CE 313 Hydraulic Engineering
Winter 2013
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Quiz 10 **Name:** Solution

1. Water is pumped with a centrifugal pump, and measurements made on the pump indicate that for a flow rate of 200 gpm the required input power is 6 hp. For a pump efficiency of 62%, what is the actual head rise of the water being pumped? Show your procedure.

   a. 7.36ft
   b. 73.6ft
   c. 0.164ft
   d. 16.3ft

20 pt

$$h_a = \frac{\eta 6hp\ 550}{\gamma Q} = \frac{0.62 \cdot 6 \cdot 550}{62.4 \times 200/(7.48 \cdot 60)}$$

$$= 73.6\ ft$$

2. A centrifugal pump having a head-capacity relationship given by the equation $h_a=180-6.10x10^{-4}\,Q^2$, with h_a in feet when Q is in gpm, is to be used with a system similar to that shown in the figure below. For $z_2-z_1=40ft$, what is the expected flowrate if the total length of constant diameter pipe is 600ft and the fluid is water? Assume the pipe diameter to be 4 in and the friction factor to be equal to 0.02. Neglect all minor loses. Show your procedure.

   a. 100 gpm
   b. 205 gpm
   c. 379 gpm
   d. 451 gpm

30pt

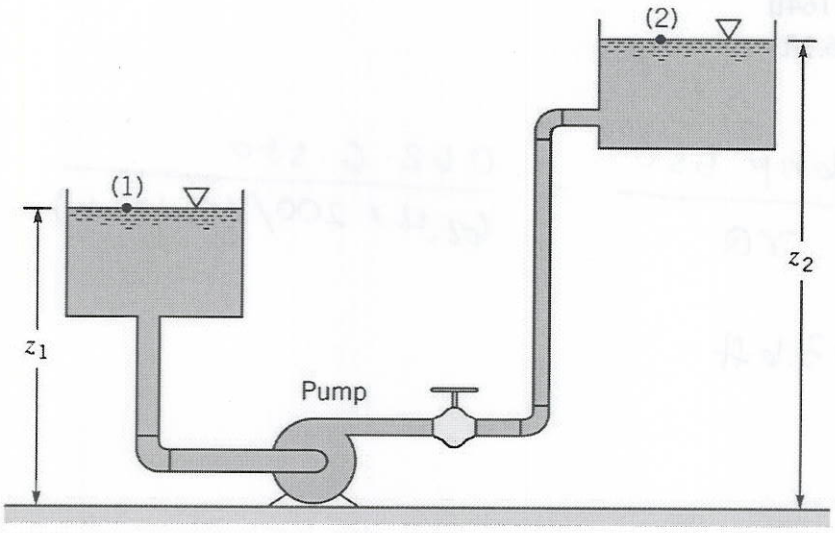


Figure 12.14

$$\cancel{P_1/\gamma_1} + \cancel{V_1^2/2g} + z_1 + h_p = \cancel{P_2/\gamma_2} + \cancel{V_2^2/2g} + z_2 + f\frac{L}{D}V^2/2g$$

10 pt

$$h_p = 40ft + f\frac{L}{D}V^2/2g = 40 + f\frac{L}{D}\left(\frac{Q}{A}\right)^2\frac{1}{2g}$$

$$h_p = 40 + 73.4\,Q^2 \quad (Q\ \text{in}\ ft^3/s) \qquad = 40 + 3.64\times10^{-4}\,Q^2 \quad (Q\ \text{in gpm})$$

5pt

73.4 is divided by $\left[\frac{7.48\,gal}{ft^3}\times\frac{60\,s}{1\,min}\right]^2$ for units to work out.

