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	:	**FCD20102**
SUBJECT TITLE	:	**FLUID MECHANICS**
LEVEL	:	**DIPLOMA**
TIME / DURATION	:	**3.30 PM – 5.30 PM** **(2 HOURS)**
DATE	:	**31 DECEMBER 2014**

INSTRUCTIONS TO CANDIDATES

1. **Please read the instructions given in the question paper CAREFULLY.**
2. **This question paper is printed on both sides of the paper.**
3. **Please write your answers on the answer booklet provided.**
4. **Answer should be written in blue or black ink except for sketching, graphic and illustration.**
5. **This question paper consists of TWO (2) sections. Section A and B. Answer all questions in Section A. For Section B, answer two (2) question only.**
6. **Answer questions in English.**
7. **Fomula is appended in the Appendices.**

THERE ARE 6 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 60 marks)

INSTRUCTION: Answer ALL questions.

Please use the answer booklet provided.

Question 1

(a) What is the definition of mass?

(2 marks)

(b) What is the definition of weight?

(2 marks)

(c) Calculate the weight of a reservoir of oil if it has a mass of 500kg. Answer in kN.

(4 marks)

(d) If the reservoir from question 1(c) has a volume of $0.817m^3$, find the :-

i. Density of oil.

(4 marks)

ii. Specific weight of oil.

(4 marks)

iii. Specific gravity of oil.

(4 marks)

Question 2

a) What is the definition of pressure?

(4marks)

b) State two (2) important principles about pressure described by Pascal's Low.

(6 marks)

c) Refer to figure Q2, shows a container of liquid with a movable piston supporting a load. Determine the pressure in the liquid under the piston if the total weight of the piston and the load 500N and the area of the piston is $1500cm^2$. Final answer in MPa

(10 marks)

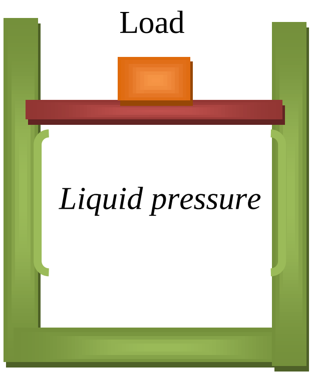

Figure Q2(C): Container of liquid

Question 3

a) Refer figure Q3, shown the manometer of oil and water. Determine the pressure difference between point A and B if the specific gravity of oil is 0.85

i. Find the density of oil and water.

(5 marks)

ii. Determine the pressure difference between point A and B.

(15 marks)

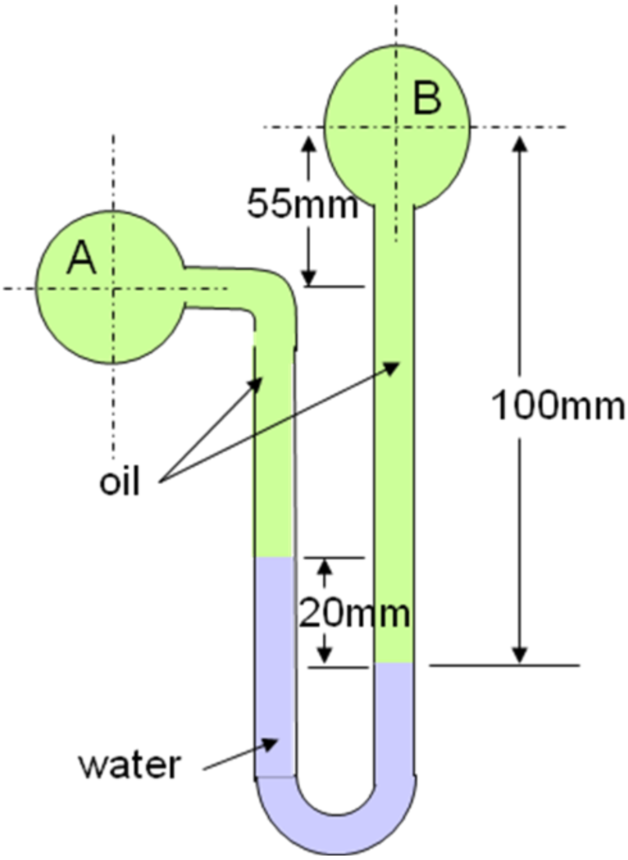

Figure Q3: Differential Manometer

SECTION B (Total: 40 marks)

INSTRUCTION: Answer only TWO questions.
Please use the answer booklet provided.

