Practice problems are examples of the kinds of problems you should be creating for yourself in your classes and your research to ensure you understand what you are working on. I encourage you to discuss these problems, and others you create for yourself, with your fellow students. You do not have to turn these in, but I am happy to discuss them in class.

1) **Vector calculus** Consider a 2-d velocity field, $\vec{u} = (u, v)$ with components $u(x, y) = \cos(kx) \cos(ly)$ and $v(x, y) = \sin(kx + ly)$. Calculate $\nabla \cdot \vec{u}$, $\nabla \times \vec{u}$, and $(\vec{u} \cdot \nabla) \vec{u}$. Invent your own 3-d velocity field and calculate the same quantities. Check your work with software packages such as Mathematica and Matlab.

2) **2-d incompressible flow**. Consider a 2-d incompressible flow with $\vec{u} = (u, v)$ and $u(x, y) = \cos(kx) \cos(ly)$. Find $v$ and the steady-state density, $\rho$ (i.e. the density field that satisfies $\partial \rho / \partial t = 0$). Graph $u$, $v$, and $\rho$ and understand physically why they are correct.