Pipe diameter: 5/16 in = 0.008 m

Given: L = 100 ft = 1200 in = 30.48 m

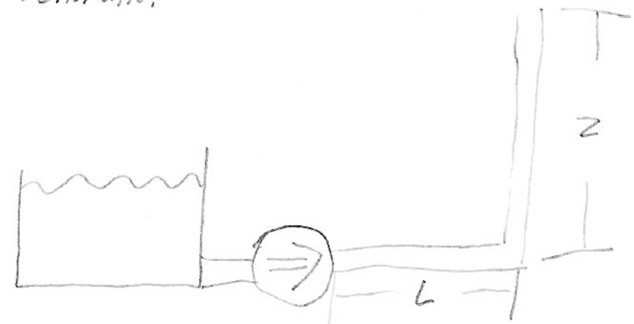
z = 6 ft = 70 in = 1.83 m

flow rate: minimum: $8.4 \cdot 10^{-6}$ L/s (Previous)

Ideal: 20 GPH = $2.1 \cdot 10^{-5}$ m^3/s

$g = 9.81\ m/s^2 = 32.2\ ft/s^2$

Schematic:



Assumption: Incompressible flow

fully developed, uniform, steady flow

Pipe is straight with no joints or fittings

Pump efficiency assumed 75%

Ideal flow

$Re = \frac{\rho Q D}{\mu A}$

$Re = 305271$ ∴ flow is Turbulent

$h_{major} = f \frac{L}{D} \frac{\bar{V}^2}{2g}$

$f = 0.02$

$\bar{V} = \frac{4(2.1 \cdot 10^{5})}{\pi (.004)^2}$

$\bar{V} = 1.67$

$h_{major} = 0.02 \left[\frac{30.48}{.008}\right]\left[\frac{1.67^2}{9.81(2)}\right]$

$h_{major} = 10.84$

$h = 10.84 + 1.83$

$h = 12.67$ m

Pump Power (Ideal flow)

$P = \frac{Q \rho g h}{\eta_t}$

$P = \frac{2.1 \cdot 10^{5} (1000)\ 9.81 (12.678)}{.75}$

$P = 3.48$ hp =

Pump Power (minimum flow)

$P = \frac{Q \rho g h}{\eta_t}$

$= \frac{8.4 \cdot 10^{-6} (1000)(9.81)(1.83)}{.75}$

$P = 0.2$ Hp

Pressure near valve (Per Ben's request)

$P = \rho g h$

$P = 1000(9.81)(1\ m)$

$P = 8829$ Pa