

**FINAL  
ALTERNATIVE ASSESSMENT**

(COVER PAGE)

Session : April 2021

Programme : Diploma in Mechanical Engineering (DMEN)

Course : EGR2178: Fluid Mechanics 1

Date of Examination : 28 July 2021 (Wednesday)

Time : 4.00pm – 6.15pm Reading Time : Nil

Duration : 2 Hours 15 Minutes

**Special Instructions :**

This paper consists of **FOUR (4)** questions. Answer all **FOUR (4)** questions. All questions carry equal marks.

Material permitted : Non-Programmable Scientific Calculator

Materials provided : Nil

Examiner(s) : Mohammad Faiz Osrin

Chief Moderator : Iylia Elena Abdul Jamil

*This paper consists of 6 printed pages, including the cover page*

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)  
EGR2178: FLUID MECHANICS 1  
FINAL ALTERNATIVE ASSESSMENT: AUGUST 2021 SESSION

**Instructions:** This paper consists of **FOUR (4)** questions. Answer all **FOUR (4)** questions. All questions carry equal marks.

**Question 1**

(a) A Pitot-static probe inserted into the duct parallel to flow is used to measure air velocity in the duct of a heating system. The differential height between the water columns connected to the two outlets of the probe is 2.4 cm. Given air temperature and pressure in the duct are 45°C and 98 kPa, respectively. The density of water  $\rho=1000\text{kg/m}^3$  and gas constant of air  $R = 0.287\text{kPa}\cdot\text{m}^3/\text{kg}\cdot\text{K}$ . Determine

(i) the flow velocity

(8 marks)

(ii) the pressure rise at the tip of the probe.

(4 marks)

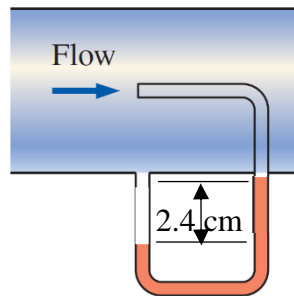


Figure Q1(a)

(b) A siphon pumps water from a large reservoir to a lower tank that is initially empty as shown in Figure Q1(b). The tank also has a rounded orifice shown in figure at 20 m below the reservoir surface where the water leaves the tank. Both the siphon and the orifice diameters are 0.02 m. Ignoring frictional losses, determine the maximum water level in the tank at equilibrium pressure.

(13 marks)

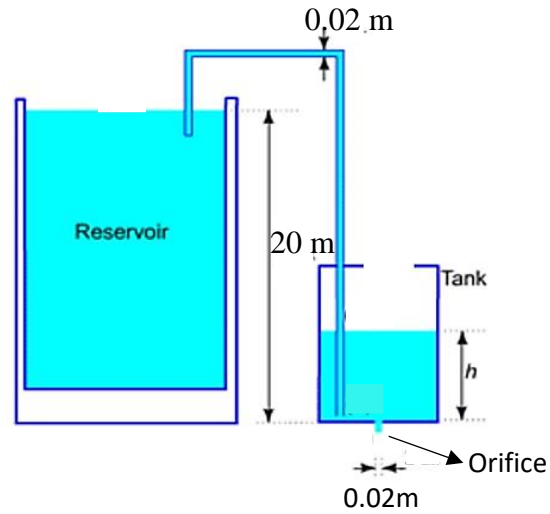


Figure Q1(b)

## Question 2

(a) Identify the primary dimensions of each of the following variables from the study of convection heat transfer as shown in Figure Q2(a). Determine

(i) heat generation rate,  $\dot{g}$

(4 marks)

(ii) heat flux,  $\dot{q}$

(4 marks)

(iii) heat transfer coefficient,  $h$

(4 marks)

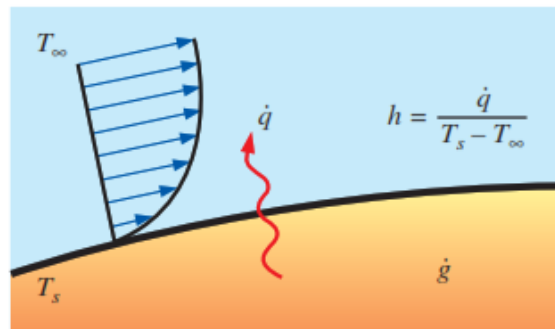


Figure 2(a)

- (b) A periodic Kármán vortex street is formed when a uniform stream flows over a circular cylinder. Given the Kármán vortex shedding frequency  $f_k$  as a function of free-stream speed  $V$ , fluid density  $\rho$ , fluid viscosity  $\mu$ , and cylinder diameter  $D$  as shown in Figure 3(b). Determine how the vortex shedding frequency depends on these using the method of repeating variables to generate dimensionless equation.

