所別：水文科學研究所碩士班　　科目：流體力學

1. Delineate the following terms:
   (a) incompressible fluid [3%]; (b) path line [3%]; (c) hydrostatic pressure [4%]

2. A two-dimensional steady flow has velocity components
   $u=y$, $v=x$.
   Derive the streamlines of the flow. [10%]

3. Consider the viscous flow in a channel of width $2b$. The channel is aligned in the x direction, and the velocity at a distance y from the centerline is given by the parabolic distribution
   $u(y)=U_0[1 - y^2/b^2]$
   In terms of the viscosity μ, calculate the shear stress at a distance of $y=b/2$. [10%]

4. Derive the *curl* of a three-dimensional velocity vector field $\boldsymbol{u}$. What the *curl* $\boldsymbol{u}$ is if the flow field is irrotational. [8%; 2%]

5. Write the Euler equation and state the physical meaning of each term. [4%; 6%]

6. Explain the following terms:
   (a) vortex-tube strength [5%]; (b) turbulent flow [5%]; (c) Froude number [5%]

7. (a) Write the definition of circulation. [5%]
   (b) Use the Stokes' theorem to describe the relationship between circulation and vorticity. [5%]

8. For a free vortex in polar coordinate (r,θ), if its velocity potential ϕ is $\phi=\frac{\Gamma}{2\pi}\theta$, with Γ the vortex strength, then show that its stream function ψ is $\psi=-\frac{\Gamma}{2\pi}\ln r$. [10%]

9. (a) Write the Bernoulli equation and state the physical meaning of each term. [10%]
   (b) Use the Bernoulli's equation to explain how a baseball pitcher throws a curve ball. [5%]