusion process described above. Present the model such that the vertical diffusion in y direction can be described. Specify boundary conditions for the following cases:
   a) no boundary,
   b) totally reflecting boundary,
   c) totally absorbing boundary.

2. Calculate for the totally absorbing boundary case the total amount of mass in the domain considered divided by M at
   a) x = 10 m
   b) x = 100 m
   Here, x is the distance from the source.
   Hint: This calculation can be performed by writing the corresponding integral in terms of error functions.

3. Derive an analytical formula for the concentration distribution that can be used for partially absorbing and partially reflecting boundaries. This formula should contain the cases of a totally absorbing boundary and a totally reflecting boundary as limit cases.

4. Use this formula to provide the analytical concentration distribution for the case of a boundary with 50% reflection. Use this formula to calculate the position of the maximum and the maximal ground concentration for this case.