

**12.005: Problem Set 7**  
**Due 5/12/06**

- 1) (20%) Problem 6-4, Turcotte & Schubert (old edition).
- 2) (15%) Consider a (very wide) river of depth 1 m and (modest - even boring) gradient of 1 m/km. Using the theory derived in problem 1, calculate the surface velocity of the river. (Water has a viscosity of 0.001 Pa s.)

The answer is surprising and obviously wrong. What's wrong with the theory?

- 4) (20%) Problem 6-5, Turcotte & Schubert (old edition).
- 5) (10%) Problem 6-6, Turcotte & Schubert (old edition).
- 6) (35%) Consider a thermal convection cell in a box of depth  $L$  and width  $L$ . The flow in the cell can be derived from the stream function:

$$\psi = A \sin(2\pi x_1/L) \sin(2\pi x_3/L)$$

- a) What are the velocities as a function of  $x_1$  and  $x_3$ ?
- b) What are the shear stresses at  $x_3 = 0, L$ ?
- c) Assuming that the only body force is in the  $x_3$  direction, what distribution of body force satisfies the equilibrium equation? Is this pattern consistent with thermal convection?