THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DIPLOMA IN TECHNOLOGY – LEVEL 03
FINAL EXAMINATION 2005/2006
MED1206/MEX3232 – THERMODYNAMICS AND FLUID MECHANICS
MEX3235 – THERMO-FLUIDS
DATE : 15th MARCH 2006
TIME : 0930 - 1230 HOURS
DURATION: THREE HOURS

YOU MAY OBTAIN TABLES OF THERMODYNAMIC AND TRANSPORT PROPERTIES OF FLUIDS ON REQUEST

Part – B

1. *Part – B consists of* ***nine*** *questions. Answer* ***only five*** *questions.*
2. *All questions carry equal marks.*
3. *Time allocation for Part B is* ***2 hrs and 15 minutes.***
4. *Do not spend more than* ***20 – 25 minutes*** *for each question.*
5. *Hand over* ***Part B*** *separately.*

1. A rectangular, uniform sluice gate AB of width 3m and length 4m is hinged at A as shown in Figure Q1. The mass of the gate is 1000kg. The gate is kept closed by a horizontal force P applied at B.
   Calculate the minimum value of force P required to keep the gate closed when the water level in the tank is 8m.
   In addition to this force a weight of 400kN too is placed at the center of gravity of the gate to maintain a higher water level in the tank. Calculate the height to which water can be filled before the gate just opens under the new arrangement.

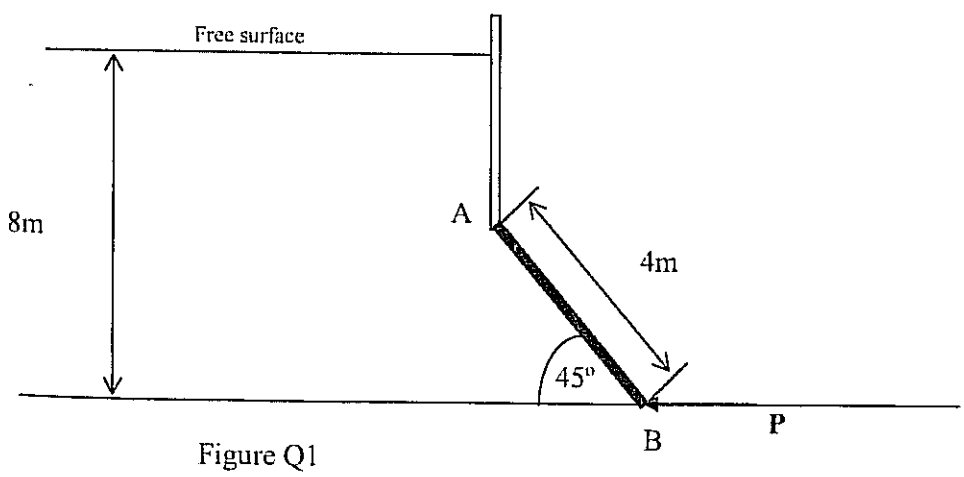


Figure Q1

Hint: In usual notation, the depth of center of pressure , H, of a plane surface fully immersed in a liquid with its plane inclined at an angle Θ to the horizontal is

$$H = \frac{\left(I_G Sin^2\theta\right)}{A\bar{h}} + \bar{h}$$

2. A single acting reciprocating pump has a bore diameter of 200mm and a stroke length 400mm. The center of the pump is 4m above the water surface in the sump and 22m below the delivery water level. The diameter and lengths of suction and delivery pipes are 100mm,5m and 100mm,30m respectively. If the pump is working at 30rev/min, determine the pressure heads on the piston at the beginning, middle and at the end of both suction and delivery strokes

3. The diameter of a pipe bend is 400mm at inlet and 250mm at outlet and the flow is turned through 120° in a horizontal plane. Neglecting friction, calculate the magnitude and direction of the net force exerted on the bend by water flowing through it at $0.45m^3/s$ when the inlet pressure is 160kPa.

4. Two reservoirs having a difference in surface level of 100m are connected by a series pipe system as shown in Figure Q4. The pipe system consists of two pipes AB and BC and their geometrical parameters are given below.

Pipe	Length(m)	Diameter(mm)
AB	600	400
BC	200	200

Assuming a constant pipe friction factor of 0.01 for both the pipes, determine the rate of flow of water from the upper reservoir. Neglect all losses other than those due to pipe friction.

