UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING: MECHANICAL*
SUBJECT	:	**FLUID MECHANICS 2**
CODE	:	**IMF 2111**
DATE	:	SUMMER SSA EXAMINATION 3 DECEMBER 2014
DURATION	:	(SESSION 2) 15:00-18:00
WEIGHT	:	40 : 60
TOTAL MARKS	:	105

EXAMINER	:	MRS V TRITCHKOVA
MODERATOR	:	MR P SIMELANE 2332
NUMBER OF PAGES	:	6 PAGES (Including cover page)

INSTRUCTIONS TO CANDIDATES:

- PLEASE ANSWER ALL QUESTIONS.
- NUMBER ALL YOUR QUESTIONS CLEARLY AND UNDERLINE YOUR FINAL ANSWERS.
- SHOW ALL THE CALCULATIONS.
- ALL ANSWERS, BOTH INTERMEDIATE AND FINAL MUST HAVE THE CORRECT UNITS, ANSWERS WITHOUT UNITS WILL NOT BE CONSIDERED.
- ASSUME ALL CONSTANTS AND PARAMETERS YOU NEED FOR YOUR CALCULATIONS.
- NO MARKS WILL BE GIVEN TO ILLEGIBLE WORK.
- ALL SKETCHES MUST BE LARGE AND CLEAR

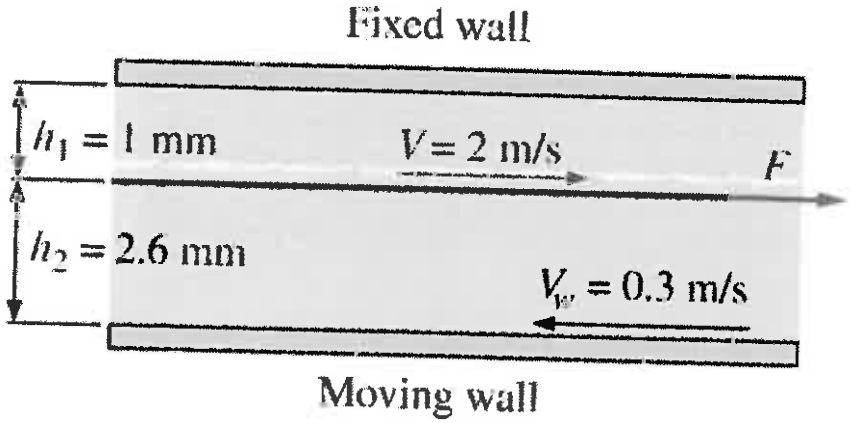
QUESTION 1

1.1 A liquid at 20°C has a relative density of 0.8 and a kinematic viscosity 2.3 centistoke. Determine its (a) unit weight and (b) dynamic viscosity in Pa.s. Take ρ_{water} at 20° as 998 kg/m^3.

(10)

1.2 If the surface tension at air-water interface is 0.073 N/m, what is the pressure difference between the inside and outside of an air bubble of diameter 0.01 mm? (3)

1.3 A thin 40 cm x 40 cm flat plate is pulled at 2 m/s horizontally through a 3.6 mm thick oil layer sandwiched between two plates one stationary and the other moving at a constant velocity 0.3 m/s, as shown in the Figure below. The dynamic viscosity of oil is 0.027 Pa.s. Assuming the velocity in each layer to vary linearly, (a) plot the velocity profile and find the location where the oil velocity is zero and (b) determine the force needed to be applied on the plate to maintain this motion.



(10)

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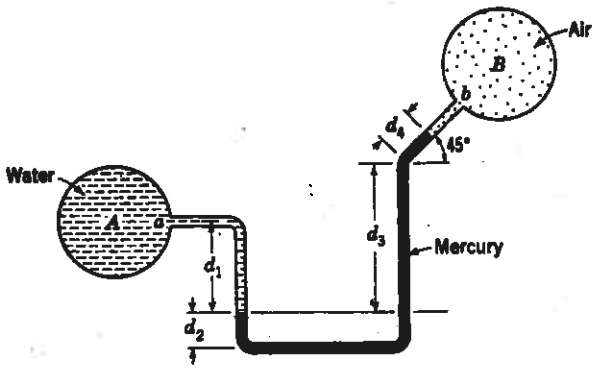
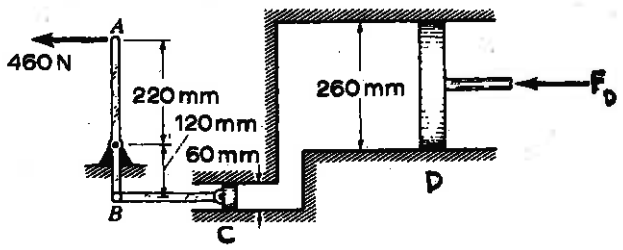
QUESTION 2

2.1 Find the difference in pressure between tanks A and B shown in the Figure below, if $d_1 = 330$ mm, $d_2 = 160$ mm, $d_3 = 480$ mm and $d_4 = 230$ mm.



