The Open University of Sri Lanka
Faculty of Engineering Technology

Study Programme	:	Diploma in Technology/Bachelor of Technology (Engineering)
Name of the Examination	:	Final Examination
Course Code and Title	:	**MEX3235 Thermo - Fluids**
Academic Year	:	2012/13
Date	:	14.08.2013
Time	:	0930hrs-1230hrs
Duration	:	3 hours

General instructions

1. Read all instructions carefully before answering the questions.
2. Answer five questions selecting at least two questions from each section.
3. All questions carry equal marks.
4. You may obtain tables of thermodynamics and transport properties of fluids on request.
5. Density of water = 1000 kg/m^3. Acceleration due to gravity = 9.81m/s^2.
6. For air C_p= 1.005kJ/kg.K ,C_v= 0.718kJ/kg.K, R = 0.287kJ/kg.K, γ = 1.4.

SECTION 1

1 a Write the equation for First Law of Thermodynamics with usual notation. (4 marks)

b Show that for a constant pressure process heat transferred (Q) can be written as
$Q = mC_p(T_2 - T_1)$
where all notation has its usual meaning. (6 marks)

c One kilogramme of gaseous CO_2 contained in a closed system undergoes a reversible process at constant pressure. During this process 42kJ of internal energy is decreased. Determine:

i Difference in temperature $(T_2 - T_1)$ (4 marks)

ii Heat supplied or rejected (3 marks)

iii Work done during the process (3 marks)

For CO_2: $C_p = 840\ J/kg\ ^\circ C$ and $C_v = 600\ J/kg\ ^\circ C$

2 a Draw p-v and T-S diagrams for Dual combustion cycle. (5 marks)

b An engine working on dual combustion cycle has a pressure of 1 bar and a temperature of 27°C at the beginning of compression. The pressure at the end of compression is 30 bar. The maximum pressure is 50 bar. During combustion half of the heat is added at constant volume and half at constant pressure. Determine:

i Pressure and temperature at all points. (10 marks)

ii Thermal efficiency of the cycle. (5 marks)

3 a Draw p-v diagram for Carnot cycle and Rankine cycle. (5 marks)

b In a steam turbine steam at 30bar and 600°C is expanded to 0.1bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Determine:

i Work done. (5 marks)

ii Thermal Efficiency (10 marks)

4 A steam flowing tube of diameter 240mm is covered with 50mm of high temperature insulation (k=0.092W/m.K) and 40mm of low temperature insulation (k=0.062W/m.K). The inner and outer surface temperatures are 390°C and 40°C respectively.

i Calculate the total heat loss per unit length of the steam pipe. (10 marks)

ii Calculate the temperature of the intermediate surface (10 marks)

SECTION 2

5 A rectangular pontoon of 12m length, 9m width and 3m height weighs 1380kN and floats in water. The pontoon carries on its upper deck a boiler of 6m diameter as shown in Figure Q 5. The weight of the boiler is 864N.

i Determine the metacentric height of the arrangement. (15 marks)

ii Comment on the stability of the arrangement. (5 marks)

