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SET B

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

JANUARY 2011 SESSION

SUBJECT CODE	:	FCB 20302
SUBJECT TITLE	:	FLUID DYNAMICS
LEVEL	:	BACHELOR
TIME / DURATION	:	9.00am – 12.00pm (3 HOURS)
DATE	:	09 MAY 2011

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 illustrations.
5. Answer all questions in English.
6. Formula sheet is appended

THERE ARE 5 PAGES OF QUESTIONS, AND 1 PAGE OF APPENDIX, EXCLUDING THIS PAGE

INSTRUCTION: Answer ALL questions.

Please use the answer booklet provided.

Question 1

(a) Differentiate between Laminar Flow and Turbulent Flow

(4 marks)

(b) The maximum pressure that can be developed for a certain fluid power cylinder is 6 000 psi. Compute the required diameter for the piston if the cylinder must exert a force of 20 000 lb.

(6 marks)

Question 2

The system in Figure Q2 is at 25°C and atmospheric pressure is 101 kPa. The absolute pressure at the bottom of the tank is 130 kPa

(a) If the specific gravity of the Fluid X is 1.25, determine the value of X in cm.

(4 marks)

(b) If the X = 60 cm, calculate the density of the Fluid X in m^3/kg, hence compute the specific gravity and specific weight in kN/m^3 of the Fluid X

(6 marks)

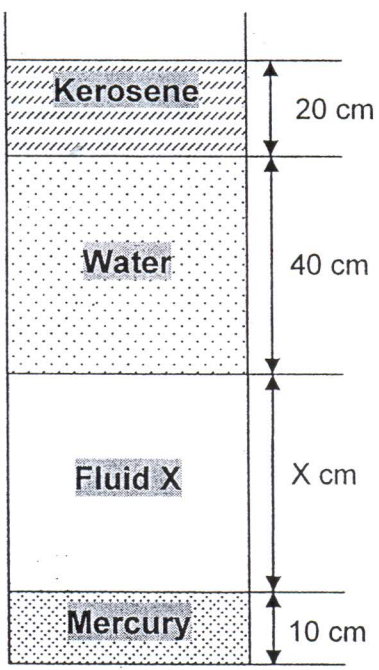


Figure Q2

Question 3

Figure Q3 shows a system in which water at 25 °C flows from a tank through a pipe system having several sizes and elevations from points A through G. Compute

(a) The volume flow rate through point G in m^3/s

(5 marks)

(b) Pressure at point B, C, D, E and F in kPa

(15 marks)

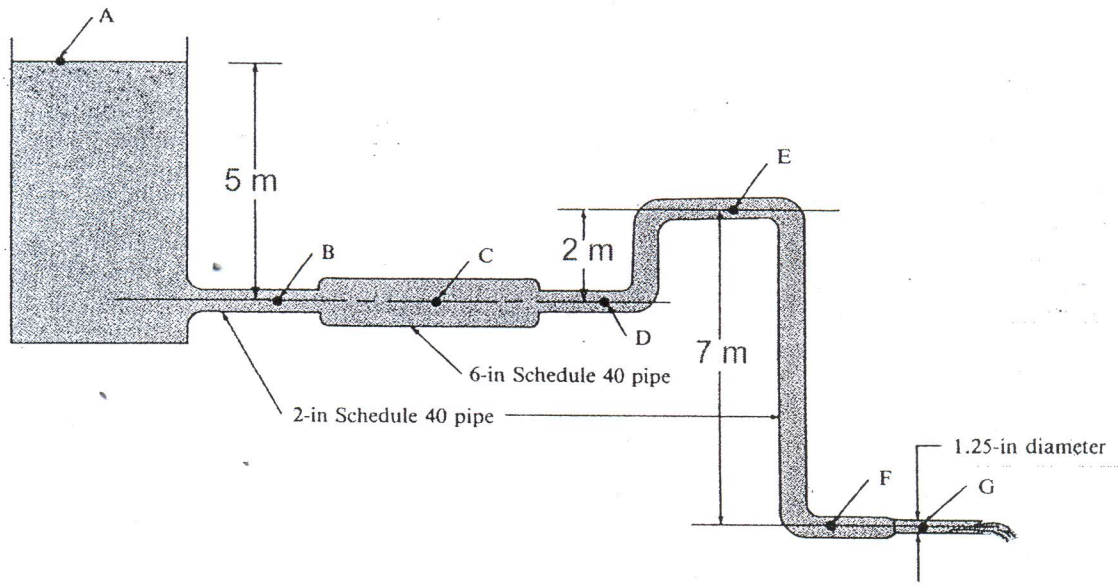


Figure Q3

Question 4

When the pump in Figure Q4 draws 220 m³/h of water at 20°C from the reservoir, the total friction head loss is 5 m. The flow discharges through a nozzle to the atmosphere. Find

