

Large numbers
 Continuum
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1) $L = 0.001$

Vis. small end = 0.001
 Vis. at root end = 2.015

$h = 0.35 \frac{(V_1 - V_2)}{g}$

Pressure at lower end = 0.5 atm

$\frac{A_1}{A_2} = \frac{V_1}{V_2} + \frac{(V_1^2 - V_2^2)}{2g} (2\rho - \rho)$

$= 2.6 + \frac{5^2 - 2^2}{2 \times 9.81} + 2 \frac{(5 - 2)}{2 \times 9.81}$

$= 2.97 + 0.7 + 2 = 4.6058$

Pressure at lower end = 5.02 atm

2) $h = 0.2m$
 $h = 0.1m$
 $C_d = 0.95$

$A_1 = \frac{\pi d^2}{4} = \frac{\pi \times 0.2^2}{4} = 0.0314$

$A_2 = \frac{\pi d^2}{4} = \frac{\pi \times 0.1^2}{4} = 0.00785$

$h = \frac{P_1 - P_2}{\rho g}$

$\rho = 1.215 \times 10^{-3} \text{ g/m}^3$
 $\Rightarrow 1.215 \times 10^{-3} \times 9.81$

$\frac{P_1}{\rho g} = 0.35 \times 9.81 = -4.08 \text{ m}$

$h = \frac{P_1 - P_2}{\rho g} = 1.177 \text{ m} - (-4.08)$

$= 4.082 \text{ m}$

$Q = 0.95 \times 0.0314 \times 9.81 \times \sqrt{0.05 \times 2 - (0.95 \times 0.1)^2}$

$Q = 0.00216$
 0.0303
 $= 0.0713 \text{ m}^3/\text{s}$

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$h = 0.5 \left[\frac{V_1^2 - V_2^2}{g} \right]$

$Q = C_d A_2 \sqrt{2gh}$

$= 0.95 \times 0.00785 \times \sqrt{2 \times 9.81 \times 4.082}$

$= 0.00216 \times 11.747$

$= 0.0254 = 2.032 \text{ m}^3/\text{s}$
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