THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DIPLOMA IN TECHNOLOGY – LEVEL 03
FINAL EXAMINATION– 2008/2009

MEX3235 - THERMO-FLUIDS
MEX3232 - THERMODYNAMICS AND FLUID MECHANICS

DATE : 31st MARCH 2009
TIME : 0930 HRS. – 1230 HRS.
DURATION : THREE HOURS

ANSWER FIVE QUESTIONS SELECTING AT LEAST ONE QUESTION FROM EACH SECTION. ALL QUESTIONS CARRY EQUAL MARKS. YOU MAY OBTAIN TABLES OF THERMODYNAMICS AND TRANSPORT PROPERTIES OF FLUIDS ON REQUEST.

Density of water = 1000kg/m^3. Acceleration due to gravity=9.81m/s^2.
For air Cp=1.005kJ/kg.K , Cv=0.718kJ/kg.K, R=0.287kJ/kg.K, γ=1.4.

SECTION 1

1. In an engine working on dual combustion cycle, the temperature and pressure at the beginning of the cycle are 90°C and 1 bar respectively. The compression ratio is 9. The maximum pressure is limited to 68bar and total heat supplied per kg of air is 1750kJ. Determine the pressure and temperature at all salient points and the thermal efficiency of the cycle.

2. A certain quantity of air initially at a pressure of 8 bar and 280°C has a volume of 0.035m^3. It undergoes the following processes in the following sequence in the cycle:
   (a) Expands at constant pressure to 0.1 m^3,
   (b) Follows polytropic process with n=1.4,and
   (c) A constant temperature process (which completes the cycle)
   Calculate the following:
   (i). Heat received in the cycle
   (ii).Heat rejected in the cycle
   (iii). efficiency of the cycle

3. In a steam turbine steam at 20 bar and 360°C is expanded to 0.08bar. It then enters the condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Assuming that this steam power plant operates in a Rankine cycle, determine;
   (i) thermal efficiency.
   (ii) work ratio.
   (iii) specific steam consumption.

4. Starting from the First Law of Thermodynamics, show that the entropy change of an ideal gas from state 1 to state 2 can be expressed as

$$S_2 - S_1 = C_v \ln\frac{T_2}{T_1} + R\ln\frac{v_2}{v_1}$$

   hence show that for a polytropic process the entropy change can be written as

$$S_2 - S_1 = C_v\left(\frac{n-\gamma}{n-1}\right)\ln\frac{T_2}{T_1}$$ where n is the index of the Polytropic process.

SECTION 2

5. A jet of water is directed at a uniform flat rectangular plate, of mass 5kg, which is suspended from a hinge along the top horizontal edge as shown in Figure Q05. Determine the pressure, P0, required in the pipe, upstream of the nozzle, to maintain equilibrium with the plate inclined at 30° to the vertical.

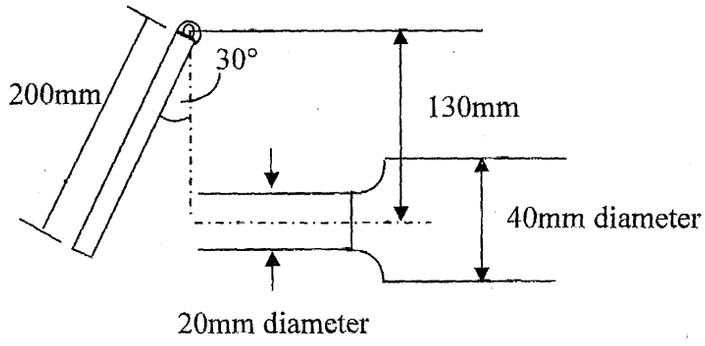


Figure Q5

6. A reservoir containing water, oil of specific gravity 0.9 and air under pressure is closed by a rectangular gate AB, 2m long and 1m wide, hinged at A as shown in Figure Q6. If the gate is of negligible weight, determine the magnitude and point of application of the resultant force on the gate and the vertical force F to be applied at B to hold the gate in the closed position. Specific gravity of Mercury is 13.6.

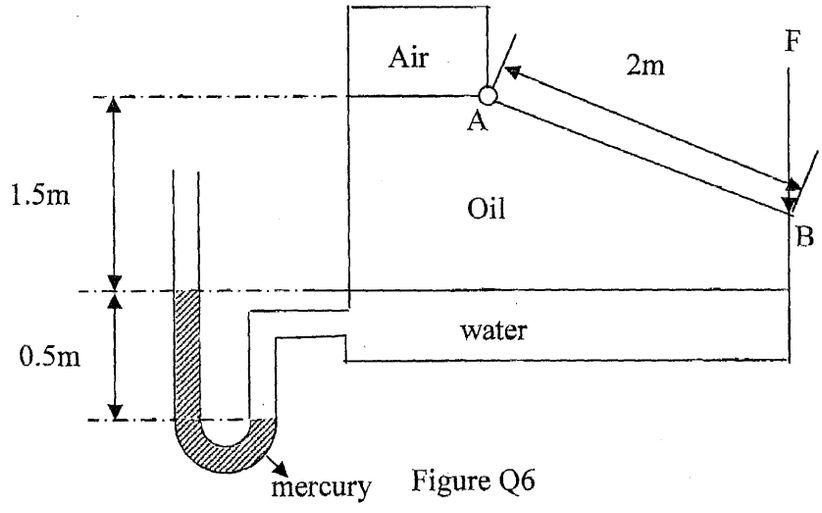


Figure Q6

7. A centrifugal pump having an overall efficiency of 75% delivers 1820litres of water per minute to a height of 18m through a pipe of 100mm diameter and 90m length. Taking f=0.012, find the power required to drive the pump.

8. Two pipes connected to a reservoir discharge water freely to the atmosphere at their outlet ends as shown in Figure Q8. The first pipe which is 150 mm in diameter and 300m in length has its outlet end at a depth of 3.8m below the water level in the reservoir. The second pipe is 200mm in diameter and 600m long. If the combined discharge is 50*l*/s find how much below the reservoir water level, the outlet end of the second pipe is situated. Consider only the friction losses. Take f= 0.0045 for both pipes.

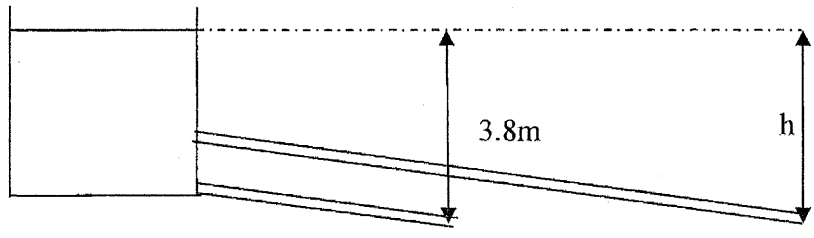


Figure Q8

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