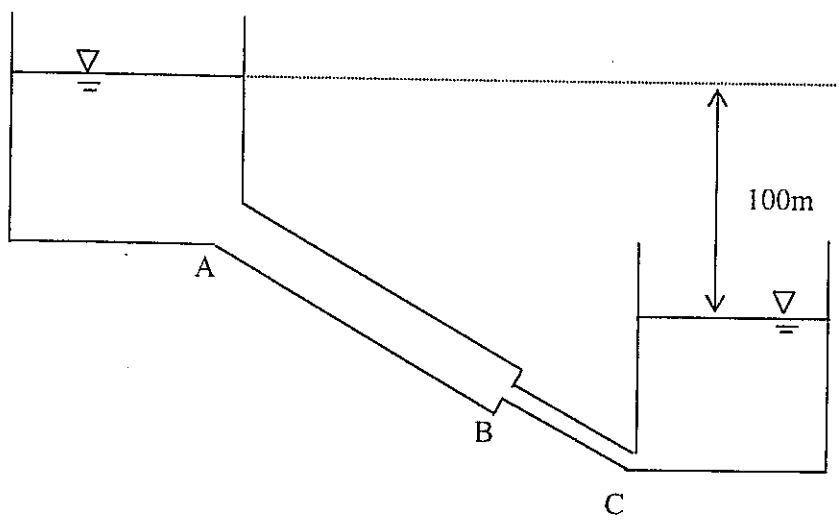


Figure Q4

5. The mass rate of flow into a steam turbine is 1.5kg/s, and the heat transfer from the turbine is 8.5kW. The following data are known for the steam entering and leaving the turbine. Determine the power output of the turbine.

	Inlet conditions	Exit conditions
Pressure (MPa)	2.0	0.1
Temperature (°C)	350	
Velocity (m/s)	50	100
Elevation above Reference plane (m)	6	3
Quality of steam	superheated	dry saturated

6. An air standard diesel cycle has a compression ratio of 20, and the heat transferred to the working fluid per cycle is 1800kJ/kg. At the beginning of the compression process, the pressure is 0.1MPa and the temperature is 15°C. Determine
   1) pressure and temperature at each point in the cycle
   2) thermal efficiency
   3) mean effective pressure

7. A steam power plant operates on a cycle with pressures and temperatures as designated in Figure Q7. The efficiency of the turbine is 86%, and the efficiency of the pump is 80%. Determine the thermal efficiency of this cycle.

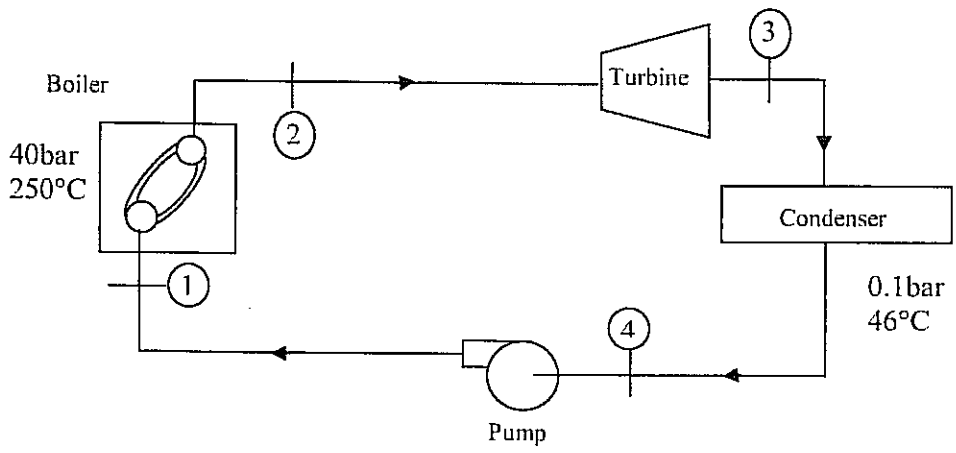


Figure Q7

8. (1) Briefly describe the four major events occurring in an engine which works on a four stroke Otto cycle.
   (2) Draw the valve- timing diagram for the above engine showing the theoretical four strokes where all valve openings and closings occur at dead centers.

9. A quantity of air occupying a volume of $1m^3$ at 4bar and 150°C is allowed to expand isentropically to 1bar. Its enthalpy is then raised by 70kJ by heating at constant pressure. The whole process indicated as 1-2-3 in Figure Q9. What is the total work done during this process?

   If the above process is to be replaced by a reversible polytropic expansion (indicated as 1-3 in Figure Q9) which will result in the same final state being reached, What index of expansion is required? Will the work done be greater or less in magnitude than the original process?

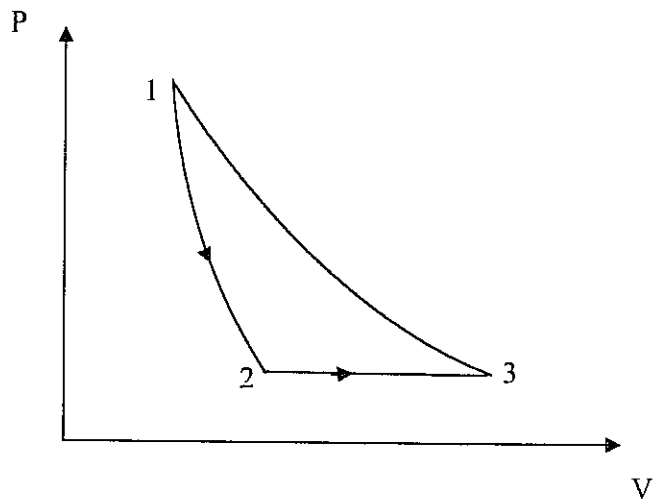


Figure Q9

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