

5.13

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. Determine the value of V .

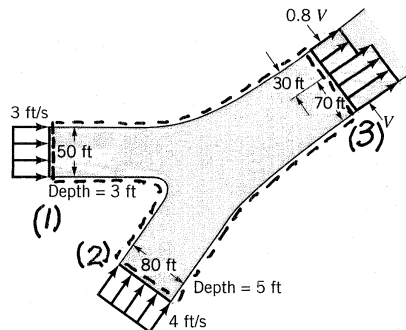


FIGURE P5.13

Use the control volume shown within broken lines in the sketch above. We note that $\dot{m} = \rho A V$ and from the conservation of mass principle we get

$$\dot{m}_1 + \dot{m}_2 = \dot{m}_3 = \dot{m}_{0.8V} + \dot{m}_V$$

Thus

$$\rho A_1 V_1 + \rho A_2 V_2 = \rho A_{0.8V} 0.8V + \rho A_V V$$

and

$$V = \frac{A_1 V_1 + A_2 V_2}{A_{0.8V} (0.8) + A_V} = \frac{(50 \text{ ft})(3 \text{ ft})(3 \frac{\text{ft}}{\text{s}}) + (80 \text{ ft})(5 \text{ ft})(4 \frac{\text{ft}}{\text{s}})}{(30 \text{ ft})(6 \text{ ft})(0.8) + (70 \text{ ft})(6 \text{ ft})}$$

$$V = \underline{\underline{3.63 \frac{\text{ft}}{\text{s}}}}$$