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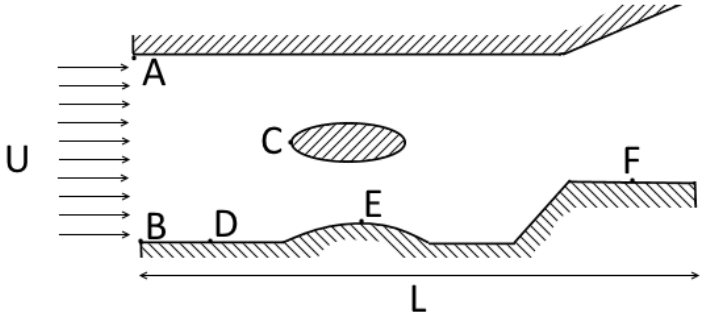
1	

a) Consider 2D inviscid incompressible uniform flow entering a channel. $U = 5\ m/s$, $AB = 2\ m$, $L = 5\ m$. Calculate the stream function values at A, B, C, D, F if $\psi_C = 5\ m^2/s$ and $\psi_E = 1\ m^2/s$.



b) For a 2D incompressible irrotational flow, the horizontal velocity component is given as $u(x, y) = y^3 - 3x^2y + 6x$. Find the vertical component (v) and the stream function (ψ).

$$v(0,0) = 0, \qquad \psi(0,0) = 0$$

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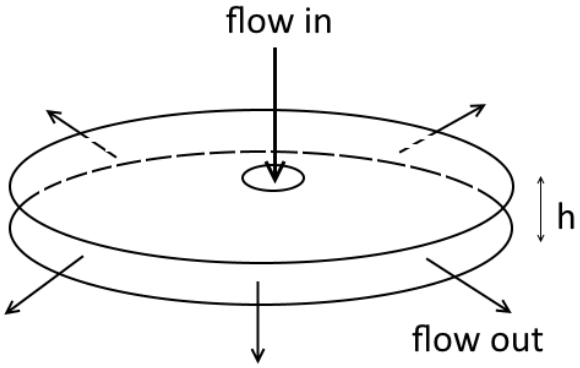

A lubricant flow radially between two circular discs because of a pressure drop Δp between inner radius r_1 and outer radius r_2. Assuming steady, laminar, incompressible, Newtonian and radially directed flow

a) Show that the equation of motion can be written as
$-\rho\frac{\xi^2}{r^3} = -\frac{dp}{dr} + \frac{\mu}{r}\frac{d^2\xi}{dz^2}$ where $\xi = rv_r$
b) When can the nonlinear term be neglected?
c) Discard the nonlinear term and find the velocity distribution as a function of r between r_1 and r_2 (Given Δp, the viscosity coefficient μ and the gap between the discs h)

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A particular flow has the following velocity, temperature and density field characteristics

$$\vec{V} = x\vec{\imath} - (t + 2y)\vec{\jmath} + z\vec{k}$$
$$T = 2x + yz$$
$$\rho = 1 - e^{-x}$$

Determine

a) The acceleration field
b) The rate of change of density at a point (1,2,2)
c) The rate of change of temperature at point (1,3,2)