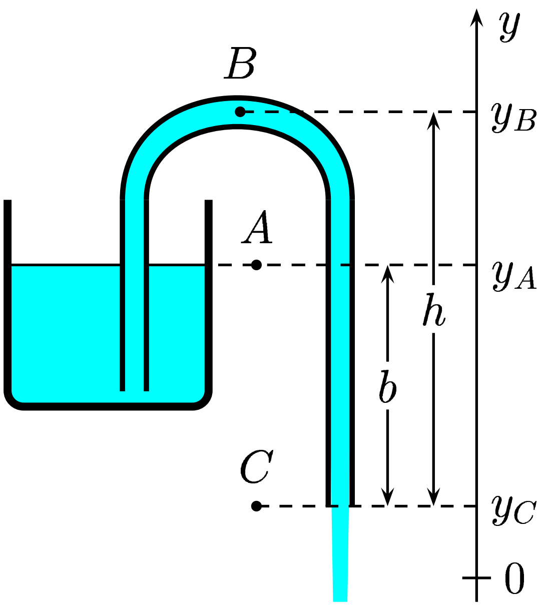

A siphon, which is a flexible tube with a circular cross section, is used to drain water from a tank, see sketch.

Assume:

1. A steady flow within the tube, at least from the water surface through the bend to the exit end.
2. No friction for the water.
3. The water cannot sustain a negative pressure.

What is the maximum vertical distance h between the top of the bend B and the exit end C, beyond which water flow is not possible?

A) $h = b - \dfrac{P_{atm}}{\rho\, g}$. B) $h = \dfrac{P_{atm}}{\rho\, g} - b$. C) $h = \dfrac{P_{atm}}{\rho\, g}$. D) $h = \dfrac{P_{atm}}{\rho\, g} + b$.

Apply Bernoulli's principle, $P_A + \frac{1}{2}\,\rho\, v_A^2 + \rho\, g\, y_A = P_B + \frac{1}{2}\,\rho\, v_B^2 + \rho\, g\, y_B$, to the height of the tube above the water's surface. Since $v_A = v_B$, this gives $\rho\, g\,(\,y_B - y_A\,) = P_A - P_B$. The maximum height above the water surface $y_B - y_A \equiv h - b$ occurs at

$$\rho\, g\,(\,y_B - y_A\,) = P_A = P_{atm}\,, \quad \text{so} \quad h - b = \frac{P_{atm}}{\rho\, g}\,, \quad \text{or} \quad h = \frac{P_{atm}}{\rho\, g} + b\,.$$

The vertical drop within the BC section is longer than the maximum height $\dfrac{P_{atm}}{\rho\, g}$ air pressure can sustain. Since non-turbulent water flow is continuous, the water flow within the AC section will pull away from the sides of the tube; *i.e.*, the diameter of the water stream will be reduced, $v_A\, d_A^2 = v_C\, d_C^2$, thus $v_C > v_A$ (similar to a water stream falling from an open faucet). Water's surface tension reduces the probability of bubbling and turbulence.

Answer **D**