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CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2014 SESSION

SUBJECT CODE	:	FCD 20102
SUBJECT TITLE	:	FLUID MECHANICS
LEVEL	:	DIPLOMA
TIME / DURATION	:	(2 HOURS) 3.30 pm - 5.30 pm
DATE	:	29 MAY 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) questions only.
6. Answer questions in English.
7. Fomula is appended in the Appendices.

THERE ARE 5 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 and state the unit of all the fluid properties

i. Temperature

(4 marks)

ii. Density

(4 marks)

iii. Specific weight

(4 marks)

iv. Specific volume

(4 marks)

v. Specific gravity

(4 marks)

Question 2

a) A fluid has a density of 0.90 g/cm^3. What is its specific weight and specific gravity in SI unit?

(10 marks)

b) A cylinder 6in in diameter and 10in high contains oil that has a density of 850 kg/m^3. Determine the weight of the oil in SI unit?

(10 marks)

Question 3

a) Determine the difference value of pressure with point A and B. Answer in kPa.
If yA = 8830N/m3 , yB = 9806 N/m3, ym = 13330 N/m3, h1= 1m, h2 = 2m, h3= 1.5m.

(20 marks)

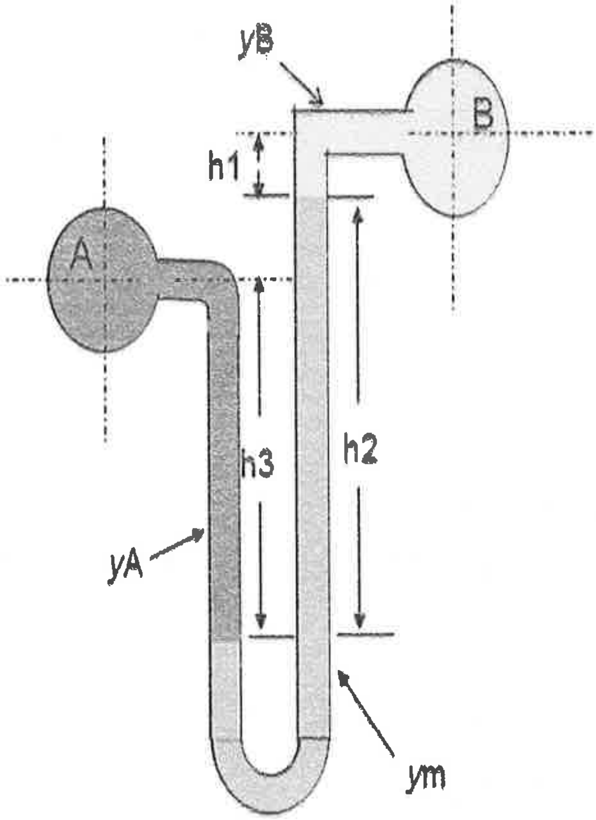

Figure Q3: Manometer

SECTION B (Total: 40 marks)

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

Question 4

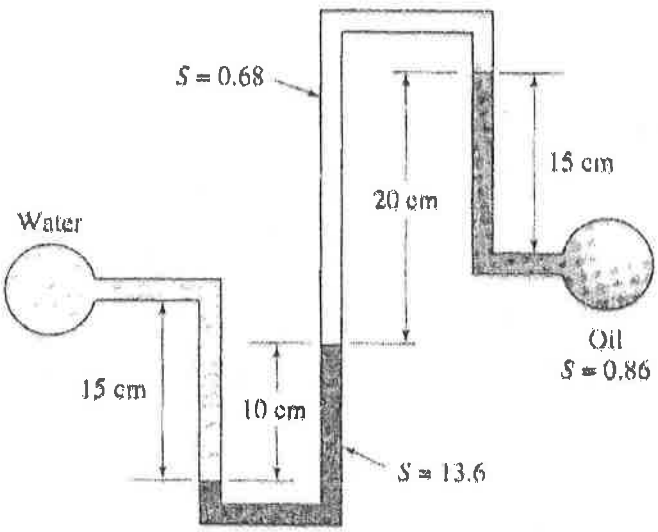

Figure Q4: Different Manometer

Refer Figure Q4, all the fluids are at 25° C.
Determine the pressure difference in KPa between water and oil pipe.

(20 marks)