(a) Velocity, V_e at the nozzle of the pipe in m/s

(3 marks)

(b) Pump head in meter

(7 marks)

(c) The pump power delivered to the water in kW and the efficiency of the pump if the required power for the pump is 40 kW

(10 marks)

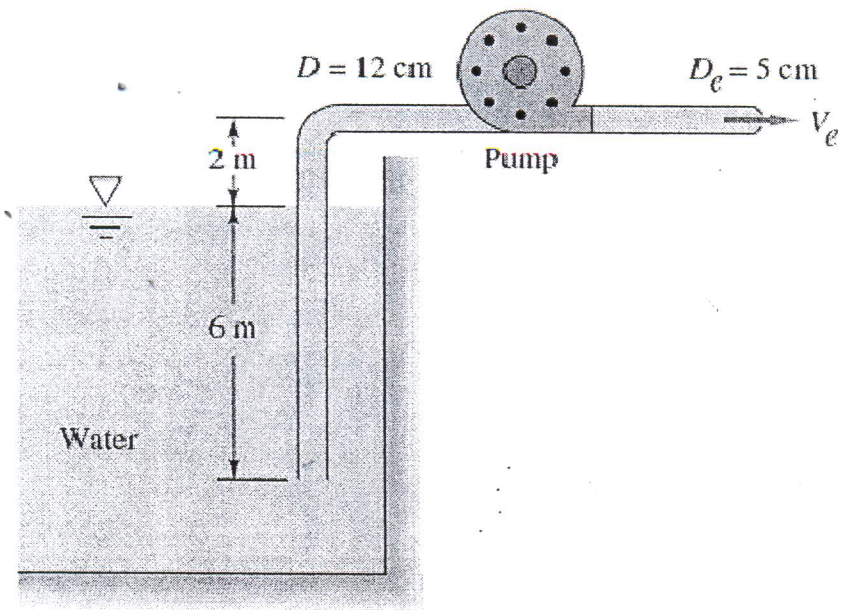


Figure Q4

Question 5

Referring Figure Q5 is a model of water cooled packaged chiller with reciprocating compressor. Return condenser water flows at 35°C through a 4" schedule 80 steel pipe to the cooling tower. The condenser water supply from cooling tower is at 30°C with flow rate of 35 L/s.

Assume that all the elbows are standard and all the butterfly valves are fully open, all check valves are a ball type and the pipe entrance from the condenser and basin of cooling tower is a square edge inlet type.

(a) Estimate density in kg/m³ and dynamic viscosity in Pa.s for supply and return condenser water

(5 marks)

(b) Calculate the Reynolds number for supply and return condenser water pipe. Determine whether the flow is laminar or turbulent

(5 marks)

(c) Calculate the friction factor and friction loss in meter of waterhead for supply condenser water pipe

(10 marks)

(d) Find the friction factor by plotting Moody's Diagram in the appendix and compute friction loss for return condenser water pipe

