TERTIARY AND VOCATIONAL EDUCATION COMMISSION

COMMON WRITTEN EXAMINATION – 2020/ 2021

Diploma in Construction Technology
NVQ Level 05 – Semester I

Hydraulics - 1	**F45C001M04**	**Three Hours**

Answer any 05 questions only

Density of water = 1000 kg/m^3

01. (a) Explain the difference between gage pressure and absolute pressure. **(04 marks)**

(b) Determine the atmospheric pressure at a location where the barometric reading is 735 mmHg. Take the density of mercury to be 13,600 kg/m^3. **(04 marks)**

(c) A pressure gage connected to a tank reads 400 kPa at the location mentioned in part (b). Determine the absolute pressure in the tank. **(04 marks)**

(d) A crane is to lower a vertical cylindrical pillar, of diameter 1.2 m, into position on a plinth submerged in water. The pillar has a mass of 5 tonnes. Calculate the tension experienced in the supporting cable when the lower end of the pillar is submerged to a depth of 2.3 m. **(08 marks)**

02. (a) The inside diameters of the pipe at sections 1 and 2 shown in the figure 1(a) are 50 mm and 100 mm, respectively. Water is flowing with an average velocity of 8.0 m/s at section 1.

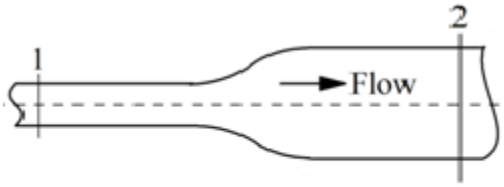

Figure 1(a)

Calculate the followings:

(i) Velocity at section 2 **(04 marks)**

(ii) Volume flow rate **(03 marks)**

(iii) Mass flow rate **(03 marks)**

(b)

In the pipe system which is used to transport an oil (ρ = 760 m^3/kg) shown in the figure 1(b), main pipe A is branched to small pipes B and C. The diameters of the pipes B and C are D_B = 0.3 m, D_C = 0.5 m and the volume flow rate in the main pipe is 0.6 m^3/s. If the ratio between the velocities in the branches v_B/v_C is 3, calculate the volume flow rate in the branch B.

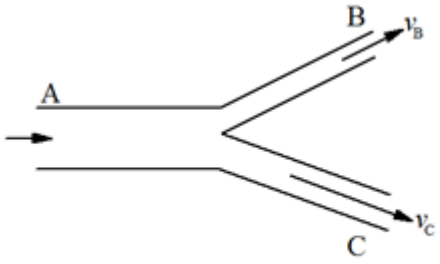

Figure 1(b)

(10 marks)

03. Figure 3(a) shows a siphon that is used to draw water from a swimming pool. The tube that makes up the siphon has an internal diameter of 40 mm and terminates with a 25 mm diameter nozzle. Assuming that there are no energy losses in the system.

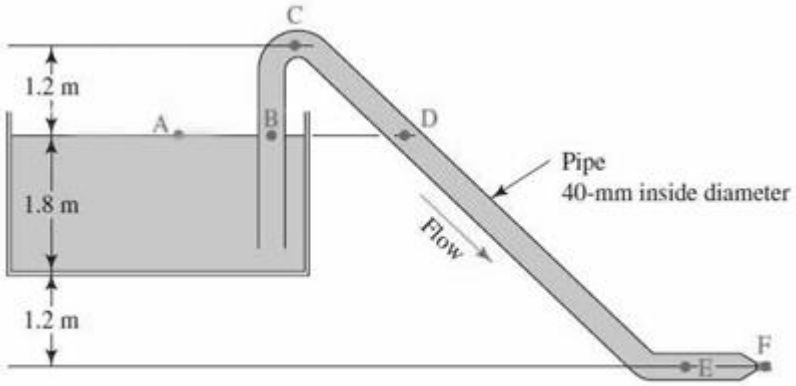

Figure 3(a)

(a) Find the velocity at the nozzle exit. **(08 marks)**

(b) Calculate the volume flow rate through the siphon. **(04 marks)**

(c) Calculate the guage pressure at point C **(08 marks)**

04. (a) A sharp-edged 60 mm diameter orifice is located in the vertical side of a large tank which discharges water under a head of 4.8 m. If Coefficient of contraction (C_c) = 0.64 and Coefficient of velocity (C_v) = 0.96. determine;

(i) The velocity of the jet at vena contracta **(06 marks)**

(ii) The discharge in m^3/s **(04 marks)**

(b) Two vertical plates (square and circular) used as gates to two separate pipes leading from a reservoir. In each case the centre of the plate is 3.2 m below the surface of the water.

