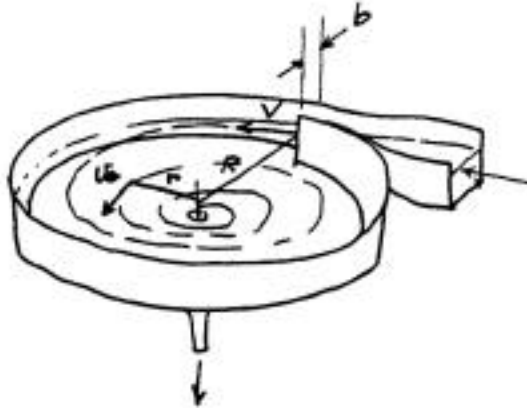# Problem 5.28
Steady sink flow

The steady sink flow in the sketch is set up by injecting water tangentially through a narrow channel near the periphery and letting it drain through a hole at the center. The vessel has a radius R. At the point of injection, the water has a velocity V and depth h_0; the width of the injection channel, b, is small compared with R.

In what follows, we consider the region of the flow not too close to the drain, and assume that in that region the flow is essentially incompressible and inviscid, and the radial velocity component $|v_r|$ is small compared with the circumferential velocity component.

(a) Show, by applying the angular momentum theorem to a control volume comprising the water between $r = r$ and $r = R$, that the angular velocity at r is

$$v_\theta = \frac{VR}{r} \ .$$

(b) Demonstrate that the assumption $|v_r| << v_\theta$ is satisfied if $b << R$.