(6)

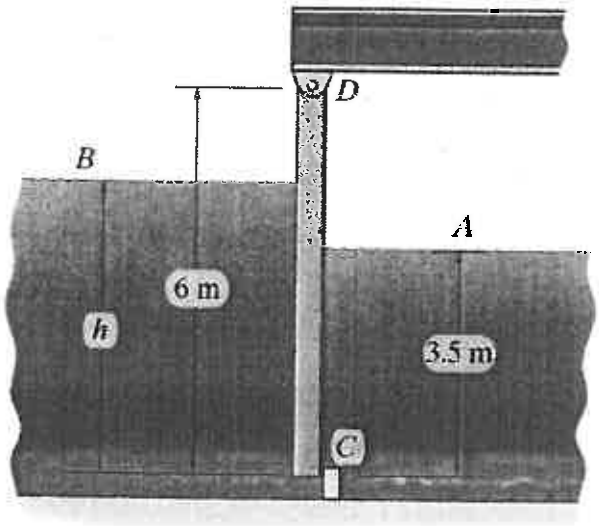
2.2 A force of 460 N is exerted on lever AB, as shown in the Figure below. The end B is connected to a piston which fits into a cylinder having diameter of 60 mm. What force F_D acts on the larger piston, if the volume between C and D is filled with water?



(10)
[16]

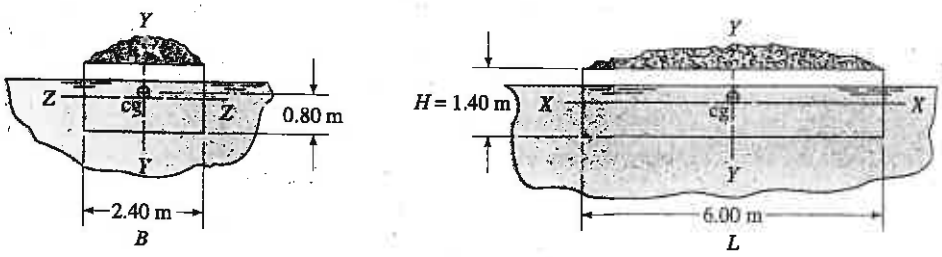
QUESTION 3

3.1 The tide gate opens automatically when the tide water at B subsides, allowing the marsh at A to drain. For water level h = 4 m, determine the horizontal reaction at the smooth stop C. The gate has a width of 2 m. At what height h will the gate be on the verge of opening?



(16)

3.2 The Figure below shows the front and the side view of a flatboat hull. When fully loaded, the boat weights 150 kN. Note the location of the centre of gravity (c.g.) and determine whether the boat is stable in fresh water.



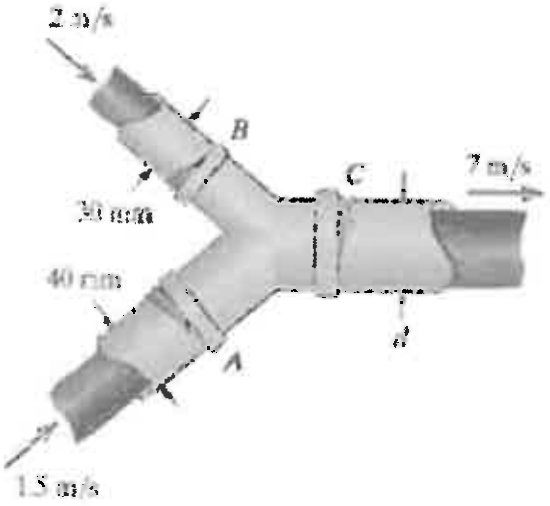
(18)

[34]

QUESTION 4

4.1 A 120 cm pipe is in series with a 60 cm pipe and the flow rate of oil in these pipes is 1660 kg/s. If the specific gravity of the oil is 0.83, what is the velocity of flow in each pipe? (10)

4.2 Determine the required diameter of pipe at C so that water flows through the pipe at the rates shown.

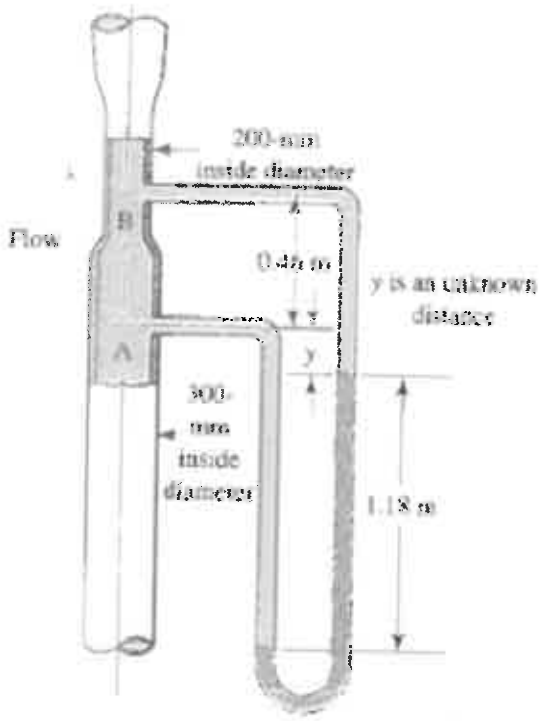


(8)

[18]

QUESTION 5

The Venturi meter shown in Figure below carries water at 60 °C. The specific gravity of gauge fluid in the manometer is 1.25. Calculate the velocity of the flow in section A and the volume flow rate of water. Assume mass density $\rho_{water} = 983.3 kg/m^3$.



[16]

TOTAL MARKS: 107
FULL MARKS : 100