Problem 27.
To evaluate the effectiveness of a new mixing device, you have been asked to write a code to simulate the flow in channel shaped somewhat like the one sketched below. The Reynolds number is only a few hundreds, so the flow is laminar, and you can take the channel to be two-dimensional. Accuracy is extremely important and you have been asked to accomplish this in only a few weeks. You only have to worry about getting the flow field correct.

Describe how you would accomplish this. You do not need to write down the detailed discrete equations, but your description should be sufficiently detailed so that it is clear what approximations you are going to use, and you should clearly state all critical issues and how you intend to deal with those.
Limit the response to less than a page!

Problem 28.
It is proposed to use a finite difference method to simulate the stirring and mixing of two fluids by a prescribed velocity field. The fluids are completely identical, except that one is red and the other is blue. The colors can mix, but diffusion is VERY small. The velocity field is unsteady (but GIVEN) and maximum velocity is one. Assume that the mixing takes place in a square, two-dimensional domain (with sides of length one) and that the initial configuration of the fluids is given.
(a) EXPLAIN the main difficulties in solving this problem and
(b) PROPOSE a method to allow us to simulate this problem. You do not have to write down the finite difference equations in detail
Limit the response to less than a page!

Problem 29.
Propose a numerical scheme to solve for the unsteady flow over a rectangular cube in an unbounded domain. The Reynolds number is relatively low, 500-1000. Identify the key issues that must be addressed and propose a solution. Limit your discussion to one page. Do NOT write down the detailed finite difference equations, but state clearly what kind of spatial and temporal discretization you would use.