National Exams May 2009

04-Agric-A4, Fluid Flow

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is an OPEN BOOK EXAM. Any non-communicating calculator is permitted.
3. Each question is of equal value.
4. All questions require calculation.

Choose either 1a or 1b

1a. The horizontal pump in the below figure discharges 20°C water at 57 m^3/hr. Neglecting losses, what power in KW is delivered to the water by the pump.

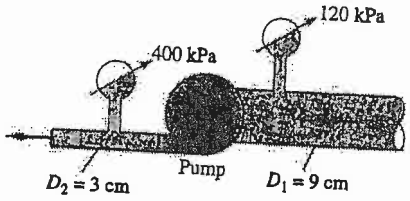

Figure for Question 1a.

1b. The large turbine in the figure below diverts the river flow under a dam as shown. System friction losses are $h_f=3.5V^2/(2g)$, where V is the average velocity is the supply pipe. For what river flow rate in m^3/s will the powered extracted be 25 MW?

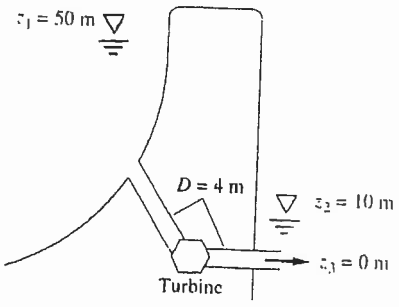

Figure for Question 1b.

2. The three arm lawn sprinkler shown below receives water at 20°C through the center at a volume of 2.7 m^3/hr. If collar friction is negligible, what is the steady rotation rate in rev/min for:

a) $\theta=0°$
b) $\theta=40°$

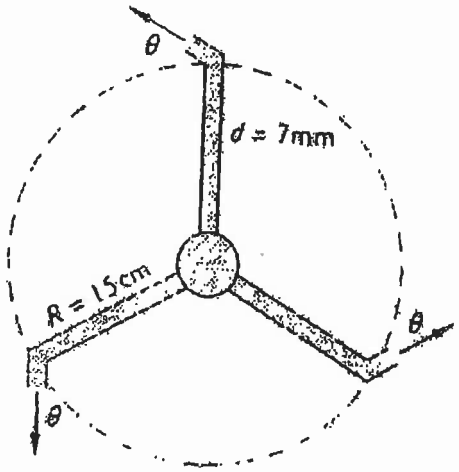

Figure for Question 2.

3. A certain water flows at 20°C has a critical cavitation number, where bubbles form, $Ca \approx 0.25$ where $Ca=2(p_a-p_{vap})/\rho V^2$. If p_a=1 atm and the vapor pressure is 0.34 pounds per square inch absolute (psia), for what water velocity will bubbles form?

Choose either 4a or 4b

4a. In Figure below, the fluid is gasoline at 20°C at a weight flux of 120 N/s. Assuming no losses, estimate the gage pressure at section 1.

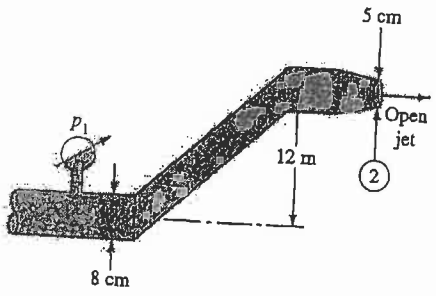

Figure for Question 4a.

4b. For the series-parallel system of figure below, all pipes are 8 cm-diameter asphalted cast iron. If the total pressure drop P_1-P_2=750 KPa, find the resulting flow rate Q m^3/hr for water at 20°C. Neglect minor losses.

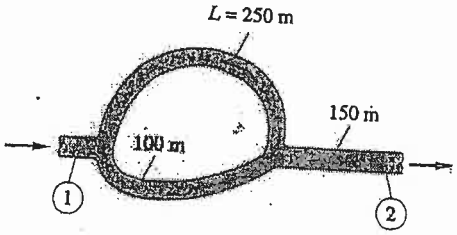

Figure for Question 4b.