UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	FLUID MECHANICS
COURSE CODE	:	BNP 10303
PROGRAMME CODE	:	BNA/BNB/BNC
EXAMINATION DATE	:	JULY/AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1.ANSWER **ALL** QUESTIONS 2.THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK.** 3.STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) Explain in detail how surface tension occurs in a water droplet.

(6 marks)

(b) A 5 m high, 6 m wide rectangular gate is hinged at the top edge at A and is restrained by a fixed ridge at B as shown in **Figure Q1(b).** Determine the hydrostatic force exerted on the gate by the 8 m high water.

(8 marks)

(c) An inclined rectangular gate (1.5 m wide) as shown in **Figure Q1(c)** contains water on one side. Analyse the total resultant force acting on the gate and the location of centre of pressure.

(11 marks)

Q2 (a) Describe briefly **THREE (3)** limitations of using the Bernoulli Equation.

(6 marks)

(b) Water discharges to the atmosphere from the orifice at the bottom of a pressurized tank as shown in **Figure Q2(b)**. Assuming frictionless flow, determine he discharge rate of water from the tank.

(8 marks)

(c) A water flows in a pipe, which bend to the horizontal axis at 45°. The inlet pipe's diameter is 700 mm and reduce to 250mm in the end. Given the inlet's pressure and flow rate are 160 kPa and 0.545 m^3/s respectively. Neglecting the friction, calculate the resultant force at the bend.

(11 marks)

Q3 (a) Distinguish **FOUR (4)** characteristics between laminar and turbulent flow.

(8 marks)

(b) A pipe with a diameter of 250 mm was used to flow 63 kg/s crude oil with a density and kinematic viscosity of 988 kg/m^3 and 2.7×10^{-4} m^2/s, respectively. Calculate the Reynolds number of the flow.

(6 marks)

(c) Water flows in galvanized iron pipe with 315 mm diameter and 100 m length at a flowrate of 0.45 m^3/s. By using moody chart, estimate the friction head loss if the kinematic viscosity is 2.27×10^{-6} m^2/s.

(11 marks)

Q4 (a) Energy line (EL) is the total head while hydraulic grade line (HGL) is the piezometric head for a certain cross section in a system.

(i) Define **THREE (3)** forms of energy develop in a pipe system.

(ii) Show the EL, HGL, and energy development in a pipe system.

(8 marks)

(b) The flow into and out of a loop pipe system is shown in **Figure Q4(b)** with the k values for each pipe were given and n = 2. Analyse the flow in each pipe and $\triangle Q$ from first trial by using Hardy Cross Method.

(11 marks)

(c) The drag force on a submarine, which is moving on the surface, is to be determined by a test on a model which is scaled down to one-twentieth of the prototype with the speed of 2.6 m/s. The test is to be carried in a towing tank, where the model submarine is moved along a channel of liquid.

(i) Show the dynamic similarity between prototype and model by using Froude number.

(ii) Calculate the speed at which the model should be moved in the towing tank.

(6 marks)

- END OF QUESTIONS -

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2022/2023
COURSE NAME : FLUID MECHANICS
PROGRAMME CODE : BNA/BNB/BNC
COURSE CODE : BNP 10303

FIGURE

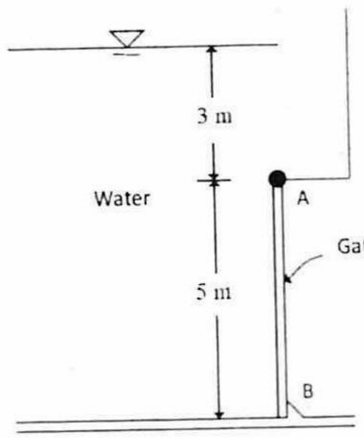

Figure Q1 (b) A water gate.

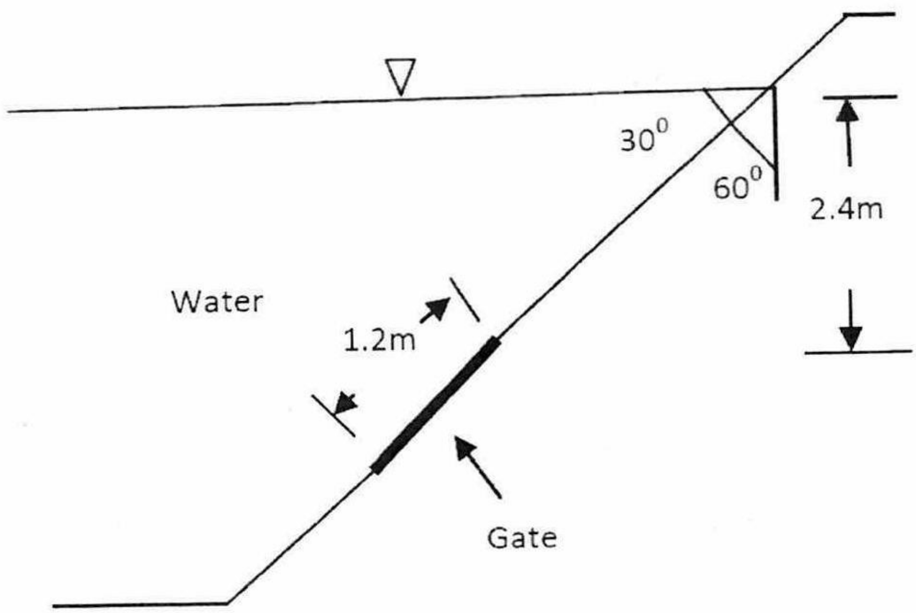

Figure Q1 (c) An inclined rectangular gate.

