

BERNOULLI STUDY AID

Apply Manometry 0-1

$$P_1 - \gamma_{H_2O} H = P_0 = 0$$

$$P_1 = \gamma_{H_2O} H = 0$$

Bernoulli 1-2

$$\frac{P_1}{\gamma_{H_2O}} + \frac{V_1^2}{2g} = \frac{P_2}{\gamma} + \frac{V_2^2}{2g}$$

$$H + \frac{V_1^2}{2g} = \frac{V_2^2}{2g}$$

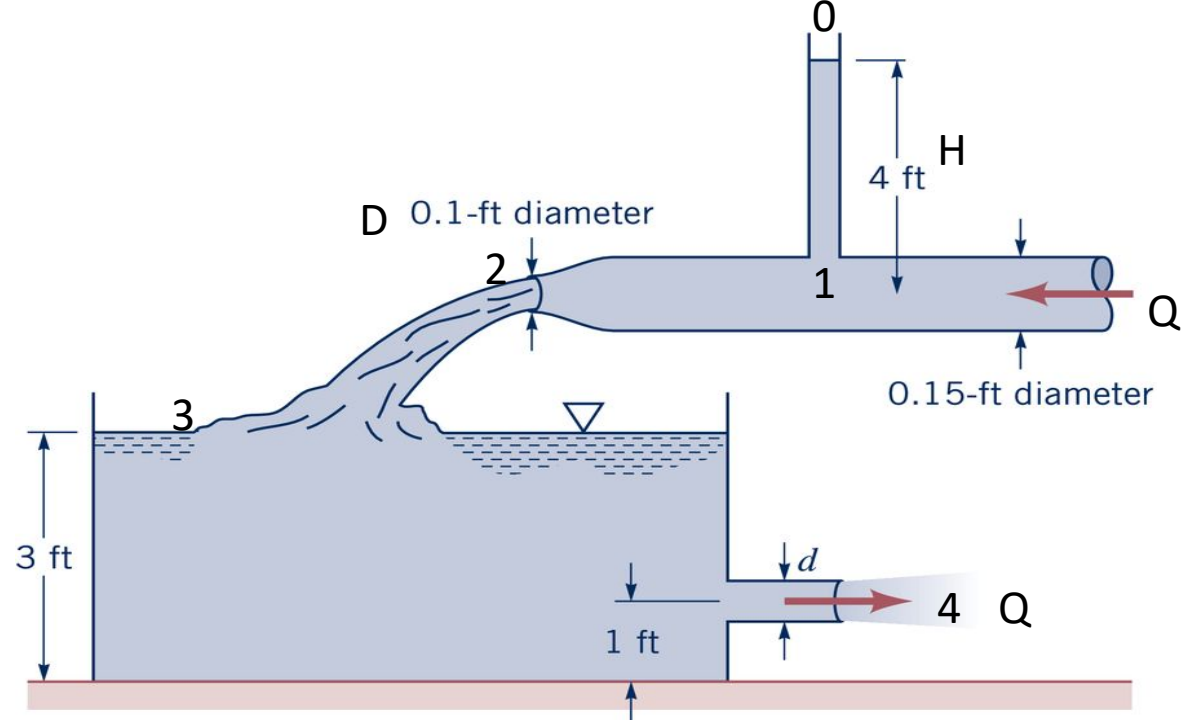
Mass Conservation

$$A_1 V_1 = A_2 V_2 = Q$$

$$V_1 = \frac{A_2 V_2}{A_1}$$

Combine

$$H(Q) = \frac{V_2^2}{2g} - \frac{V_1^2}{2g} = \frac{Q^2}{2g} \left(\frac{1}{A_2^2} - \frac{1}{A_1^2} \right)$$



Bernoulli 3(surface)-4 (free jet)