Question 4

Refer to Figure Q4. Chilled Water at 70°C is flowing at section 1 to section 2, the velocity of flow is 3.0 m/s with its diameter is of 80mm. Section 2 is 20mm in diameter.
Assuming there is no energy loss in the system,

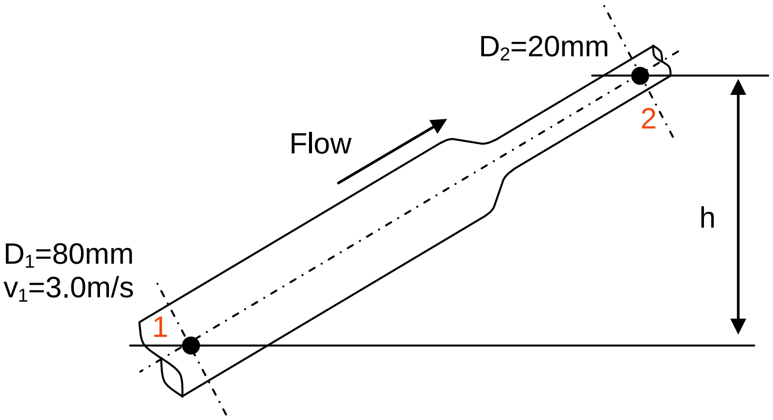

Figure Q4: Conservation of Bernoulli's

(a) Calculate the velocity in m/s

(5 marks)

(b) In order to maintain the same pressure $P_1=P_2$, calculate the elevation h in N.m/N.

(15 marks)

Question 5

The volume flow rate through the pump shown in Figure Q5, is $0.014m^3/s$. The fluid being pump is oil with a specific gravity of 0.85. Calculate the energy delivered by the pump to the oil per unit weight of oil flowing in the system. Neglect any energy losses in the system.

i. Find the specific weight of oil.

(5 marks)

ii. Determine the energy added to the system in SI unit.

(10 marks)

iii. Determine the power delivered by the pump to the oil in SI unit

(5 marks)

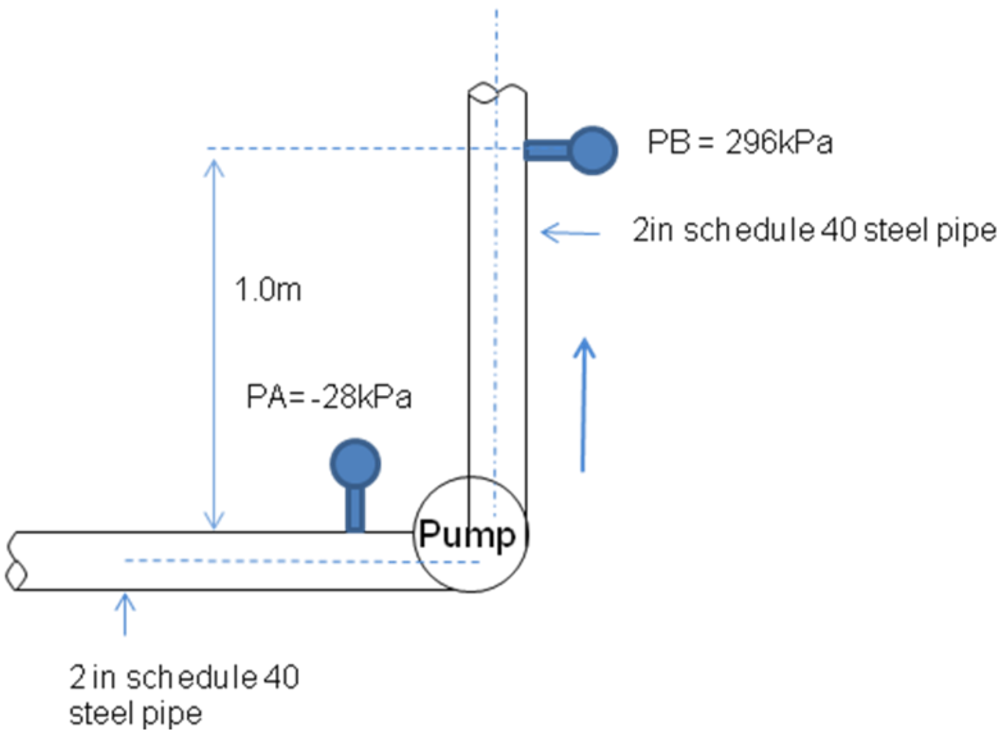

Figure Q5: Power of the pump

Question 6

Refer to Figure Q6 and using Appendix Technical document, type of pipe (refer appendix 4) is copper with a pipe diameter is 25mm. Water flowing at 70^{o}c where the average velocity of the flow is 4m/s.