TERBUKA

FINAL EXAMINATION

SEMESTER/SESSION : SEM II/ 2022/2023
COURSE NAME : FLUID MECHANICS
PROGRAMME CODE : BNA/BNB/BNC
COURSE CODE : BNP 10303

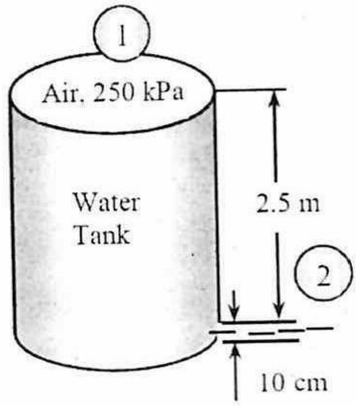

Figure Q2 (b) A water tank.

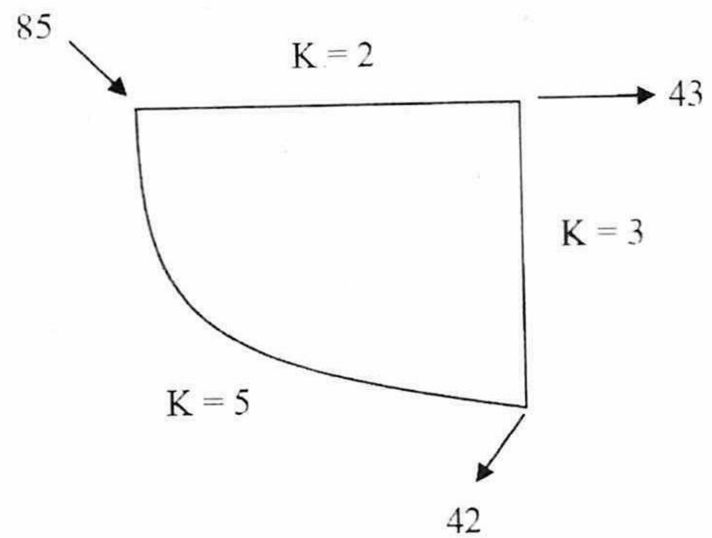

Figure Q4 (b) A loop pipe system.

FINAL EXAMINATION	
SEMESTER/SESSION : SEM II / 2022/2023 COURSE NAME : FLUID MECHANICS	PROGRAMME CODE : BNA/BNB/BNC COURSE CODE : BNP 10303

FORMULA

$Q = \frac{m}{\rho}$ $V = \frac{Q}{A}$ $R = \frac{VD}{\nu}$ $\varepsilon = \frac{e}{D}$ $h_f = \frac{fLV^2}{2gD}$

$h_L = KQ^n$ $n|KQ^{n-1}|$ $\Delta Q = -\sum h_L / \sum n h_L = -\sum KQ^n / \sum n[KQ^{n-1}]$

$F_r = \frac{V}{\sqrt{gL}}$ $Q = AV$ $a_{circle} = \frac{\pi D^2}{4}$ $F = m\,(v_2 - v_1)$ $F_x = \rho g H_c A$

$Re = \frac{\rho V D}{\mu} = \frac{DV}{\nu}$ $F_r = \frac{V}{\sqrt{gL}}$ $h_f = f\left(\frac{L}{D}\right)\frac{V^2}{2g}$ $y_R = \frac{I_{xc}}{y_c} + y_c$

$H = \frac{P}{\gamma} + z + \frac{V^2}{2g}$ $h_k = k\frac{v^2}{2g}$ $F = \sqrt{F_x^{\ 2} + F_y^2}$ $F_y = \rho g V$

$P_1A_1 - P_2A_2\cos\theta - Fx = \rho Q(v_2 \text{kos}\,\theta - v_1)$ $-P_2A_2\sin\theta + Fy = \rho Q(v_2\sin\theta - 0)$

$F_x = \rho g A\bar{x}$ $\phi = \tan^{-1}\frac{F_y}{F_x}$ $bh^3/12$

$R = \rho g V$ $\rho = \frac{M}{V}$ $P = \rho g h$ $\gamma = \rho g$

$V = \sqrt{2gh}$ $h_L = H - \frac{V_a}{2g}$ $F_r = \frac{V}{\sqrt{gL}}$

$\nu = \mu/\rho$ $\tau = \mu\ (du/dy)$

$Q = C_d a\sqrt{2gH}$ $m = \rho A V$ $P = F/A$ $W = mg$

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2022/2023 PROGRAMME CODE :BNA/BNB/BNC
COURSE NAME : FLUID MECHANICS COURSE CODE : BNP 10303