2. A vertically oriented vortex tube is in your bathtub. The tube is circular with a radius of 5 cm. The tube is rotating clockwise (as viewed from above) with a tangential velocity of 0.5 cm/s.

a. Calculate the average vorticity of the tube.

Answer: 0.2 s$^{-1}$

b. As the tube moves over the drain it is stretched, and its radius shrinks to 1 cm. What is the new average vorticity?

Answer: 1 s$^{-1}$

3. Calculate the vorticity of the following flows at point \((x,y) = (1\text{m},2\text{m})\).

a. \(u = u_0 xy\) \(v = v_0 y\) \(u_0 = 2\text{ m s}^{-1}, v_0 = 1\text{ s}^{-1}\) Answer: \(-2\text{ s}^{-1}\)

b. \(u = u_0 y\) \(v = v_0 x\) \(u_0 = 2\text{ s}^{-1}, v_0 = 1\text{ s}^{-1}\) Answer: \(-1\text{ s}^{-1}\)

c. \(u = u_0\) \(v = v_0 x^2\) \(u_0 = 2\text{ m s}^{-1}, v_0 = 1\text{ m s}^{-1}\) Answer: \(2\text{ s}^{-1}\)

d. \(u = u_0\) \(v = v_0 \cos kx \sin ly\) \(u_0 = 2\text{ m s}^{-1}, v_0 = 1\text{ m s}^{-1}, k = 2.1\text{ m}^{-1}, l = 0.9\text{ m}^{-1}\) Answer: \(-1.8\text{ s}^{-1}\)