Question 5

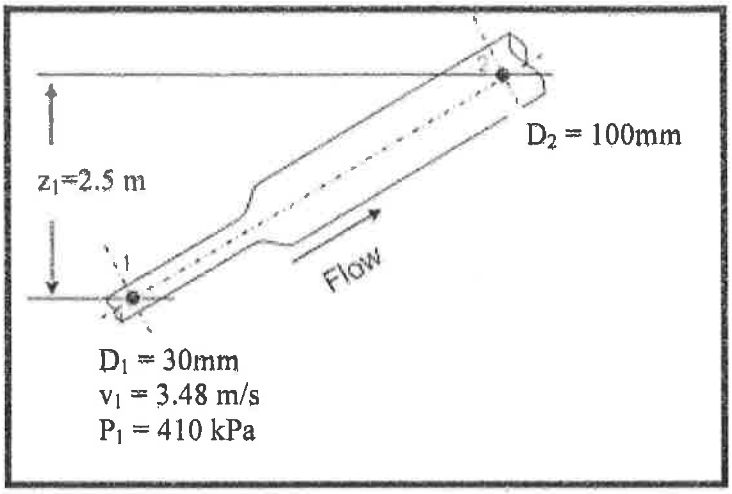

Figure Q5: Conservation of Bernoulli's

Figure Q5, show the water flow at 10 ^{0}C in section 1 to section 2 with diameter 30 mm and 100 mm respectively. About the velocity, consider at section 1 is 3.48 m/s and the pressure (section 1) is 410 kPa. The elevation at section 1 to section 2 is 2.5 m and assuming there is no energy loss in the system.

Calculate:-

(a) The velocity in m/s at section 2, V_2

(5 marks)

(b) The pressure in kPa at section 2, P_2

(7 marks)

(c) The volume flow rate, Q (in m^3/h) and prove it volume flow rate at section 1 and section 2 is same.

(8 marks)

Question 6

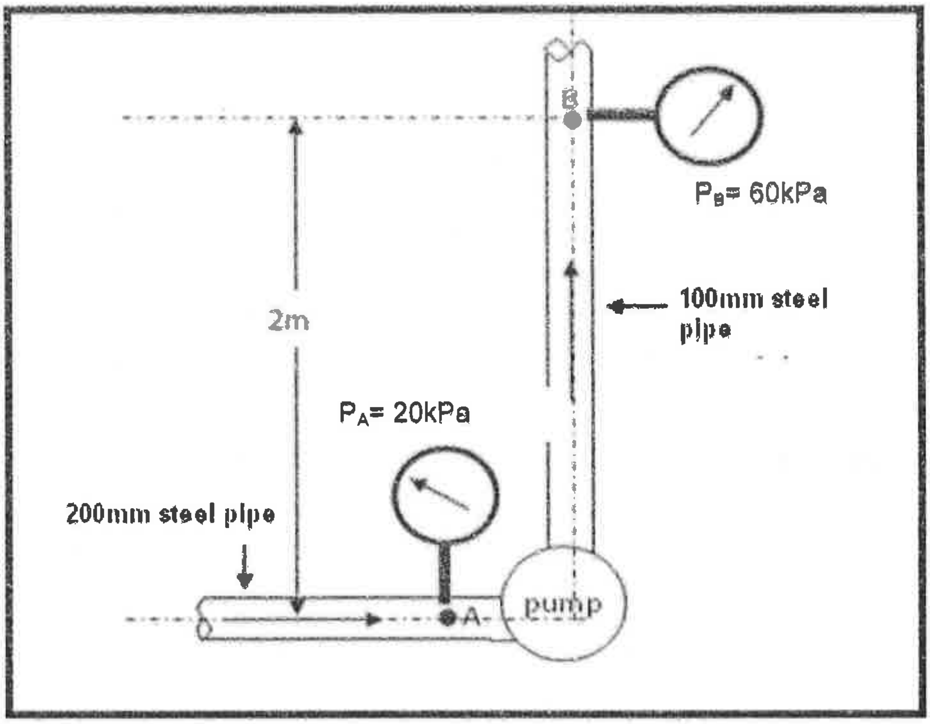

Figure Q6: Power of the pump

Refer to Figure Q6, the volume flow rate through the pump is 0.50 m^3/s, with the inner diameter pipe at A is 200mm and inner diameter pipe at B is 100mm. The fluid being pumped is oil with specific gravity; SG is 0.95. The elevation at section A to section B is 2 m. Pressure at section A and section B is 20 kPa and 60 kPa respectively.

Neglect any energy loss in the system

Calculate:-

a) The specific weight in N/m^3 for the oil, γ

(5 marks)

b) The head (energy) delivered, h_A by the pump in N.m/N

(8 marks)

c) The power delivered, P_A by the pump in kW

(7 marks)