(a) Calculate the Reynolds Number (N_R)

(6 marks)

(b) State the flow either laminar or turbulent flow. Why?

(4 marks)

(c) Plot and find the friction factor by using Moody's diagram (refer to Appendices document).
(Note: Detach the Moody's Diagram and attached with your answer sheet)

(10 marks)

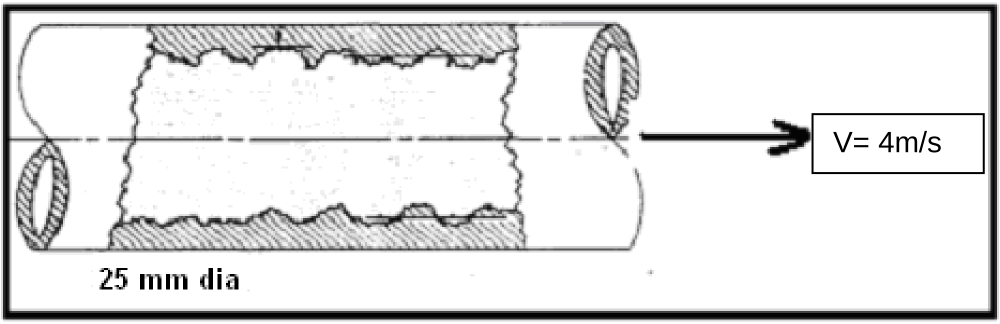

Figure Q6: Cooper pipe

END OF QUESTION

APPENDICES

Appendix Technical Document

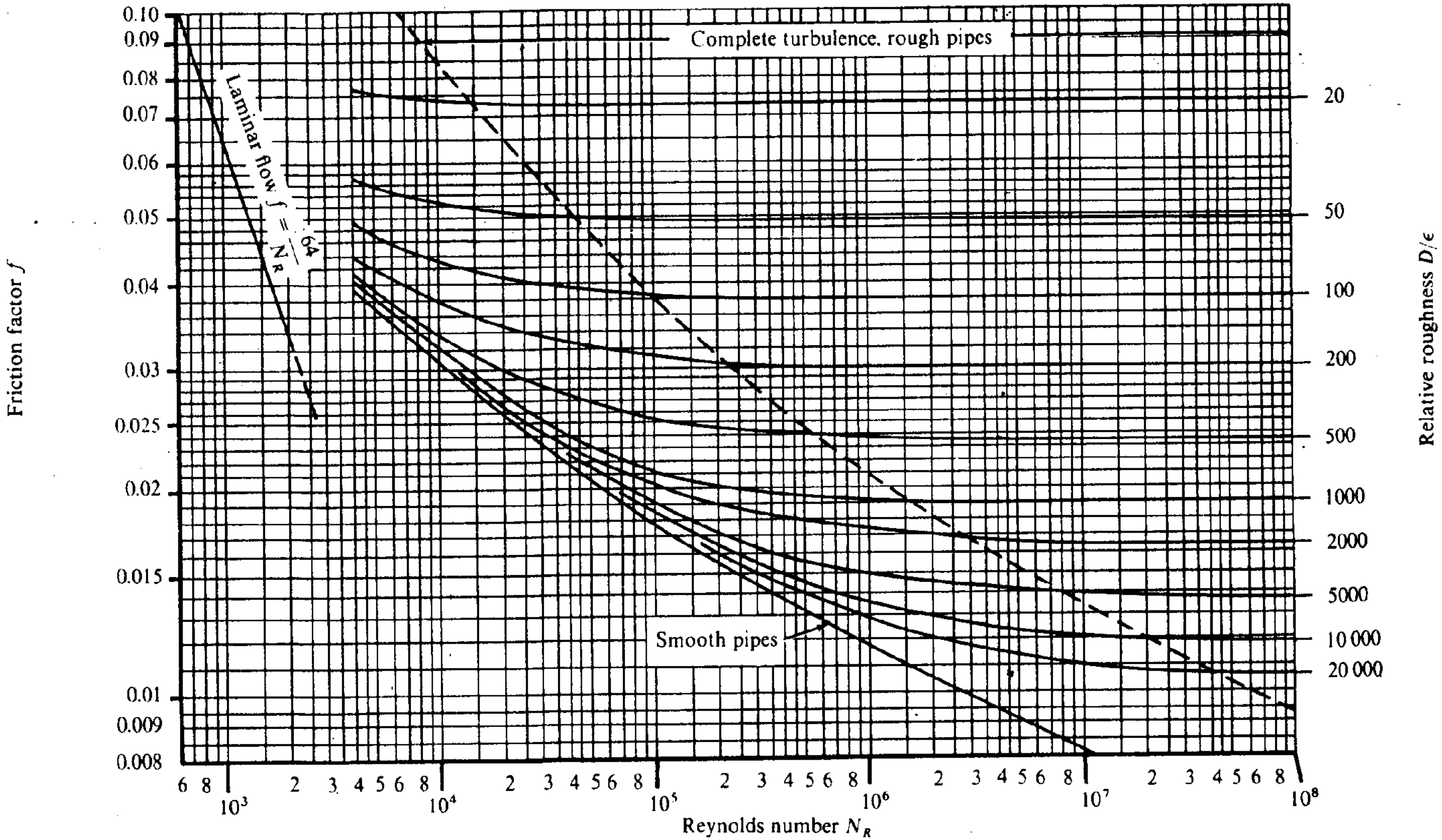

FIGURE 9.2
Moody's diagram. (Source: Pao, R. H. F. 1961. *Fluid Mechanics*. New York: John Wiley & Sons, p. 284)

Table of water properties in SI unit

TABLE A.1
SI Units [101 kPa (abs)]

Temperature (°C)	Specific Weight γ (kN/m^3)	Density ρ (kg/m^3)	Dynamic Viscosity μ ($Pa \cdot s$) or ($N \cdot s/m^2$)	Kinematic Viscosity ν (m^2/s)
0	9.81	1000	1.75×10^{-3}	1.75×10^{-6}
5	9.81	1000	1.52×10^{-3}	1.52×10^{-6}
10	9.81	1000	1.30×10^{-3}	1.30×10^{-6}
15	9.81	1000	1.15×10^{-3}	1.15×10^{-6}
20	9.79	998	1.02×10^{-3}	1.02×10^{-6}
25	9.78	997	8.91×10^{-4}	8.94×10^{-7}
30	9.77	996	8.00×10^{-4}	8.03×10^{-7}
35	9.75	994	7.18×10^{-4}	7.22×10^{-7}
40	9.73	992	6.51×10^{-4}	6.56×10^{-7}
45	9.71	990	5.94×10^{-4}	6.00×10^{-7}
50	9.69	988	5.41×10^{-4}	5.48×10^{-7}
55	9.67	986	4.98×10^{-4}	5.05×10^{-7}
60	9.65	984	4.60×10^{-4}	4.67×10^{-7}
