1. (20)Consider the flow field given by $\psi = ax^2 - ay^2$, where $a = 3s^{-1}$. Show that the flow is irrotational. Determine the velocity potential for this flow.

2. (20)The shaded area shown is in a flow where the velocity field is given by $\vec{V} = ax\hat{i} - by\hat{j}$; $a = b = 1s^{-1}$, and the coordinates are measured in meters. Evaluate the volume flow rate and the momentum flux through the shaded area.
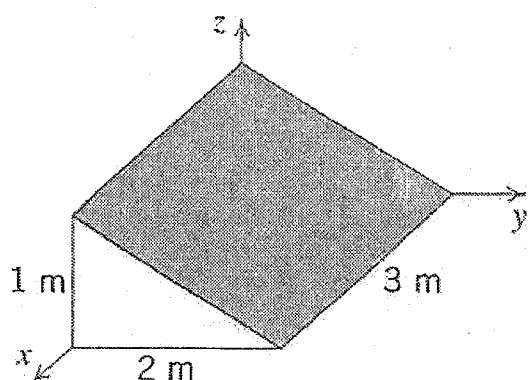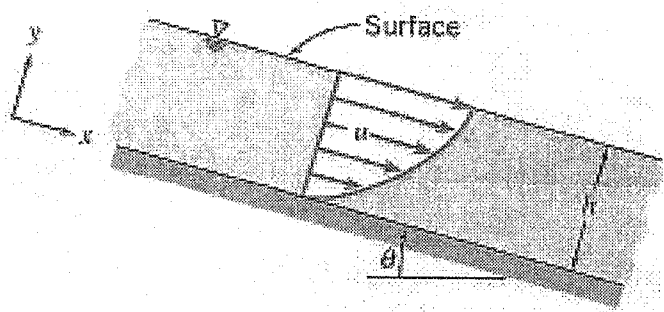

P4.11

3. (20)Oil flows steadily in a thin layer down an inclined plane. The velocity profile is

$$u = \frac{\rho g \sin \theta}{\mu}\left[hy - \frac{y^2}{2} \right]$$

Express the mass flow rate per unit width in terms of ρ, μ, g, θ, and h.

4. (20)Known $\vec{v} : \begin{cases} v_r = 0 \\ v_\theta = f(r) \end{cases}$　　　(a) find f(r) if flow is a free vortex

　　　(b) find f(r) if the flow is a forced vortex

背面尚有試題

5. (20)The horizontal velocity in the wake behind an object in an air stream of velocity U is given by

$$u(r) = U\left(1 - \cos\left(\frac{\pi r}{2}\right)^2\right) \quad |r| \le 1$$

$$u(r) = U \qquad\qquad\qquad |r| > 1$$

where r is the non-dimensional radial coordinate, measured perpendicular to the flow. Find an expression for the drag on the object.