END OF QUESTION

APPENDICES

Appendix 1: Moody's Diagram

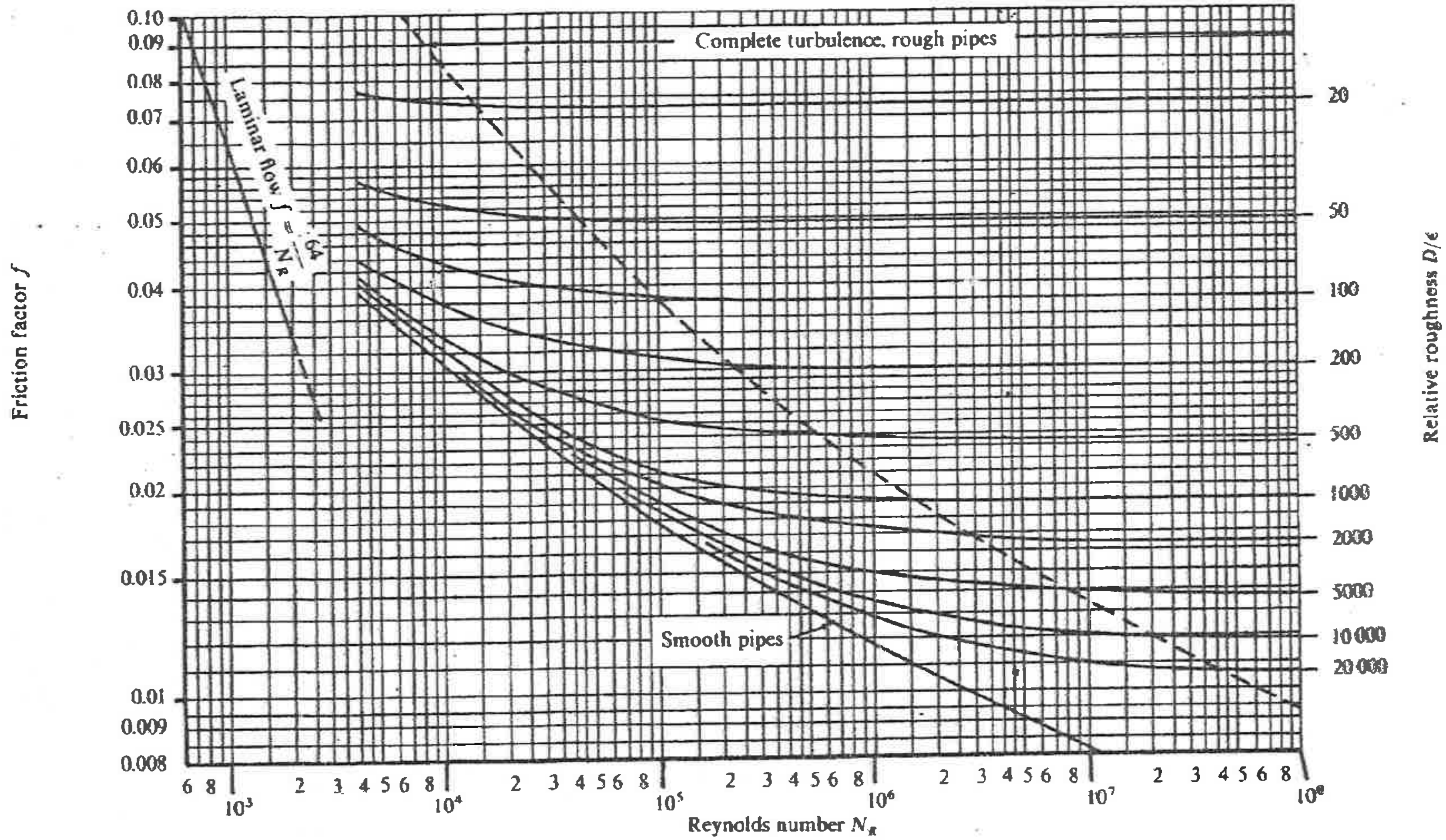

FIGURE 9.2
Moody's diagram. (Source: Pao, R. H. F. 1961. *Fluid Mechanics.* New York: John Wiley & Sons. p. 284)

Appendix 2: Table of water properties in SI unit

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

Temperature (°C)	Specific Weight γ (kN/m³)	Density ρ (kg/m³)	Dynamic Viscosity μ (Pa·s) or (N·s/m²)	Kinematic Viscosity ν (m²/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}

Appendix 3: 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}

Appendix 4: Pipe characteristic

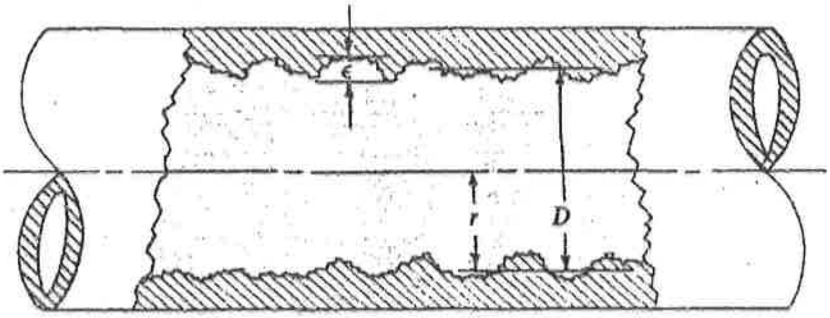

FIGURE 9.1
Pipe wall roughness.

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}

Appendix 5: 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
- $\text{Reynold's\_number}: N_R = \frac{vD\rho}{\mu} = \frac{vD}{\upsilon}$
- $h_L = \frac{32\mu L v}{\gamma D_2} = f \times \frac{L}{D} \times \frac{v^2}{2g}$
- $\text{minor\_loss}: h_L = \frac{C_L v_1^2}{2g}$
- $loss\_coefficient: C_L = \left[1 - \left(\frac{A_1}{A_2}\right)^2\right]$