**6.43** As illustrated in Fig. P6.43 a tornado can be approximated by a free vortex of strength Γ for $r > R_c$, where R_c is the radius of the core. Velocity measurements at points A and B indicate that $V_A = 125$ ft/s and $V_B = 60$ ft/s. Determine the distance from point A to the center of the tornado. Why can the free vortex model not be used to approximate the tornado throughout the flow field ($r \geq 0$)?
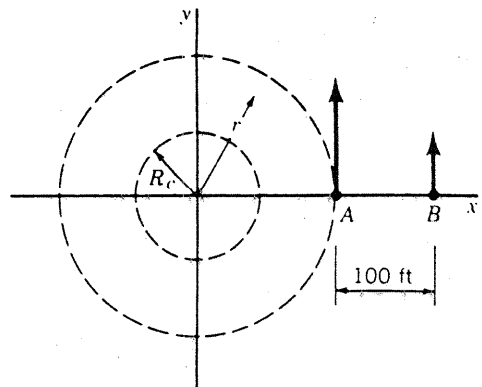
■ **FIGURE P6.43**

For a free vortex

$$V_\theta = \frac{K}{r} \qquad (Eq.\ 6.86)$$

Thus, at r_A, $V_\theta = 125 \frac{ft}{s}$, so that $K = 125\, r_A$

and at r_B, $V_\theta = 60 \frac{ft}{s}$, so that $K = 60\, r_B$.

Therefore,

$$125\, r_A = 60\, r_B$$

and since

it follows that $r_B - r_A = 100\ ft$

$$125\, r_A = 60\left(100 + r_A\right)$$

or

$$r_A = 92.3\ ft$$

The free vortex cannot be used to approximate a tornado throughout the flow field since at $r=0$ the velocity becomes infinite.