Document No : UniKL MFI_SD_AC41
Revision No: 02
Effective Date: 01 December 2008

CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

SEPTEMBER 2014 SESSION

SUBJECT CODE	:	**NMB21203**
SUBJECT TITLE	:	**FLUID MECHANICS 1**
LEVEL	:	**BACHELOR**
TIME / DURATION	:	**9.00 AM – 12.00 PM (3.0 HOURS)**
DATE	:	**30 DECEMBER 2014**

INSTRUCTIONS TO CANDIDATES

1. **This is an OPEN BOOK Examination. Only ONE (1) main reference text book are allowed.**
2. **Please read the instructions given in the question paper CAREFULLY.**
3. **This question paper is printed on both sides of the paper.**
4. **Please write your answers on the answer booklet provided.**
5. **Answer should be written in blue or black ink except for sketching, graphic and illustration.**
6. **This question paper consists of 5 questions. Choose and answer four (4) questions only.**
7. **Answer all questions in English.**

THERE ARE 5 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

INSTRUCTION: Answer FOUR (4) questions only.
Answer on the answer booklet provided.

Question 1

a) Saturated refrigerant-134a liquid at *10ºC* is cooled to *0ºC* at constant pressure. Using coefficient of volume expansion data, determine the change in the density of the refrigerant.

(7 marks)

b) Carbon dioxide enters an adiabatic nozzle at *1200ºK* with a velocity of $50\ ms^{-1}$ and leaves at *400ºK*. Assuming constant specific heats at room temperature, determine the Mach number

i. at the inlet

(6 marks)

ii. at the exit of the nozzle

(12 marks)

Question 2

a) The pressure of water flowing through a pipe is measured by the arrangement, as shown in **Figure 1** below. For the values given, calculate the pressure in the pipe.

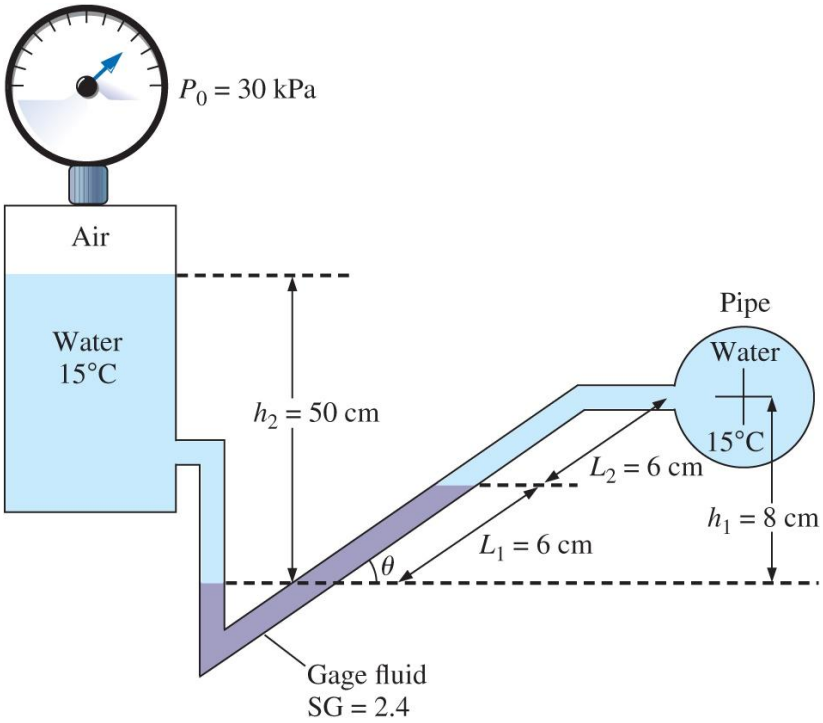

Figure 1

(10 marks)

b) The two sides of a V-shaped water trough are hinged to each other at bottom where they meet, with a width of *3 m*, as shown in **Figure 2** below. The two parts are held together by a cable and turnbuckle. Calculate the tension in each cable when the trough is filled to the rim.

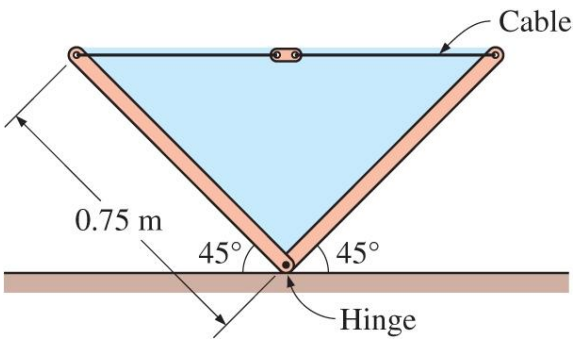

Figure 2

(15 marks)

Question 3

a) Electric power is to be generated by installing a hydraulic turbine-generator at a site *110 m* below the free surface of a large water reservoir, as shown in **Figure 3** below that can supply water steadily at a rate of *900 kg/s*. If the mechanical power output of the turbine is *800 kW* and the electric power generation is *750 kW*, determine the turbine efficiency and the combined turbine generator efficiency of this plant. Neglect loss in the pipes.