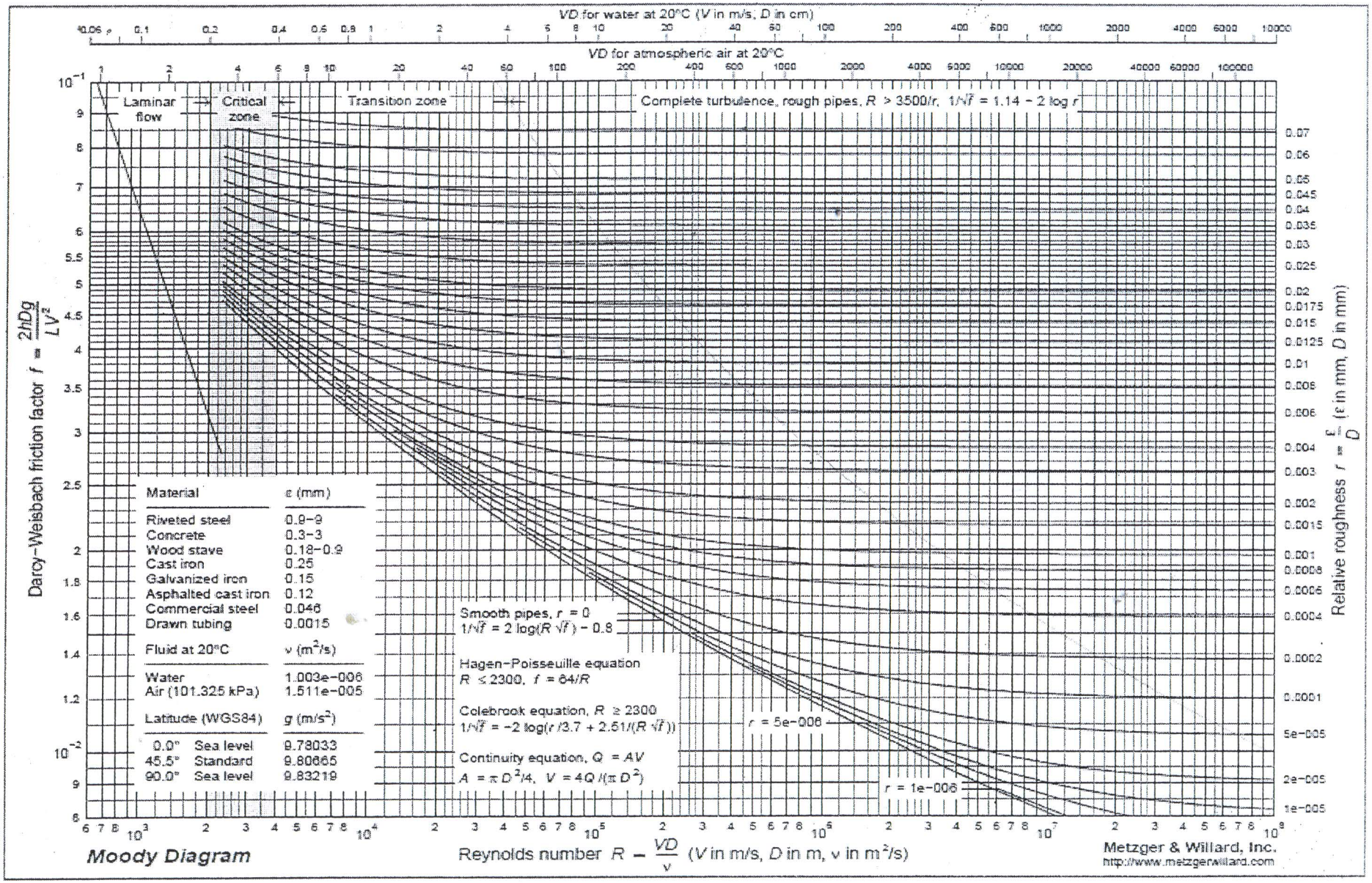
(Note: Moody's Diagram to be submitted together with answer booklet)

(10 marks)

(e) Determine the Total Energy Loss in the system in meter of waterhead

(10 marks)

APPENDIX


VD for water at 20°C (V in m/s, D in cm)
VD for atmospheric air at 20°C
Laminar flow
Critical zone
Transition zone
Complete turbulence, rough pipes, R > 3500/r, 1/√f = 1.14 − 2 log r
Darcy–Weisbach friction factor f = 2hDg/LV²
Relative roughness r = ε/D (ε in mm, D in mm)
Material ε (mm)
Riveted steel 0.9–9
Concrete 0.3–3
Wood stave 0.18–0.9
Cast iron 0.25
Galvanized iron 0.15
Asphalted cast iron 0.12
Commercial steel 0.046
Drawn tubing 0.0015
Fluid at 20°C ν (m²/s)
Water 1.003e−006
Air (101.325 kPa) 1.511e−005
Latitude (WGS84) g (m/s²)
0.0° Sea level 9.78033
45.5° Standard 9.80665
90.0° Sea level 9.83219
Smooth pipes, r = 0
1/√f = 2 log(R √f) − 0.8
Hagen–Poisseuille equation
R ≤ 2300, f = 64/R
Colebrook equation, R ≥ 2300
1/√f = −2 log(r/3.7 + 2.51/(R √f))
Continuity equation, Q = AV
A = π D²/4, V = 4Q/(π D²)
r = 5e−006
r = 1e−006
Moody Diagram
Reynolds number R = VD/ν (V in m/s, D in m, ν in m²/s)
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