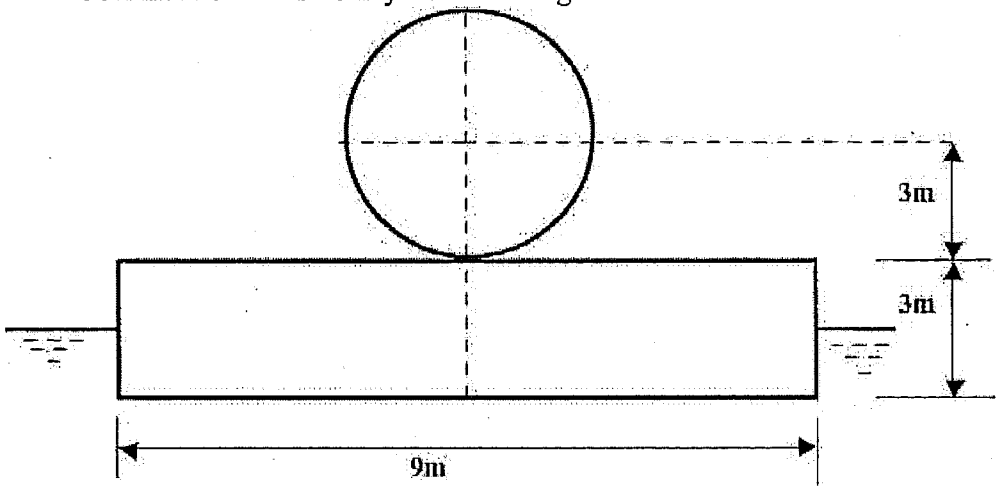


Figure Q 5

6 Oil of specific gravity 0.85 flows at a rate of $0.5m^3/s$ through a 90° **vertical** circular bend with an inlet pressure $118kN/m^2$as shown in Figure Q 6. The inlet and out let diameters are 0.4m and 0.3m respectively. Water enters and exits the bend at 45° to the horizontal. The volume of the bend is $0.1m^3$. Neglecting friction and assuming both inlet and exit sections to be at same horizontal level, find the magnitude and direction of the force on the bend. (20 marks)

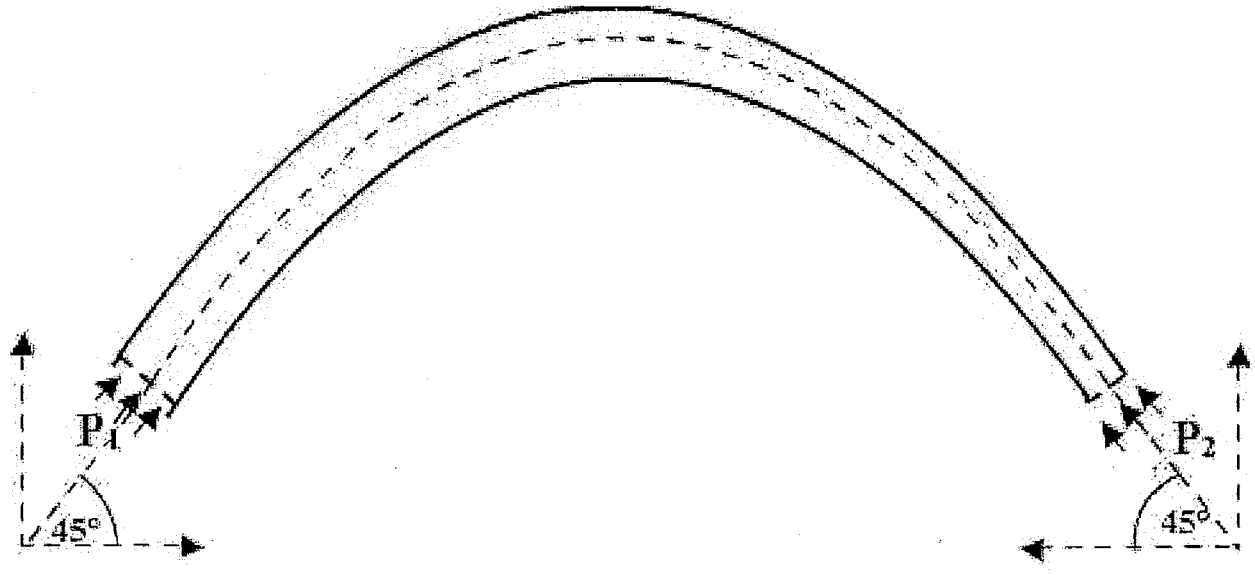


Figure Q 6

7 It is required to connect two pipes of different lengths and diameters to a common header supplied with 8×10^{-3} m^3/s of water from a pump as shown in Figure Q 7. One pipe is 100m long and 50mm in diameter. The other pipe is 800m long. Friction factor for both pipes is 0.08. Assume the pipes to be laid on leveled horizontal ground. Determine:

a Diameter of the second pipe such that both pipes have the same flow rate. (15 marks)

b Head loss in meters of water in the pipe. (5 marks)

