EXAM1 October 4, 2010

1. A layer of water flows down an inclined fixed surface with the velocity profile shown in Fig. 1. Determine the shearing stress that the water exerts on the fixed surface for U = 2 m/s and h = 0.1 m. (Use μ = 1.12 × 10^{-3} N·s/m^2 for water)

2. The dam in Fig. 2 is a quarter-circle 50 m wide into the paper. Determine the horizontal and vertical components of hydrostatic force against the dam and the angle of the resultant force from the vertical. (Use γ = 9790 N/m^3 for water)

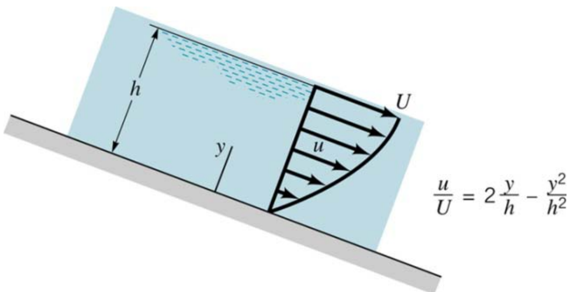

Fig. 1

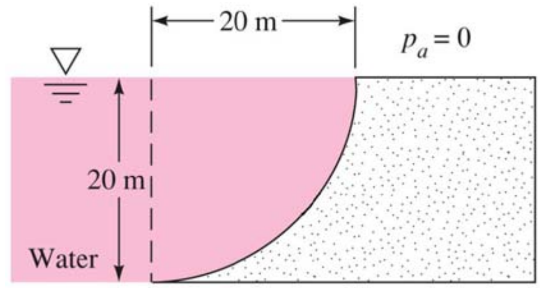

Fig. 2

3. Blood (SG = 1) flows with a velocity of 0.5 m/s in an artery. It then enters an aneurysm in the artery (i.e., an area of weakened and stretched artery walls that cause a ballooning of the vessel as shown in Fig. 3) whose cross-sectional area is 1.8 times that of the artery. Determine the pressure difference between the blood in the aneurysm and that in the artery. Assume the flow is steady and inviscid. (Use ρ_{water} = 999 Kg/m^3)

4. The velocity components for steady flow through the nozzle shown in Fig. 4 are $u = -V_0 x/\ell$ and $v = V_0[1 + (y/\ell)]$, where V_0 and ℓ are constants. Determine the pressure gradient along the y-axis at point (2) when the fluid is water with $V_0 = 1\ \mathrm{m/s}$ and $\ell = 0.1\ \mathrm{m}$. Neglect viscous effects and use the Euler quation $\nabla p = -\rho\left(\underline{a} - \underline{g}\right)$, where gradient $\nabla = \frac{\partial}{\partial x}\hat{\imath} + \frac{\partial}{\partial y}\hat{\jmath}$, $\underline{a} = a_x\hat{\imath} + a_y\hat{\jmath}$ is the flow acceleration, and $\underline{g} = -g\hat{\jmath}$ is the gravity. (Use ρ = 999 Kg/m^3 for water)

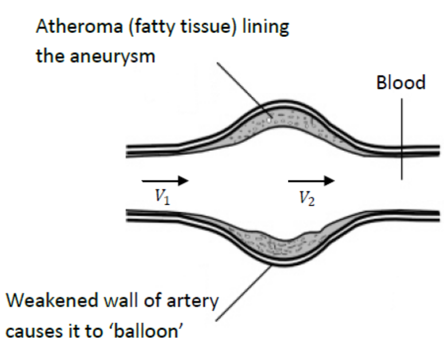

Fig. 3

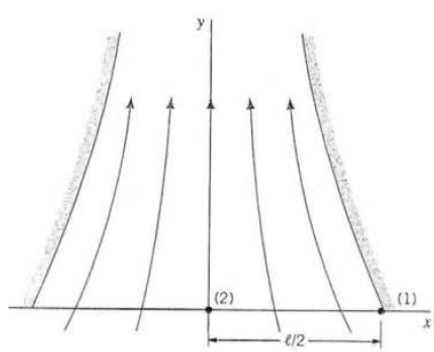

Fig. 4