Solution: Set F = 0 in Prob. 8.48 and find the proper pressure from Bernoulli:

$$F_{up} = 0 \text{ if } \quad p_i = p_o - \frac{4}{3}\rho U_\infty^2, \quad \text{but also } \; p_i = p_A = p_o - \frac{\rho}{2}(2U_\infty \sin\theta_A)^2$$

$$\text{Solve for } \quad \sin\theta_A = \sqrt{2/3} = 0.817 \quad \text{or} \quad \theta_A \approx \mathbf{125°} \quad \textit{Ans.}$$

(or **55°** = poor position on rear of body)

8.50 It is desired to simulate flow past a ridge or "bump" by using a streamline *above* the flow over a cylinder, as shown in Fig. P8.50. The bump is to be *a*/2 high, as shown. What is the proper elevation *h* of this streamline? What is U_{max} on the bump compared to U_∞?

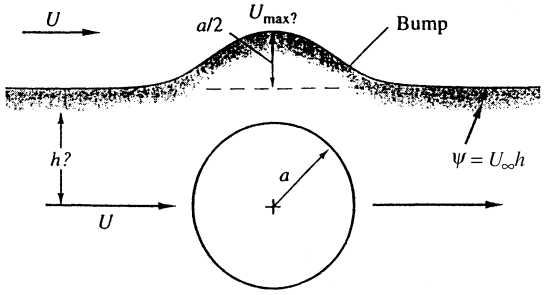

Fig. P8.50

Solution: Apply the equation of the streamline (Eq. 8.32) to θ=180° and also 90°:

$$\psi = U_\infty \sin\theta\left(r - \frac{a^2}{r}\right) \quad \text{at } \; \theta = 180° \text{ (the freestream) gives } \; \psi = U_\infty h$$

$$\text{Then, at } \theta = 90°, \quad r = h + \frac{a}{2}, \quad \psi = U_\infty h = U_\infty \sin 90°\left(h + \frac{a}{2} - \frac{a^2}{h + a/2}\right)$$

$$\text{Solve for } \quad \mathbf{h = \frac{3}{2}a} \quad \textit{Ans.} \quad \text{(corresponds to } r = 2a)$$

The velocity at the hump (r = 2a, θ = 90°) then follows from Eq. (8.33):

$$U_{max} = U_\infty \sin 90°\left[1 + \frac{a^2}{(2a)^2}\right] \quad \text{or} \quad \mathbf{U_{max} = \frac{5}{4}U_\infty} \quad \textit{Ans.}$$

8.51 Modify Prob. 8.50 above as follows: Let the bump be such that $U_{max} = 1.5U_\infty$. Find (a) the upstream elevation *h*; and (b) the height *Z* of the bump.