UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING: MECHANICAL*
SUBJECT	:	**FLUID MECHANICS II**
CODE	:	**IMF2111**
DATE	:	SUMMER SSA EXAMINATION 2017 11 JANUARY 2017
DURATION	:	(SESSION 3) 15:00 - 18:00
WEIGHT	:	40: 60
TOTAL MARKS	:	100

EXAMINER	:	MR B NKOSI
MODERATOR	:	MR SP SIMELANE FILE NO **2005**
NUMBER OF PAGES	:	4 EXAMINATION PAGES (Including cover page)

INSTRUCTIONS :

1. PLEASE ANSWER ALL QUESTIONS NEATLY.
2. SHOW ALL CALCULATIONS
2. ANSWERS WITHOUT UNITS WILL BE PENALIZED
3. NUMBER YOUR ANSWERS STRICTLY ACCORDING TO THE QUESTIONS
4. $g = 9.81\ m/s^2$
5. **DRAW DIADRAMS, DRAW DIAGRAMS, DRAW DIAGRAMS**

REQUIREMENTS: CALCULATORS ARE PERMITTED (ONE PER STUDENT).

2/…

QUESTION 1

1.1 What is a Newtonian fluid? Is water a Newtonian fluid? (3)

1.2 Consider two identical small glass balls dropped into two identical containers, one filled with water and the other with oil. State which ball will reach the bottom of the container first and why. (2)

1.3 How does the dynamic viscosity of (a) liquids and (b) gases vary with temperature? (2)

1.4 Mercury makes an angle of 130^0 when in contact with a clean glass. What distance will the mercury depress in a 20 mm diameter glass tube if the surface tension is 0.4 N/m? (3)

1.5 The braking system of a Toyota Conquest uses about 350 ml DOT 5 brake fluid. Assuming there is no free tolerance in the braking system, a force of 2450 N is applied on the master cylinder piston with a diameter of 19.5 mm to stop the vehicle.

1.5.1 Determine the distance this piston will move when the braking force is applied. The bulk modulus of the oil is 2.25 GPa. (7)

1.5.2 After servicing the brakes, there is 1.5% air in the system. Determine the distance that the piston will now move when the same braking force is applied as previously. (7)

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QUESTION 2

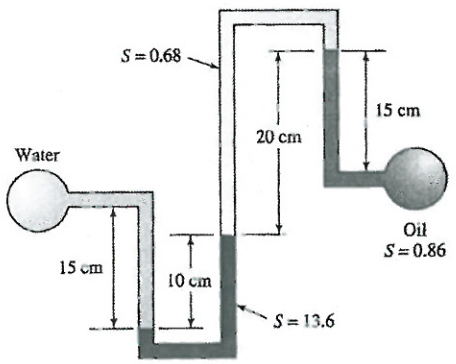
The lever of a hydraulic jack has a fulcrum advantage of 15:1. The hydraulic jack has a plunger with a diameter of 25 mm and a stroke of 75 mm. The ram diameter is 300 mm. The hydraulic fluid has a relative density of 0.8. Find the effort required for the ram to lift a mass of 1500 kg if:

2.1 The ram and plunger are at the same level (4)
2.2 The ram is 5 m above the plunger (4)
2.3 Calculate the number of strokes required to lift the ram by 250 mm. (4)
2.4 Determine the **output** power required to complete the lift in 1 minute. (4)

[16]

QUESTION 3

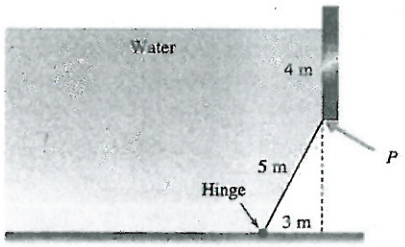
A multifluid manometer shown in the figure is used to measure the pressure difference between a water pipe and an oil pipe. Redraw the diagram and use it to determine this pressure difference.



[10]

QUESTION 4

Redraw the diagram shown in the figure and use it to determine the force P needed to hold the 4 m wide gate in position.



[9]

QUESTION 5

5.1 A car ferry is rectangular with dimensions 8 m wide and 100 m long. If 60 cars, with an average weight per car of 15 kN, are loaded on the ferry, how much farther will it sink into the water? (4)

5.2 A 250 mm diameter cylinder is composed of a material with specific gravity of 0.8. Determine and state whether the cylinder will float in water in an upright position if its length is 300 mm. (11)

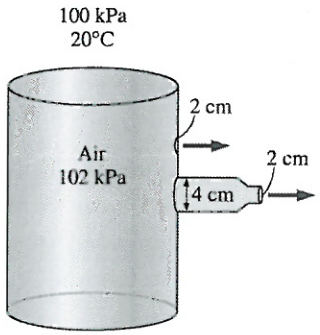
[15]

QUESTION 6

A very large tank shown below contains air at 102 kPa at a location where the atmospheric pressure is 100 kPa and temperature is 20 °C. Now a 2 cm diameter tap is opened.

6.1 Determine the maximum flow rate of air through the hole.

6.2 What would your response be if air is discharged through a 2 m long, 4 cm diameter tube with a 2 cm diameter nozzle?
R_{air} = 0.287 kJ/kg.K.



[11]

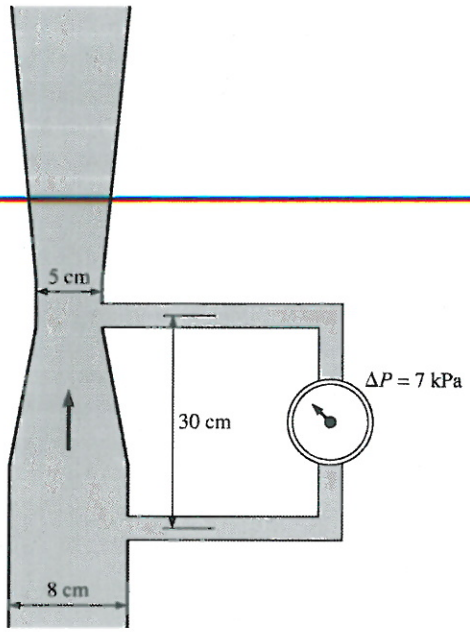
QUESTION 7

7.1 A reservoir mounted sharp-edged orifice has a diameter of 50 mm. the water head is 4.8 m. If $C_c = 0.62$ and $C_v = 0.98$, calculate:

7.1.1 The jet (vena contracta) diameter (2)
7.1.2 The actual velocity at the vena contracta, and (2)
7.1.3 The flow rate in dm^3/s. (3)

7.2 A vertical Venturi meter equipped with a differential pressure gauge shown is used to measure the flow rate of liquid propane through an 8-cm-diameter vertical pipe. For a discharge coefficient of 0.98, and the density of propane of $\rho = 514.7\ kg/m^3$, determine:

7.2.1 The volume flow rate of propane through the pipe. (6)
7.2.2 The average flow velocity in the pipe. (2)



[15]

TOTAL: [100]