(13 marks)

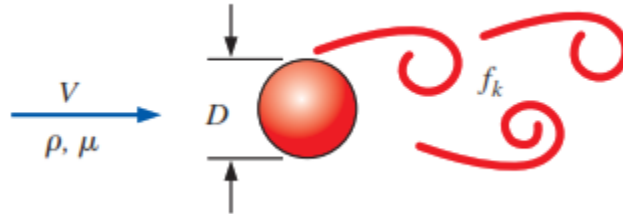


Figure 3(b)

**Question 3**

- (a) Water at  $20^\circ\text{C}$  flows upwards through the 50 mm diameter cast iron pipe at 5.88 kg/s as shown in Figure 4(a). The water is discharged into the atmosphere at B. Determine

- (i) the major head loss that occurs over the 8-m-long vertical segment,

(7 marks)

- (ii) the pressure at A

(3 marks)

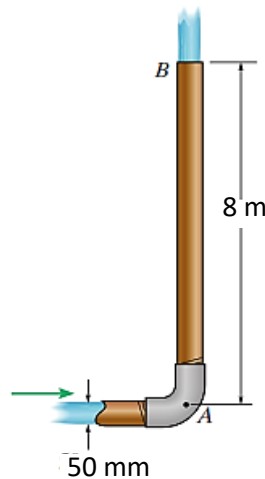


Figure 4(a)

(b) Water at  $10^{\circ}\text{C}$  ( $\rho = 999.7 \text{ kg/m}^3$  and  $\mu = 1.307 \times 10^{-3} \text{ kg/ms}$ ) is flowing steadily in a 0.12 cm diameter pipe as shown in Figure Q3(b). The length 15m-long pipe at an average velocity of 0.9 m/s as. Determine

(i) the pressure drop, (7 marks)

(ii) the head loss, (3 marks)

(iii) the pumping power requirement to overcome this pressure drop. (5 marks)

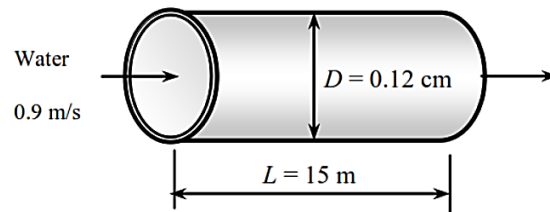


Figure Q3(b)

#### Question 4

(a) Air at  $20^{\circ}\text{C}$  is blowing at 2 m/s as it passes over the flat surface as shown in Figure Q4(a). From the distance of  $x = 0.5 \text{ m}$  from leading edge, determine

(i) the boundary layer thickness, (6 marks)

(ii) the displacement thickness of the boundary layer, (3 marks)

(iii) the velocity of the flow at half the boundary layer thickness. (4 marks)

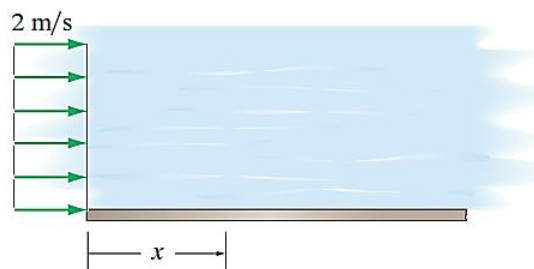


Figure Q4(a)

(b) The ship in Figure 7 below moving slowly at 0.2m/s through still water. Given kinematic viscosity,  $\nu = 1.10 \times 10^{-6} \text{ m}^2/\text{s}$ . Determine

(i) the thickness of the boundary layer at a point  $x = 1 \text{ m}$  from the bow,

(5 marks)

(ii) the velocity of the water within the boundary layer at  $y = \delta$ ,

(2 marks)

(iiy) the velocity of the water within the boundary layer at  $y = \delta/ 2$ .

(6 marks)

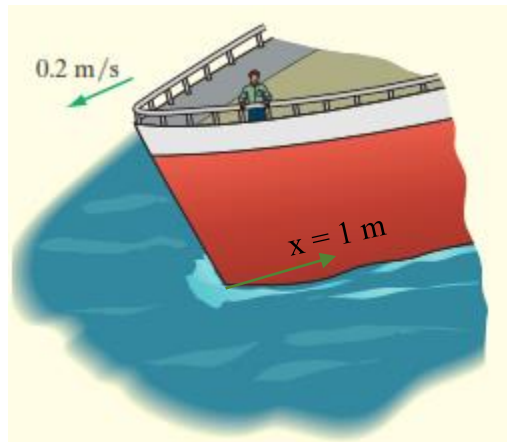


Figure Q4(b)

**~THE END~**

*EGR2178 (F)/ August2021 Session/ formatted*