

# Practice 2: Steady Flows

PHY250 - Fall 2021

## Exercise 1

**Blood flow.** In humans, blood flows from the heart into the aorta, from which it passes into the major arteries. These branch into the small arteries (arterioles), which in turn branch into myriads of tiny capillaries. The blood returns to the heart via the veins. The radius of the aorta is about  $1.2\text{cm}$ , and the blood passing through it has a speed of about  $40\text{cm/s}$ . A typical capillary has a radius of about  $4 \times 10^{-4}\text{cm}$ , and blood flows through it at a speed of about  $5 \times 10^{-4}\text{m/s}$ .

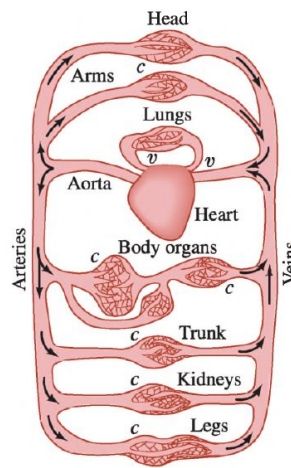


Figure 1: Exercise 1

## Exercise 2

Calculate the velocity,  $v_1$ , of a liquid flowing out of a spigot at the bottom of a reservoir.

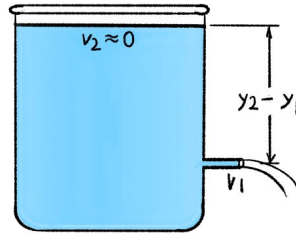


Figure 2: Exercise 2

### Exercise 3

The wind speed near the center (“eye”) of a hurricane, whose radius is  $30\text{ km}$ , reaches about  $200\text{ km/h}$ . As air swirled in from the rim of the hurricane toward the eye, its angular momentum remained roughly constant. (a) Estimate the wind speed at the rim of the hurricane. (b) Estimate the pressure difference at the earth’s surface between the eye and the rim. Where is the pressure greater?

### Exercise 4

A siphon is a convenient device for removing liquids from containers. To establish the flow, the tube must be initially filled with fluid. Let the fluid have density  $\rho$  and let the atmospheric pressure be  $P_{atm}$ . Assume that the cross-sectional area of the tube is the same at all points along it. (a) If the lower end of the siphon is at a distance  $h$  below the surface of the liquid in the container, what is the speed of the fluid as it flows out the lower end of the siphon? (Assume that the container has a very large diameter, and ignore any effects of viscosity. (b) A curious feature of a siphon is that the fluid initially flows “uphill.” What is the greatest height  $H$  that the high point of the tube can have if flow is still to occur?

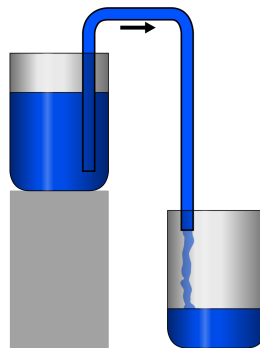


Figure 3: Exercise 4