65	9.62	981	4.31×10^{-4}	4.39×10^{-7}
70	9.59	978	4.02×10^{-4}	4.11×10^{-7}
75	9.56	975	3.73×10^{-4}	3.83×10^{-7}
80	9.53	971	3.50×10^{-4}	3.60×10^{-7}
85	9.50	968	3.30×10^{-4}	3.41×10^{-7}
90	9.47	965	3.11×10^{-4}	3.22×10^{-7}
95	9.44	962	2.92×10^{-4}	3.04×10^{-7}
100	9.40	958	2.82×10^{-4}	2.94×10^{-7}

Table of water properties in US unit

TABLE A.2
U.S. Customary System Units (14.7 psia)

Temperature (°F)	Specific Weight γ (lb/ft³)	Density ρ (slugs/ft³)	Dynamic Viscosity μ (lb-s/ft²)	Kinematic Viscosity ν (ft²/s)
32	62.4	1.94	3.66×10^{-5}	1.89×10^{-5}
40	62.4	1.94	3.23×10^{-5}	1.67×10^{-5}
50	62.4	1.94	2.72×10^{-5}	1.40×10^{-5}
60	62.4	1.94	2.35×10^{-5}	1.21×10^{-5}
70	62.3	1.94	2.04×10^{-5}	1.05×10^{-5}
80	62.2	1.93	1.77×10^{-5}	9.15×10^{-6}
90	62.1	1.93	1.60×10^{-5}	8.29×10^{-6}
100	62.0	1.93	1.42×10^{-5}	7.37×10^{-6}
110	61.9	1.92	1.26×10^{-5}	6.55×10^{-6}
120	61.7	1.92	1.14×10^{-5}	5.94×10^{-6}
130	61.5	1.91	1.05×10^{-5}	5.49×10^{-6}
140	61.4	1.91	9.60×10^{-6}	5.03×10^{-6}
150	61.2	1.90	8.90×10^{-6}	4.68×10^{-6}
160	61.0	1.90	8.30×10^{-6}	4.38×10^{-6}
170	60.8	1.89	7.70×10^{-6}	4.07×10^{-6}
180	60.6	1.88	7.23×10^{-6}	3.84×10^{-6}
190	60.4	1.88	6.80×10^{-6}	3.62×10^{-6}
200	60.1	1.87	6.25×10^{-6}	3.35×10^{-6}
212	59.8	1.86	5.89×10^{-6}	3.17×10^{-6}

