

**PROGRAM** : NATIONAL DIPLOMA  
*ENGINEERING: MECHANICAL*

**SUBJECT** : **FLUID MECHANICS II**

**CODE** : **IMF2111**

**DATE** : SUMMER EXAMINATION 2015  
16 NOVEMBER 2015

**DURATION** : (SESSION 2) 12:30 - 15:30

**WEIGHT** : 40: 60

**TOTAL MARKS** : 110

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**EXAMINER** : MR MD MUKHAWANA

**MODERATOR** : MR S.P SIMELANE FILE NO 2005

**NUMBER OF PAGES** : 5 EXAMINATION PAGES (Including cover page)

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**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.  $g = 9.81 \text{ m/s}^2$
  5. **DRAW DIAGRAMS**
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**REQUIREMENTS**: CALCULATORS ARE PERMITTED

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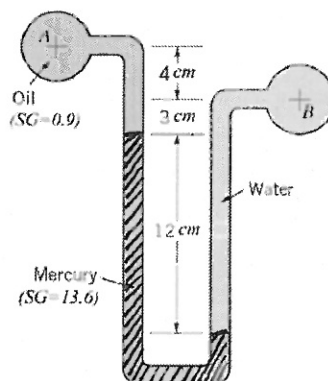
**QUESTION 1**

- 1.1 A volume of oil is 3 litre and the weight is 20N, determine
- The specific volume,
  - The relative density and
  - The specific weight of oil. (9)
- 1.2 A rigid tank contains 20 kg of air at 140 kPa and 20 °C. More air is added to the tank until the pressure and temperature rise to 250 kPa and 30 °C, respectively. Determine the amount of air added to the tank. Use  $R_{\text{air}} = 287 \text{ J/kg K}$ . (5)
- 1.3 A 4.5 mm diameter glass tube is inserted into mercury, which makes a contact angle of 140 °C with glass. Determine the capillary drop of mercury in the tube if the mercury-glass surface tension is  $\sigma_s = 0.440 \text{ N/m}$ . (3)

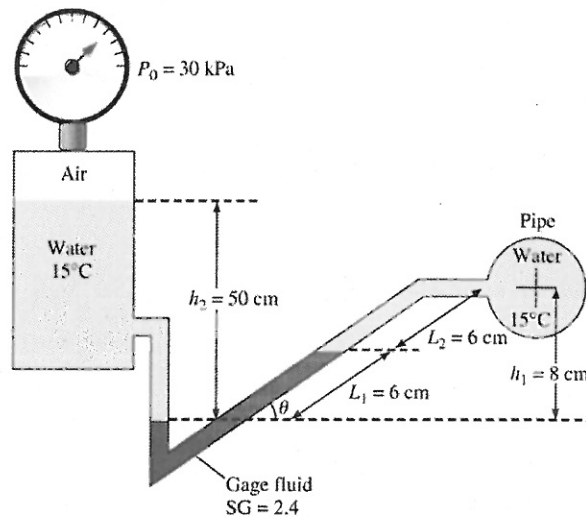
[17]

**QUESTION 2**

- 2.1 A U-tube manometer contains oil, mercury and water (SG = 1) as shown below. For the column heights indicated, what is the pressure differential between pipes A and B in kPa? (6)



- 2.2 The pressure of water flowing through a pipe is measured by the arrangement shown below. For the values given, calculate the pressure in the water pipe in kPa. (8)



[14]

### QUESTION 3

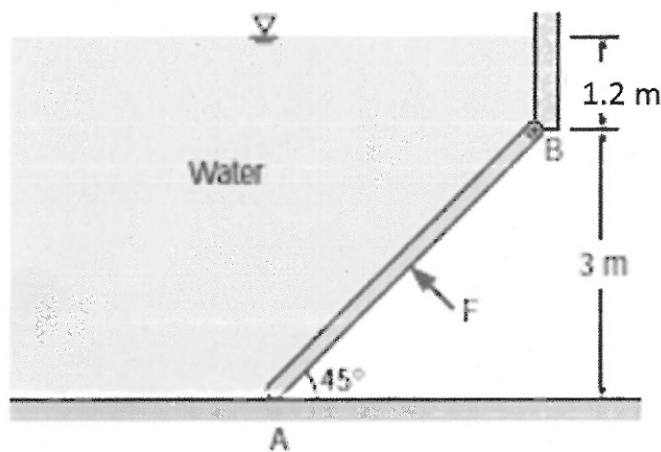
A hydraulic press has a diameter ratio between two pistons of 8:1. The diameter of the larger piston is 600 mm and it is required to support a mass of 3500 kg. The press is filled with a hydraulic fluid of specific gravity 0.8. Draw a neat sketch and calculate the force required on the smaller piston to provide the required force when:

