Consider a large water tank perched on stilts. The top of the tank is open to the atmosphere. Two open pipes extend horizontally outward from the tank's sides to drain the tank. The pipes have identical diameter, are made from the same material, and attach to the tank at exactly the same height in exactly the same way. However, pipe 1 is twice as long as pipe 2. Will water flow faster out of pipe 1, pipe 2, or will the flow rate be the same? Explain your answer with as little math as possible.

1. \( P_1, P_2 \) same for both pipes, so \( P_1 - P_2 \) also same (3 pts)

2. All things being equal, longer pipe will have more friction. However, in order to maintain \( \Delta P \) the same, the flow in the longer pipe must have smaller velocity (3 pts)

Pipe 2 (shorter one) has higher velocity and flow rate. (4 pts)

(Mathematically:)

\[
\frac{P_1}{\rho} + \frac{\sqrt{2g}v_1^2}{2} + g \frac{z_1}{2} - \left[ \frac{P_2}{\rho} + \frac{\sqrt{2g}v_2^2}{2} + g \frac{z_2}{2} \right] = h_{L,T} \text{ total head loss}
\]

\[
P_1 = \rho g \left( H + P_{\text{atm}} \right)
\]

\[
z_1 = z_2
\]

Assume = 1

\[
\Rightarrow gH = \frac{\sqrt{2g}v_2^2}{2} + h_{L,T} = \frac{\sqrt{2g}v_2^2}{2} \left[ 1 + C + f \frac{L}{D} \right]
\]

To account for minor losses (same for both pipes) (same for both pipes)

So: if \( L \uparrow \), outlet \( V \downarrow \) must go down. Also, \( V \uparrow \) means \( f \uparrow \), which accentuates the velocity change.)