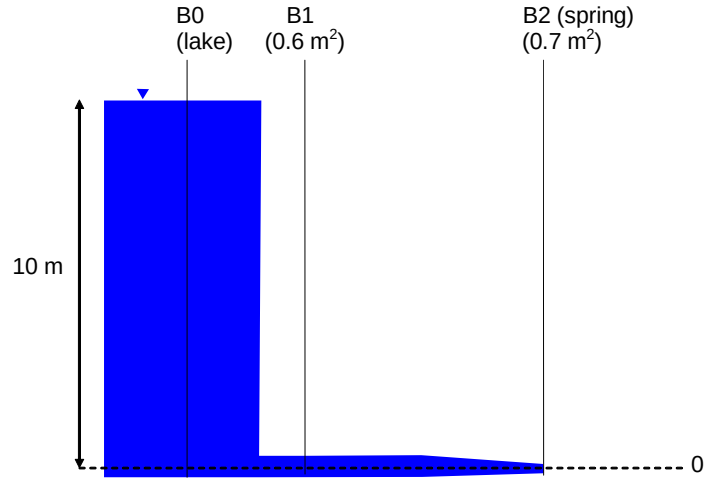
Example Bernoulli

A lake on a karst terrain feeds a spring through a horizontal conduit (pipe). The conduit of varying cross-sectional area is 10 m below the water level in the lake (B0).



$$h_0 = \frac{v^2}{2g} + z + \frac{P}{\rho g} = 10m = const$$

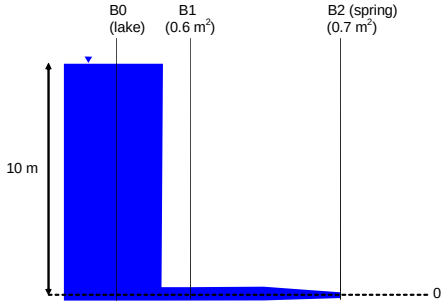
B2: Fluid leaves pressure tube → pressure $P_2 = 0$

Ideal frictionless fluid – no energy lost, therefore:

$$h_0 = h_2 = \frac{v_2^2}{2g} + z_2 + \frac{P_2}{\rho g} = \frac{v_2^2}{2g} + 0 + 0 = 10m$$

$$v_2 = \sqrt{h_0 2g} = \sqrt{10m * 2 * 9.81m/s^2} = \sqrt{196.2}m/s = 14.007m/s$$

$$Q_2 = v_2 * A_2 = 14.007m/s * 0.7m^2 = 9.805m^3/s$$

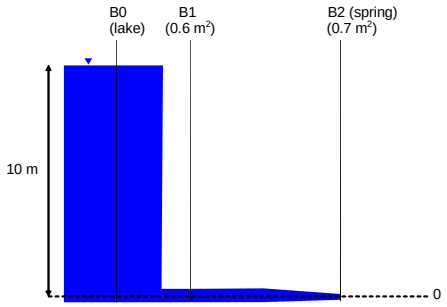


Pressure head at B1…

$$Q = Q_3 = v_1 \cdot A_1 = v_2 \cdot A_2 = const = 9.805 m^3/s$$

$$v_1 = v_2 \frac{A_2}{A_1} = 14.007 m/s \frac{0.7 m^2}{0.6 m^2} = 16.342 m/s$$

$$h_{p1} = h_0 - \frac{v_1^2}{2g} = 10 - \frac{(16.342 m/s)^2}{2 \cdot 9.81 m/s^2} = -3.611 m$$



Example Darcy

The following parameters were measured in a constant head permeameter test:

- Δh = - 2 cm
- Δz = 20 cm
- Cross sectional area A_s = 100 cm^2
- Duration of experiment t = 1 h
- Volume of percolated water after 1 h: V = 0.5 liter

What is the hydraulic conductivity of the sample in [m/d]?

$$V = Qt = -KtA_s \frac{\Delta h}{\Delta z}$$

$$-V \frac{\Delta z}{tA_s \Delta h} = K$$

$$-0.5 \cdot 10^{-4} m^3 \frac{0.2m}{3600 \sec \cdot 0.01 m^2 (-0.02m)} = K = 0.0001389 m/s = 1.389E-4 m/s$$

$$K = 12 m/d$$