- The two pistons are at same level (5)
- The smaller piston is 2.6 m below the larger piston. (5)

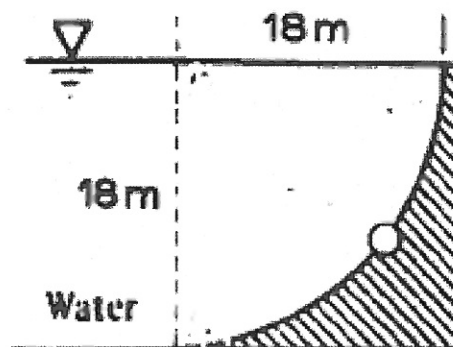
[10]

**QUESTION 4**

- 4.1 A 5-m-wide rectangular water gate shown below is hinged at  $B$  and leans against the floor at  $A$  making an angle of  $45^\circ$  with the horizontal. The gate is to be opened from its lower edge by applying a normal force at its center. Determine the minimum force  $F$  required to open the water gate. (12)



- 4.2 The water side of the wall of a 40-m-long dam is a quarter circle with a radius of 18 m. Determine the magnitude and direction of the hydrostatic force on the dam. (11)



[23]

**QUESTION 5**

5.1 A body of dimensions 2m x 1m x 3m weighs 3924 N in water. Calculate:

- a) Its weight in air (5)
- b) Its specific gravity (3)

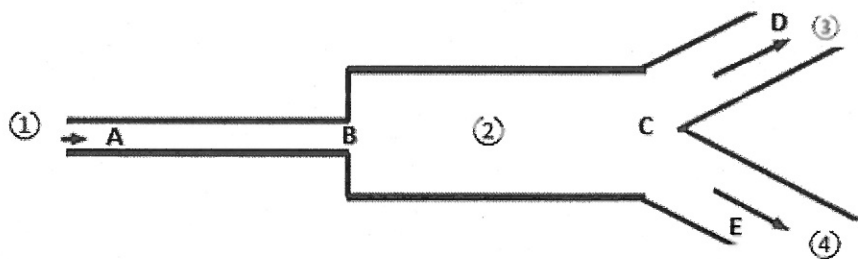
5.2 A block of wood with specific gravity of 0.8 floats in water. Determine the metacentric height of the block if its size is 3 m long x 2 m wide x 1 m height (8)

[16]

**QUESTION 6**

Water flows through a pipe AB of diameter  $d_1 = 50$  mm, which is in series with a pipe BC of diameter  $d_2 = 75$  mm in which the mean velocity  $v_2 = 2$  m/s. At C the pipe forks and one branch CD is of diameter  $d_3$  such that the mean velocity  $v_3$  is 1.5 m/s. The other branch CE is of diameter  $d_4 = 30$  mm and conditions are such that the discharge  $Q_2$  from BC divides so that  $Q_4 = \frac{1}{2} Q_3$ . Calculate :

- a) Discharge at pipe 1, (5)
- b) Mean velocity at pipe AB (3)
- c) Discharge at pipe CD (3)
- d) Diameter of pipe CD (3)
- e) Discharge and velocity at pipe 4 (6)



[20]

**QUESTION 7**

A Venturi meter is 50 mm bore diameter at inlet and 10 mm bore diameter at the throat. Oil of density 900 kg/m<sup>3</sup> flows through it and a differential pressure head of 80 mm is produced. Given  $C_d = 0.92$ , determine the mass flow rate in kg/s [8]

TOTAL = 110