PRETEST (Revision) Fluid Mechanics and Hydrodynamics skill set

Question 1

Water at a temperature of 14°C flows vertically downward out of a tap in a stream of 6mm diameter.

(a) Determine the maximum velocity of the water in order for the flow out of the tap to be initially laminar. (Use attached copy of appendix 13 for viscosity)

(b) If the water flowing out of tap had an initial velocity as determined in (a), determine the distance below the tap outlet when turbulent flow commences. Neglect the change in diameter of the stream, air friction.

(a) What will the flow regime be between the tap outlet and the position where turbulent flow commences?

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Question 2

Oil with viscosity 50×10^{-6} m^2/s and relative density 0.89 is pumped at a rate of 10 L/s through a horizontal steel pipe of diameter 75mm and length 100m. The pump has an efficiency of 65%. Determine:

(a) the friction factor

(b) the head loss

(c) the pressure drop

(d) the fluid power

(e) the pump shaft power

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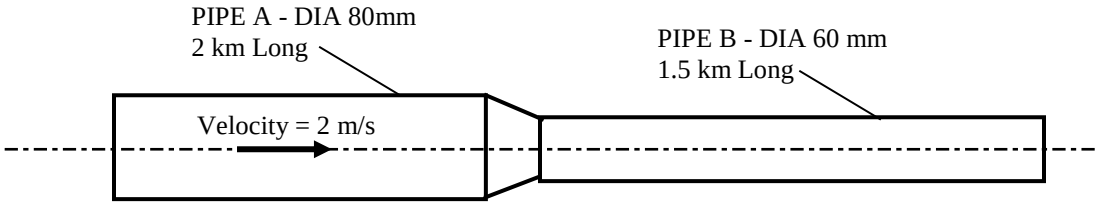
Question 3

Two steel pipes are connected in series as shown in figure below. Determine the friction factor and head loss in each pipe and hence total head loss. Neglect minor losses and losses due to the contraction. {Given: $\mu = 1.1 \times 10^{-3}$ PaS, $\rho = 1000$ kg/m^3 and $\acute{\varepsilon} = 0.045$mm}.



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Question 4

A channel is vee shaped with each side inclined at 30° to the vertical. The depth of water in the channel is 250 mm and the flow rate is 35 L/s. the Chezy coefficient is 50 $m^{1/2}s^{-1}$. Determine:

a. the velocity of water

b. the slope of the channel

c. the equivalent friction factor

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Question 5

A centrifugal pump used in a system has a head-flow rate performance as given in the following table:

Flow Rate (L/s)	0	10	20	30	40	50
Head (m)	65	62	57	50	42	40

The pump is used in a system where the system head equation is:

$$H = 18 + 0.0215\,Q^2 \quad \{H \text{ is in (m) and } Q \text{ is in (L/s)}\}$$

Determine the flow rate through the system

Question 6.

A vertical freshwater lock is 5m wide and 3m high. The water level is 2.7 m above the base of the lock on one side, there being no water on the other side. The mass of the lock is 4 t and the coefficient of friction between the lock and the slides is 0.25. Determine the force necessary to raise the lock

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Question 7.

Air flows through a horizontal duct of dimensions 300 x 300 mm with velocity 15 m/s. At the position 1 in this duct a water gauge (water manometer) registers a height of 215 mm. The duct bends downwards and reduces in size to 240 x 240 mm, dropping a distance of 12 m to position 2. The specific volume of the air is 0.85 m3/kg and this may be taken to be constant. Determine:

a) the volume flow rate and mass flow rate
b) the pressure at 1 in kPa (gauge)
c) the velocity at 2
d) the pressure at 2 in kPa (gauge) and mm water gauge if losses are neglected
e) the pressure at 2 in kPa (gauge) and mm water gauge if losses are 10% of the total head at 1 and elevation 2 is used as datum

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Question 8.

Water is pumped at the rate of 60 L/s through the system in figure below. Head loss in the suction line is 0.8 m and in the delivery line is 4.5 m. The pump has an efficiency of 72%. Determine:

a) the pressure at the inlet to the pump (P1)
b) the pressure at the outlet to the pump (P2)
c) the power required to drive the pump.