CVG3116 Midterm 2011

1a) continuity (mass balance)
Bernoulli (energy balance)
momentum (force balance)

(2 marks each)

b) f is independent of Re (independent of v)

c) continuity at each node; $Q_{in} = Q_{out}$

d) turbulence is greater due to flow separation
so head loss is greater

e) upstream; valve can not travel upstream
against high flow velocity

f) assume value for H_j
→ solve for system
→ adjust H_j to flow balance

g) friction factor f changes with flow

Note f can not be negative otherwise
give ∞

2a) $H_{p,sys} = (y_2 - y_1) + (\text{losses})\frac{V^2}{2g}$ (1)

$= \underset{(1)}{30} + \left(f\frac{L}{D} + \Sigma k_L + \overset{(0.5)}{1}\right)\frac{V^2}{2g}$

└ exit

(1or) $\Sigma k_L = 2 \times 0.25 + 0.25 + 0.5$

2 bends, valve, entrance

(could be any # → I didn't give it to them)

$\Sigma k_L = 1.25$

f from Moody

$Q = 0.001\ m^3/s$

$D = 0.025\ m$

$V = \frac{Q}{A} = \frac{Q}{\left(\frac{\pi D^2}{4}\right)} = 2.04\ m/s$

$R_e = \frac{VD}{\nu} = \frac{2.04 \times 0.025}{1 \times 10^{-6}} = 4.9 \times 10^4$

$\frac{\varepsilon}{D} = \frac{1 \times 10^{-5}}{0.025} = 0.0004$

from Moody $f \Rightarrow 0.022$ (1)

$\therefore H_{p,sys} = 30 + \left(\text{[illegible]} + 1.25 + 1\right)\frac{Q^2}{\left(\frac{\pi D^2}{4}\right)^2 2g}$

$H_{p,sys} = 30 + \text{[illegible]}\, Q^2$

[illegible] (1)

3a) use Manning

$$Q = \frac{1}{n} \frac{A^{5/3}}{P^{2/3}} S^{1/2}$$ (1)

$Q = 10\ m^3/s$

$n = 0.03$

$S = 0.001$

~~A~~ $b = 10\ m$

$A = b\,y_n$

$P = b + 2y_n$

need to iterate (1) to find $y_n = 1.05\ m$

(Note: students did not need to do the iteration)

b) ~~From graph~~

$y_c = 0.45\ m$

$y_n > y_c$

so mild (1)

b) From graph $E_{c_1} - E_{c_2} = \Delta E_{min} = 0.4\ m$ (1)

for no backwater (2)

c) From graph at $E_{c_2} = E_c$ (1)

so $y_2 = 0.75\ m$ (1)

d) From graph at $M = M_{y_1} = M$ (at for the depth) (1)

$y_2 = 0.18\ m$ (1)

e) Note (1) y_1 is conjugate for y_2 ... [illegible]

[illegible]