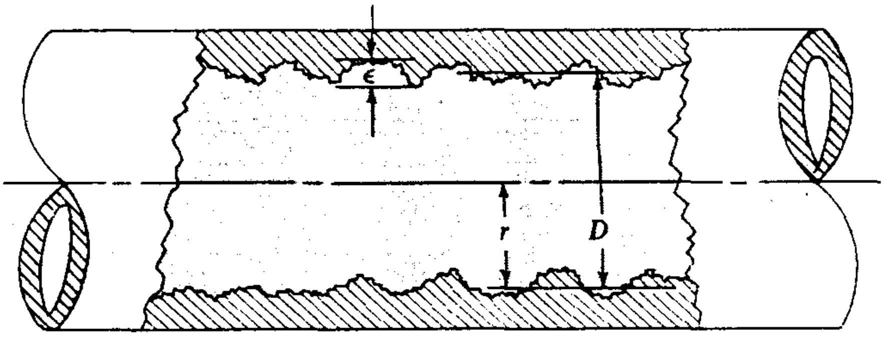

FIGURE 9.1
Pipe wall roughness.

TABLE 9.1
Pipe roughness—Design values

Material	Roughness, ϵ (m)	Roughness, ϵ (ft)
Glass, plastic	Smooth	Smooth
Copper, brass, lead (tubing)	1.5×10^{-6}	5×10^{-6}
Cast iron—uncoated	2.4×10^{-4}	8×10^{-4}
Cast iron—asphalt coated	1.2×10^{-4}	4×10^{-4}
Commercial steel or welded steel	4.6×10^{-5}	1.5×10^{-4}
Wrought iron	4.6×10^{-5}	1.5×10^{-4}
Riveted steel	1.8×10^{-3}	6×10^{-3}
Concrete	1.2×10^{-3}	4×10^{-3}

Formula:

- 1in= 0.0254m , 1000L=1m^3
- $P_{abs} = P_{atm} + P_{gage}$
- $P = \frac{F}{A}$ where P=Pressure, F=Force, A= C/S Area
- $S.G_s = \frac{\rho_s}{\rho_{water\_@\_4°C}}$ where S.G= spec.Gravity, ρ_s=density substance
- $S.G_s = \frac{\gamma_s}{\gamma_{water\_@\_4°C}}$ where S.G= spec.Gravity, γ = specific weight
- $\gamma = \rho g$ where ρ=density, g=gravity
- $Q = A v$ where Q=Volume flow ,rate A=C/S area, v= speed
- $\rho = \frac{m}{V}$ where ρ=density, m=mass, V=Volume
- $M = \rho A v$ where M=mass flow rate, ρ= density
- $W = \rho g V$ where W=weight, V=Volume
- $W = \gamma Q$ where W=weight flow rate, γ= specific weight
- $P = \rho g h$ where P= pressure, g=gravity, h= height
- $Conservation\_of\_energy: \frac{p_1}{\gamma} + z_1 + \frac{v_1^2}{2g} = \frac{p_2}{\gamma} + z_2 + \frac{v_2^2}{2g}$
- $General\_energy\_equation: \frac{p_1}{\gamma} + z_1 + \frac{v_1^2}{2g} + h_A - h_R - h_L = \frac{p_2}{\gamma} + z_2 + \frac{v_2^2}{2g}$
- $Power: P_A = h_A W = h_A \gamma Q; P_R = h_R W = h_R \gamma Q$

  where P_A=Added Power, P_R=Removed Power

- $mechanical\_efficiency: e_M = \frac{P_A}{P_i}; e_M = \frac{P_o}{P_R}$

  where P_i=power input, P_o=power output

- $Reynold's\_number: N_R = \frac{vD\rho}{\mu} = \frac{vD}{\upsilon}$
- $h_L = \frac{32\mu L v}{\gamma D_2} = f \times \frac{L}{D} \times \frac{v^2}{2g}$
- $minor\_loss: h_L = \frac{C_L v_1^2}{2g}$
- $loss\_coefficient: C_L = \left[1 - \left(\frac{A_1}{A_2}\right)^2\right]$