# Fluid Mechanics

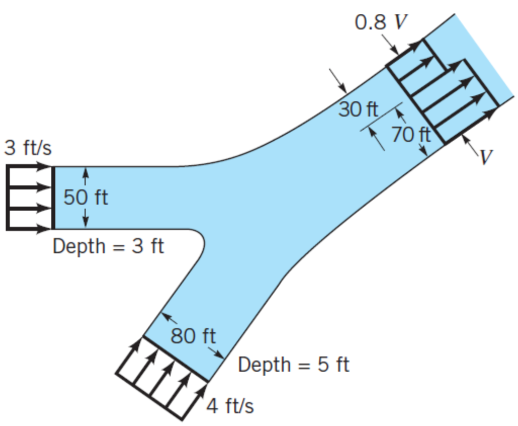
## Assignment # 5

**4.1** The velocity field of a flow is given by $\mathbf{V} = (3y + 2)\hat{\mathbf{i}} + (x - 8)\hat{\mathbf{j}} + 5z\hat{\mathbf{k}}$ ft/s, where $x$, $y$, and $z$ are in feet. Determine the fluid speed at the origin ($x = y = z = 0$) and on the $y$ axis ($x = z = 0$).

**4.5** The $x$ and $y$ components of velocity for a two-dimensional flow are $u = 3$ ft/s and $v = 9x^2$ ft/s, where $x$ is in feet. Determine the equation for the streamlines and graph representative streamlines in the upper half plane.

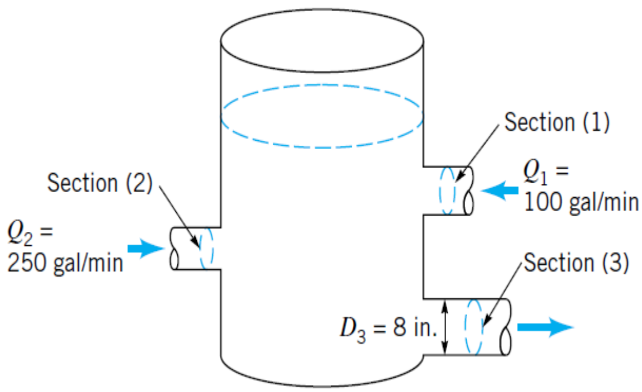
**4.6** Show that the streamlines for a flow whose velocity components are $u = c(x^2 - y^2)$ and $v = -2cxy$, where $c$ is a constant, are given by the equation $x^2y - y^3/3 =$ constant. At which point (points) is the flow parallel to the $y$ axis? At which point (points) is the fluid stationary?

**5.13** Two rivers merge to form a larger river as shown in Fig. P5.13. At a location downstream from the junction (before the two streams completely merge), the nonuniform velocity profile is as shown and the depth is 6 ft. Determine the value of $V$.



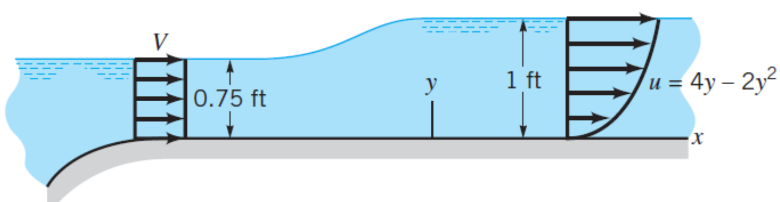

■ FIGURE P5.13

**5.10** Water enters a cylindrical tank through two pipes at rates of 250 and 100 gal/min (see Fig. P5.10). If the level of the water in the tank remains constant, calculate the average velocity of the flow leaving the tank through an 8-in. inside-diameter pipe.




■ FIGURE P5.10

**5.19** As shown in Fig. P5.19, at the entrance to a 3-ft-wide channel the velocity distribution is uniform with a velocity $V$. Further downstream the velocity profile is given by $u = 4y - 2y^2$, where $u$ is in ft/s and $y$ is in ft. Determine the value of $V$.

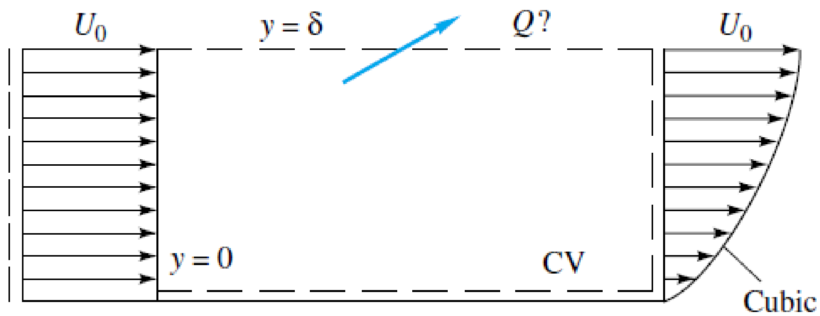



■ FIGURE P5.19

**P3.16** An incompressible fluid flows past an impermeable flat plate, as in Fig. P3.16, with a uniform inlet profile $u = U_0$ and a cubic polynomial exit profile

$$u \approx U_0\left(\frac{3\eta - \eta^3}{2}\right) \qquad \text{where } \eta = \frac{y}{\delta}$$

Compute the volume flow $Q$ across the top surface of the control volume.




**P3.16**