Find the resultant hydrostatic force on

(i) the square plate of side 1.6 m **(03 marks)**

(ii) the circular plate of diameter 1.6 m. **(03 marks)**

(iii) Is the location of centre of pressure same for both the square plate and the circular plate? **(04 marks)**

05. (a) Describe "Forced vortex motion" with a suitable diagram. **(05 marks)**

(b) Consider a device with one inlet and one outlet. If the volume flow rates at the inlet and at the outlet are the same, is the flow through this device necessarily steady? Explain. **(05 marks)**

(c) Define external, internal and open-channel flows. **(05 marks)**

(d) Explain how uniform flow differs from varied flow in open channels. In what kind of channels is uniform flow observed? **(05 marks)**

06. (a) A 0.70 m high broad-crested weir is used to measure the flow rate of water in a 4 m wide rectangular channel. The flow depth well upstream from the weir is 1.6 m. If the weir discharge coefficient (C_{wd}) is 0.45, determine the flow rate through the channel. **(05 marks)**

(b) What is a sharp-crested weir? On what basis are the sharp-crested weirs classified? Explain. **(05 marks)**

(c) (i) The flow rate of water flowing in a 4 m wide channel is to be measured with a V- notch weir 0.8 m above the channel bottom with a notch angle of 80^0. If the flow depth upstream from the weir is 1.5 m,

determine the flow rate of water through the channel. Take the weir discharge coefficient to be 0.57

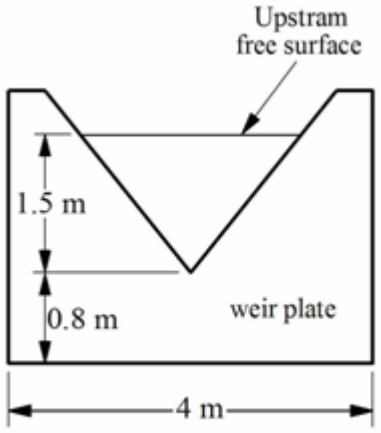

Figure 6(c)

(05 marks)

(ii) If the above V-notch weir is replaced by sharp crested rectangular weir with the discharge coefficient 0.73, determine the new flow rate. Assume the same weir head. Crest width is 3 m. **(05 marks)**

07. Water flows in a channel whose bottom slope is 0.003 and whose cross section is shown in the figure 7. The dimensions and the Manning coefficients for the surfaces of different subsections are also given on the figure.

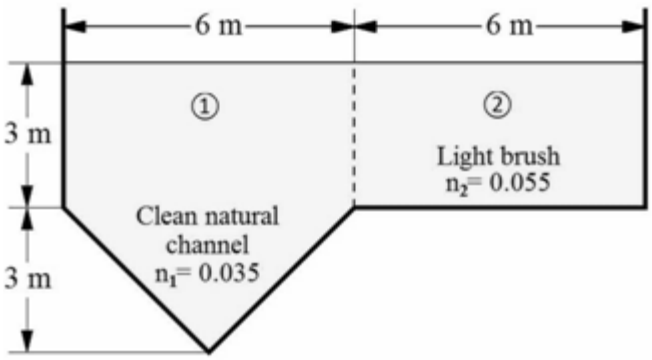

Figure 7

Determine;

(a) Hydraulic radius for each subsection. **(04 marks)**

(b) Flow rate through the entire channel **(10 marks)**

(c) Effective manning coefficient for the entire channel **(06 marks)**