8.72 Water at 10 °C is pumped from a lake as shown in Fig. P8.72. If the flowrate is 0.011 m^3/s, what is the maximum length inlet pipe, ℓ, that can be used without cavitation occurring?

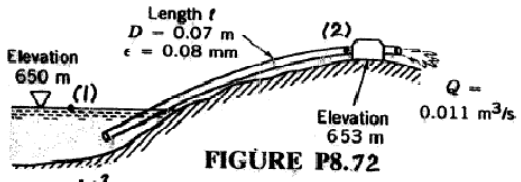

FIGURE P8.72

$\frac{p_1}{\gamma}+\frac{V_1^2}{2g}+z_1=\frac{p_2}{\gamma}+\frac{V_2^2}{2g}+z_2+\left(f\frac{\ell}{D}+\Sigma K_L\right)\frac{V^2}{2g}$, where $p_1=101\ kPa$, $z_1=650m$

$V_1=0$, $V_2=V$, $z_2=653\ m$, and from Table B.2 $p_2=p_v=1.228\ kPa$ (1)

Also, $V=\frac{Q}{A}=\frac{0.011\frac{m^3}{s}}{\frac{\pi}{4}(0.07m)^2}=2.86\frac{m}{s}$ so that

$Re=\frac{VD}{\nu}=\frac{(2.86\frac{m}{s})(0.07m)}{1.307\times10^{-6}\frac{m^2}{s}}=1.53\times10^5$. With this Re and from Table 8.1 with

$\frac{\varepsilon}{D}=\frac{0.08mm}{70mm}=0.00114$ we obtain $f=0.0216$ (see Fig. 8.20)

Hence, with $\Sigma K_L=0.8$ for the entrance, Eq.(1) becomes

$$\frac{(101-1.228)\times10^3\frac{N}{m^3}}{9.80\times10^3\frac{N}{m^2}}+650\ m=653\ m+\left(1+(0.0216)\left(\frac{\ell}{0.07m}\right)+0.8\right)\frac{(2.86\frac{m}{s})^2}{2(9.81\frac{m}{s^2})}$$

or $\ell=\underline{\underline{50.0\ m}}$