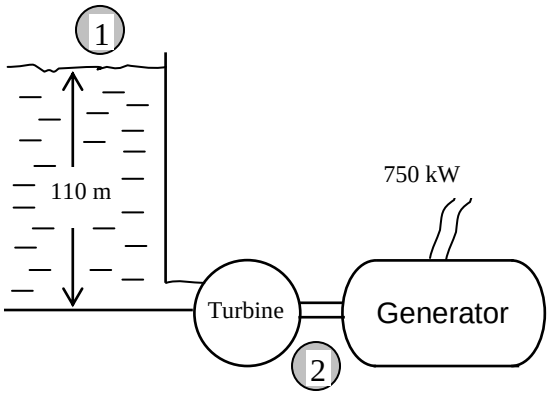

Figure 3

(13 marks)

b) The air velocity in the duct of a heating system is to be measured by a Pitot-static probe inserted into the duct parallel to the flow, as shown in **Figure 4**. The air temperature and pressure in the duct are *45ºC* and *98 kPa* respectively. If the differential height between the water columns connected to the two outlets of the probe is *2.4 cm*, determine the pressure rise at the tip of the probe, and the flow velocity.

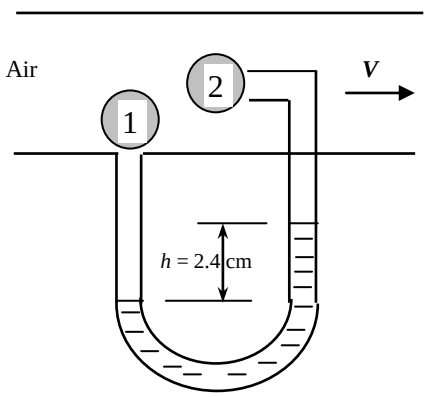

Figure 4

(12 marks)

Question 4

a) A student team is to design a human-powered submarine for a design competition. The overall length of the prototype submarine is *4.85 m*, and its student designer's hope that it can travel fully submerged through water at *0.44* ms^{-1}. The water is freshwater (a lake) at *T= 15ºC*. The design team builds a one-fifth scale model to test in their university's wind tunnel, as shown in *Figure 5* below. A shield surrounds the drag balance strut so that the aerodynamic drag of the strut itself does not influence the measured drag. The air in the wind tunnel is at *25ºC* and at one standard atmosphere pressure. Determine at what air speed do they need to run the wind tunnel in order to achieve similarity?

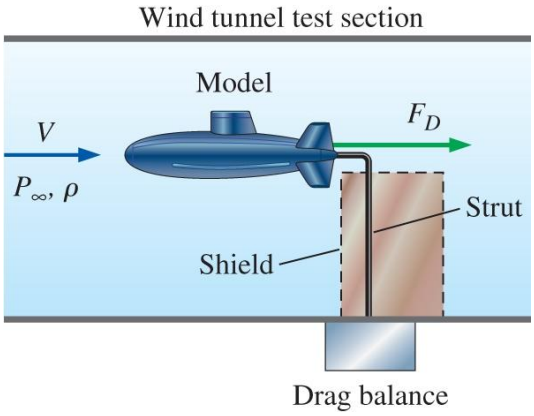

Figure 5

(15 marks)

b) Repeat Question 4 (a) as above, with *all the same conditions* except that the only facility available to the students is a much *smaller* wind tunnel. Their model submarine is a one-twenty-fourth scale model instead of a one-fifth scale model. Determine at what air speed do they need to run the wind tunnel in order to achieve similarity?

(10 marks)

Question 5

The conical container with a thin horizontal tube attached at the bottom, as shown in **Figure 6** below, is to be used to measure the viscosity of oil. The flow through the tube is laminar. The discharge time needed for the oil level to drop from h_1 to h_2 is to be measured by a stopwatch. Develop an expression for the viscosity of oil in the container as a function of discharge time t.

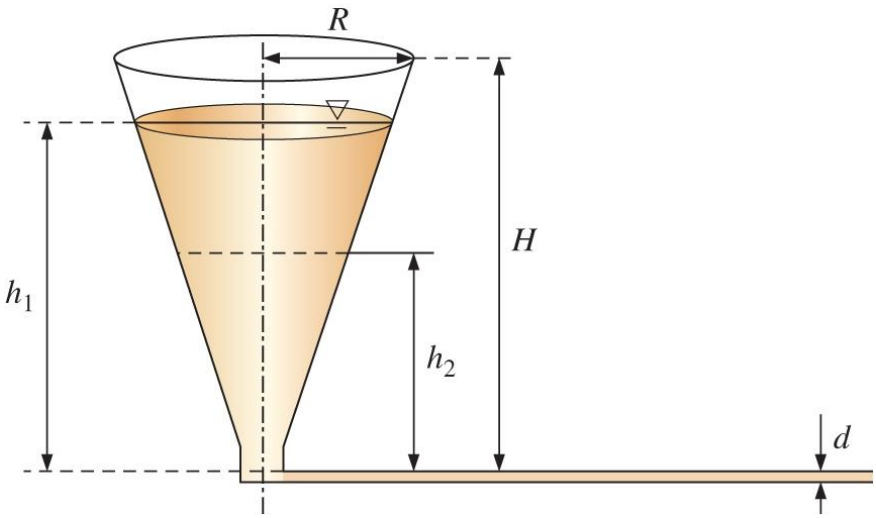

Figure 6

(25 marks)

- END OF QUESTION -