

## Sample Questions from Past Qualifying Exams

This list may give the impression that the exams consist of a series of questions fired at the student one after another. In fact most exams have more the character of a conversation with considerable give and take. Hence this list cannot be expected to indicate accurately the difficulties involved.

The list indicates the professor associated to each question where available. Some have been in the MGSA files for a while, and this information has been lost (if it was ever there).

Many of the questions in the MGSA archives seem to center on basic Linear Algebra. Since many of these papers date from before the restructuring of the Prelims and Qualls, they probably reflect the antiquated system. Therefore, I will be ommitting them from this list.

The listing by section is approximate, since some questions may fit under more than one heading.

### Fluid Mechanics

- State Kelvin's circulation theorem. What does it imply about the flux of vorticity across a surface moving with the flow?
- Prove that if a surface is initially a vortex sheet and moves with isentropic flow, then it remains a vortex sheet.
- What quantities do you need ofr the Reynolds number? Write the homogeneous, incompressible Navier-Stokes equations and explain how you arrive at an expression involving Reynolds number.
- Imagine a semi infinite flat plate (i.e. with leading edge) in a uniform flow  $\underline{u} = (u_0, 0)$ . What characteristic length do we use for the Reynolds number? Draw what the velocity profile might look like downstream. In what region above the plate do you expect the viscous effect to be importatn? Conclude that the boundary layer thickness varies as the square root of the distance from the leading edge.
- State the uniform boundedness principle.