$$h_p = h_a = 180 - 6.10\times10^{-4}\,Q^2$$

10pt

Solve for Q $\longrightarrow$ $Q = 379$ gpm

5pt

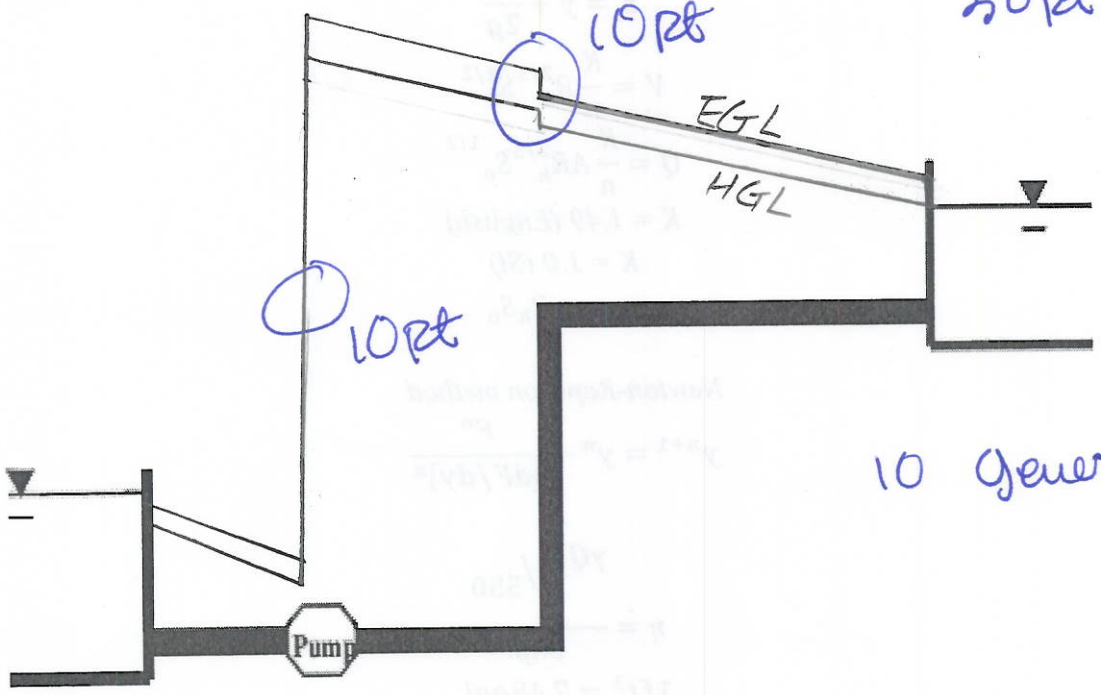
3. Can the HEC-RAS model represent two-dimensional flows? Why or why not?

No because it assumes 1D flow throughout the channel 5pt

4. What is the most probable cause of dynamic geysers according to the presentation on Wednesday, 3/13/2013?

Air Water interaction 5pt

5. Sketch the energy grade line (EGL) and the hydraulic grade line (HGL) for the pipeline system below.



30pt

10 General shape

$$\rho_w = 1000\frac{kg}{m^3} \text{ and } v_w = 1.12 \times 10^{-6} m^2/s$$

$$h_L = f\frac{l}{D}\frac{V^2}{2g}$$

$$h_L = K_L\frac{V^2}{2g}$$

$$Re = \frac{\rho VD}{\mu} = \frac{VD}{v}$$

$$Q = C_n Q_{ideal} = C_n A_n \sqrt{\frac{2(p_1 - p_2)}{\rho(1-\beta^4)}}$$

$$Q = C_v Q_{ideal} = C_v A_T \sqrt{\frac{2(p_1 - p_2)}{\rho(1-\beta^4)}}$$

$$\beta = \frac{d}{D}$$

$$Fr = \frac{v}{\sqrt{gy}}$$

$$C = \sqrt{gy}$$

$$E = y + \frac{V^2}{2g}$$

$$V = \frac{K}{n} R_h^{2/3} S_0^{1/2}$$

$$Q = \frac{K}{n} A R_h^{2/3} S_o^{\ 1/2}$$

K = 1.49 (English)

K = 1.0 (SI)

$$\tau_w = \gamma R_h S_o$$

Newton-Raphson method

$$y^{n+1} = y^n - \frac{F^n}{[dF/dy]^n}$$

$$\eta = \frac{\gamma Q h_a / 550}{bhp}$$

$$1ft^3 = 7.48gal$$