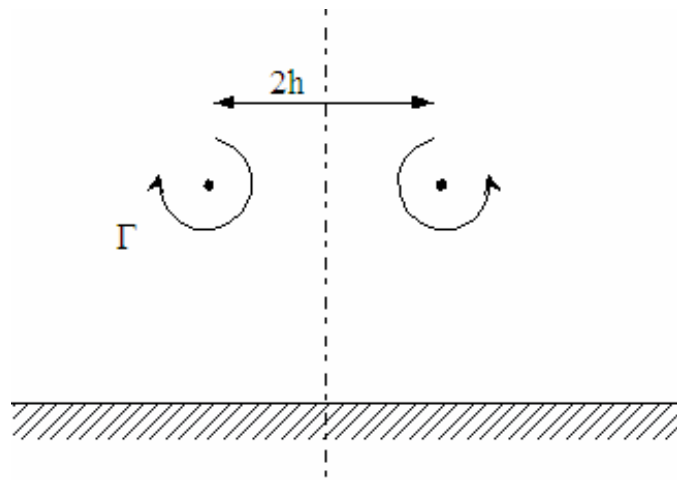


**Written Preliminary Exam
2004**

Fluid Mechanics

A counter rotating pair of infinitely long line vortices, with fixed separation $2h$ impinges upon a solid infinite flat surface as shown.



- 1 Discuss the inviscid motion of the vortices as they approach the surface. Calculate the induced pressure field on the surface using potential flow theory. Show sketches.
- 2 Compare the motion for a viscous flow. As part of this discussion, show that for an incompressible flow new vorticity can only be generated at a solid surface (use equations). Discuss the boundary layer which develops on the plate. Do you expect boundary layer separation (if so, where? use drawings) and what effect will this have on the motion of the vortex pair?
- 3 Discuss how the inviscid and viscous cases would be different a circular vortex ring (with the same circulation Γ) impinging on the wall, as shown below.

