National Exams   May 2015

04-Bio-A7, Fluid Mechanics

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. Four (4) questions constitute a complete exam paper.

4. Each question is of equal value.

5. All questions require calculation.

1. A centrifugal pump with backward-curved blades has the following measured performance when tested with water at 20°C:

Q, gal/min:	0	400	800	1200	1600	2000	2400
H, ft:	123	115	108	101	93	81	62
P, hp:	30	36	40	44	47	48	46

(a) Estimate the best efficiency point and the maximum efficiency. (b) Estimate the most efficient flow rate, and the resulting head and brake horsepower, if the diameter is doubled and the rotation speed increased by 50%.

2. Determine the gage pressure at point A in the below figure, in Pascal's. Is it higher or lower than $P_{atmosphere}$?(γ_{water}=9790 N/m³, $\gamma_{mercury}$=133100 N/m³)
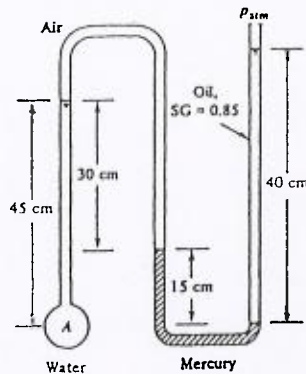

Figure for Question 2.

3. Two oil tanks are connected by two 9-m-long pipes, as shown in the below figure. Pipe 1 is 5 cm in diameter and is 6 m higher than pipe 2. It is found that the flow rate in pipe 2 is twice as large as the flow in pipe 1.
(a) What is the diameter of pipe 2?
(b) Are both pipe flows laminar?
(c) What is the flow rate in pipe 2 (m³/s)?
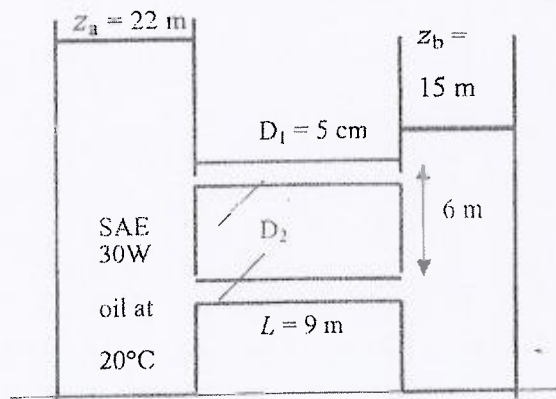Neglect minor losses.(ρ_{oil}=891 Kg/m³, μ_{oil}=0.29 Kg/m.s)

Figure for Question 3.

4. The parallel galvanized-iron pipe system(ε=0.15 mm) of below figure delivers water at 20°C(ρ=998 Kg/m^3, μ=0.001 Kg/m.s) with a total flow rate of 0.036 m^3/s. If the pump is wide open and not running, with a loss coefficient K = 1.5, determine (a) the flow rate in each pipe and (b) the overall pressure drop.
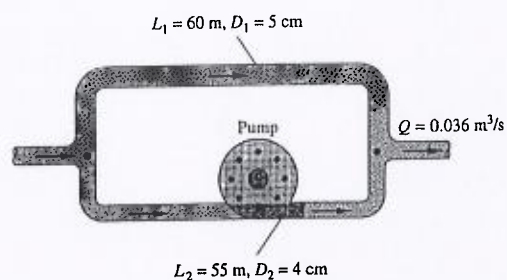

$L_1 = 60$ m, $D_1 = 5$ cm

Pump

$Q = 0.036$ m^3/s

$L_2 = 55$ m, $D_2 = 4$ cm

Figure for Question 4