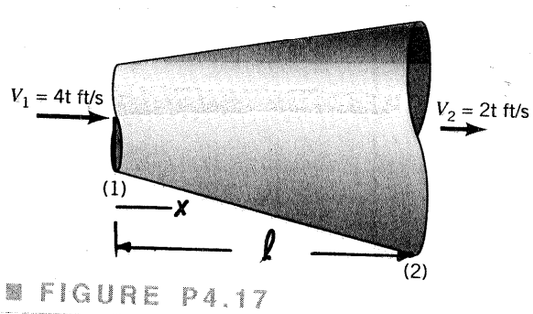
4.17

4.17 The velocity of air in the diverging pipe shown in Fig. P4.17 is given by $V_1 = 4t$ ft/s and $V_2 = 2t$ ft/s, where t is in seconds. **(a)** Determine the local acceleration at points (1) and (2). **(b)** Is the average convective acceleration between these two points negative, zero, or positive? Explain.



■ FIGURE P4.17

a) $\left.\frac{\partial u}{\partial t}\right|_{(1)} = 4\ \frac{ft}{s^2}$ and $\left.\frac{\partial u}{\partial t}\right|_{(2)} = 2\ \frac{ft}{s^2}$

b) convective acceleration along the pipe $= u\frac{\partial u}{\partial x}$

where $u > 0$. At any time, t, $V_2 < V_1$. Thus, between (1) and (2)

$\frac{\partial u}{\partial x} \approx \frac{V_2 - V_1}{\ell} < 0$

Hence, $u\frac{\partial u}{\partial x} < 0$ or the average convective acceleration is negative.