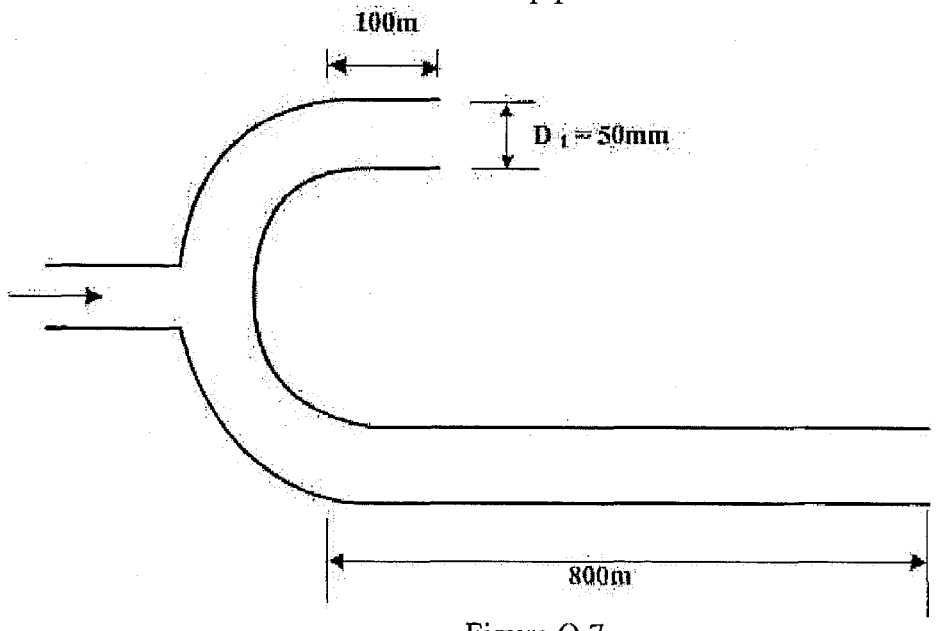


Figure Q 7

8 A pump is 2.2m above the water level in the sump and has a pressure of **--200mm** of mercury at the suction side as shown in Figure Q8. The suction pipe is of 200mm diameter and the delivery pipe is a 250mm diameter pipe ending in a nozzle of 80mm diameter. If the nozzle is directed vertically upwards at an elevation of 4.2m above the water sump level, Determine:

i Discharge. (5 marks)

ii Power input into the flow by the pump. (10 marks)

iii Elevation above the water sump level, to which the jet would reach. (5 marks)

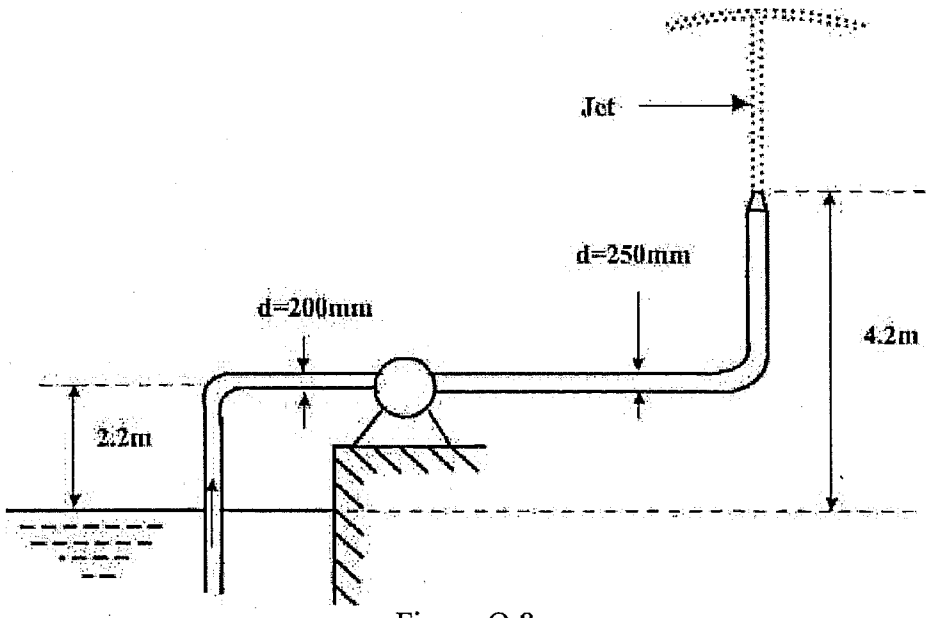


Figure Q 8

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