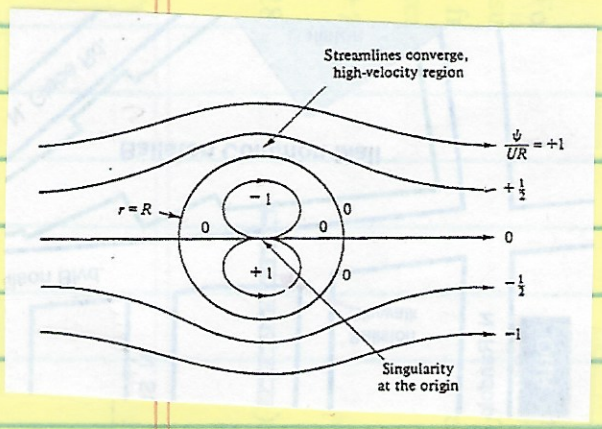
8.43 Water at 20°C flows past a 1-m-diameter circular cylinder. The upstream centerline pressure is 128,500 Pa. If the lowest pressure on the cylinder surface is exactly the vapor pressure, estimate, by potential theory, the stream velocity.

$\rho = 998 \text{ kg/m}^3 \quad p_{vap} = 2337 \text{ Pa}$



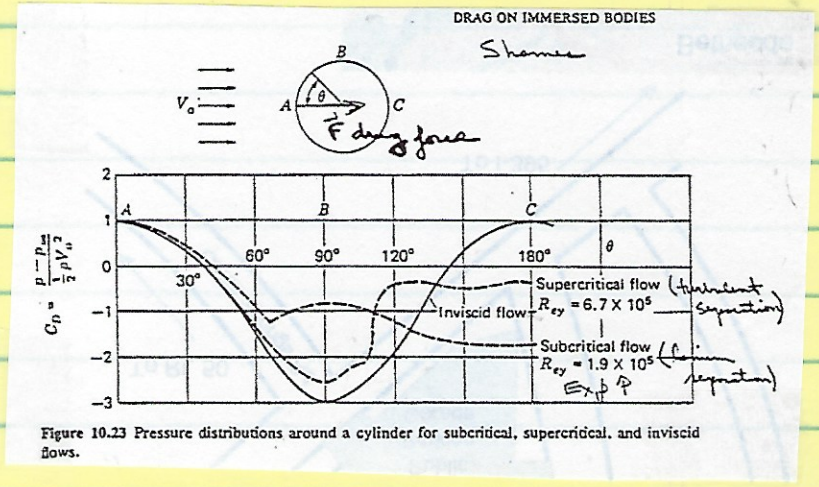


Figure 10.23 Pressure distributions around a cylinder for subcritical, supercritical, and inviscid flows.

$v_r(R) = 0 \quad v_\theta(R) = -2V_\infty \sin\theta \quad C_p(R) = 1 - 4\sin^2\theta$

$$v_\theta(R)_{max} \Big|_{\theta=90^\circ} = \mp 2V_\infty$$

$$p_\infty + \tfrac{1}{2}\rho V_\infty^2 + \gamma z_\infty = p_{vap} + \tfrac{1}{2}\rho V_{max}^2 + \gamma z_{\theta=90}$$

$$128{,}500 + \frac{998}{2} V_\infty^2 + 0 = 2337 + \frac{998}{2}(2V_\infty)^2 + 9790(.5)$$

$$V_\infty = 9 \text{ m/s}$$