How to Determine a Flow Rate

1) Determine the driving force

2) Use Bernoulli's Eq'n (with losses!)

$$\Delta P_T = \rho g \Delta h + \frac{1}{2}\rho\left(\frac{Q}{A}\right)^2\left[1 + 4f_f\frac{L}{D} + \Sigma K\right]$$

- ΔP_T: total head to drive flow
- $\rho g \Delta h$: change in elevation
- $\left(\frac{Q}{A}\right)^2$: pipe area
- $\left[1 + \ldots\right]$: acceleration
- $4f_f\frac{L}{D}$: very weak function of Q/A
- ΣK: fittings

3) Solve for Q! (Iterate to get correct f_f)
↳ guess $f_f \approx 0.004$ to start (a typical value)

4) If we don't know ΔP_T, but know the power, we use:

$$\text{Power} = \Delta P_T Q = Q\left(\rho g \Delta h + \frac{1}{2}\rho\left(\frac{Q}{A}\right)^2\left[1 + 4f_f\frac{L}{D} + \Sigma K\right]\right)$$

and again iterate...