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:

$$\psi = A \sin \left( \frac{2\pi x_1}{L} \right) \sin \left( \frac{2\pi x_3}{L} \right)$$

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?