$$2 = \frac{V_4^2}{2g} = \frac{Q^2}{2g} \frac{1}{A_4^2}$$

$$A_4(Q) = \frac{\pi d^2}{4} = \sqrt{\frac{Q^2}{2g}}$$

$$d(Q) = \sqrt{\frac{4}{\pi} \sqrt{\frac{Q^2}{2g}}}$$

KEY POINTS

Static Tap

Stagnation Tap

Fluid Interfaces

Inlet/Exit

Free Surface

Free Jets

UNKNOWN DIMENSIONS

Apply Manometry

1-2-3-4

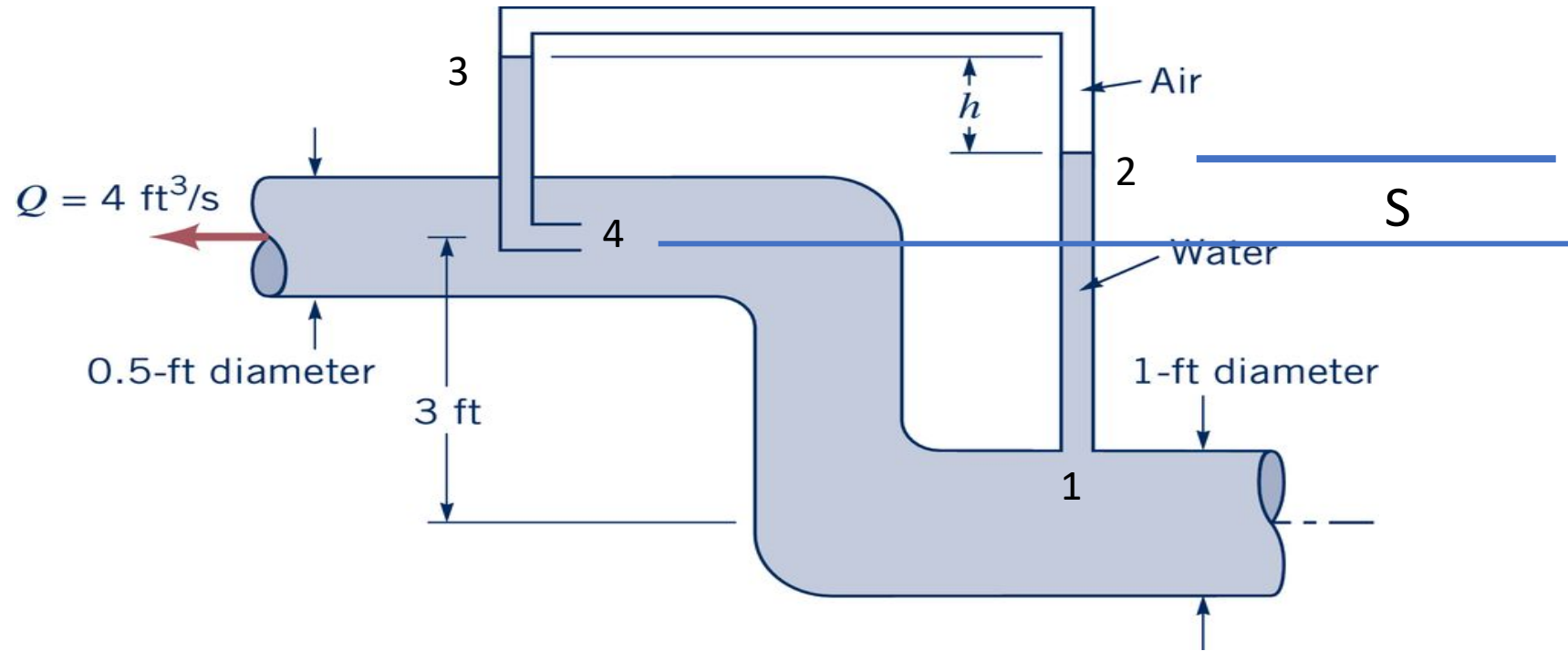
$$P_1 - \gamma_{H20}(3 + \cancel{h}) - \gamma_{air}h + \gamma_{H20}(h + \cancel{h}) = P_4$$

$$P_1 - P_4 = \gamma_{H20}(3 - h) + \gamma_{air}h$$

$$\frac{P_1 - P_4}{\gamma_{H20}} = (3 - h) + \frac{\gamma_{air}h}{\gamma_{H20}}$$

$$\frac{P_1 - P_4}{\gamma_{H20}} = (3 - h) + \underbrace{1.94}_{\text{SMALL}}$$

SMALL



Apply Bernoulli 1-4

$$\frac{P_1}{\gamma_{H20}} + Z_1 + \frac{V_1^2}{2g} = \frac{P_4}{\gamma_{H20}} + Z_4 + \frac{V_4^2}{2g}$$

$$\frac{V_1^2}{2g} = \frac{P_4}{\gamma_{H20}} - \frac{P_1}{\gamma_{H20}} + Z_4 - Z_1 + \frac{V_4^2}{2g}$$

$$\frac{V_1^2}{2g} = h - 3 + 3 - 0 - 0 = h \rightarrow V = \frac{Q}{A}$$

$$\frac{Q^2}{2gA_1^2} = h$$