UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	GROUND WATER ENGINEERING
COURSE CODE	:	BFW40403
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JUNE/ JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS IN **PART A** AND **THREE (3)** QUESTIONS IN **PART B**

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

PART A

Q1 (a) Briefly describe the reason why the pH value measurement must be monitored for groundwater quality.

(3 marks)

(b) Explain **THREE (3)** factors affecting the movement of contamination to groundwater.

(9 marks)

(c) Point out some tips to protect and conserve groundwater for daily life.

(4 marks)

(d) Revise **THREE (3)** approaches for the protection of groundwater resources in terms of pollution prevention.

(9 marks)

PART B

Q2 (a) List **FIVE (5)** properties to identify the types of aquifer in measure of the productivity.

(5 marks)

(b) Illustrate with the aid of sketches the following;

(i) Soil water zone
(ii) Zone of saturation
(iii) Groundwater table

(6 marks)

(c) Distinguish between unconfined and confined aquifer.

(6 marks)

(d) During one year, the water balance terms for a lake include rainfall P = 1040 mm/year, evaporation E = 720 mm/year, surface inflow I = 55 mm/year, surface outflow O = 135 mm/year, and change in storage ΔS = 60 mm/year. Design the net groundwater flow for the lake.

(8 marks)

Q3 (a) Construct a simple method to find water underground.

(4 marks)

(b) Relate **THREE (3)** characteristics of groundwater and surface water interacts according to surface water bodies, water movement and quantity effects.

(6 marks)

(c) Based on your understanding, rewrite according to statement *"Surface water and groundwater systems are connected in most landscapes"*.

(6 marks)

(d) Consider **THREE (3)** factors of groundwater interacts for two wells system built in sandy clay layer (40m deep) using indirect recharge method as shown in **Table Q3(d).**

(9 marks)

Q4 (a) Differentiate **TWO (2)** characteristics between discharge and recharge in terms of unsteady flow.

(4 marks)

(b) Give an example of each of the following main factors concerning the ability the ground condition to hold water:

(i) porosity

(ii) permeability

(6 marks)

(c) A cylindrical field sample of an unconfined aquifer with length of 60 cm and diameter of 20 cm is tested for a period of 10 minutes under a constant head difference of 15 cm. The pore diameter and effective porosity is found to be, 0.037 cm and 0.1, respectively. If the hydraulic conductivity K computed is 1.736×10^{-3} cm/min,

(i) Assemble the type of material of the aquifer by refering to **Table Q4(c)**.

(5 marks)

(ii) Appraise the applicability of Darcy's law if dynamic viscosity and density of water are 1.005×10^{-3} kg/ms and 998.2 kg/m^3, respectively.

(10 marks)

Q5 (a) Identify **THREE (3)** purposes of test pumping water well.

(3 marks)

(b) Water flows through a sand aquifer15 m deep and 1 km wide with a piezometric head gradient of 0.01. If the hydraulic conductivity and effective porosity of the aquifer are $2\,m/day$ and 0.3 respectively, estimate the specific discharge, seepage velocity, the volumetric flowrate and time it take the groundwater to move 100 m.

(7 marks)

(c) Analyse the permeability of an artesian unconfined aquifer being pumped by a fully penetrating well. The steady state pumping rate is 300m^3/hr. The drawdown at an observation well 50 m away is 40 m whilst in a second observation well 100 m away is 43 m. Sketch the section view of wells and groundwater profile.

(8 marks)

(b) After a period of pumping at a rate of 120 m^3/hour, the drawdowns in observation wells of 15 m and 30 m distance from the pumped well are found to be 1.0 m and 0.75 m, respectively. Estimate the transmissivity of the aquifer.

(7 marks)

- END OF QUESTIONS –

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TABLES

Table Q3(d): Discharge and recharge records

Well	Discharge (m^3/d)	Recharge(m^3/d)	Recharge (%)
W1	40	7.43	19
W2	100	12.1	12

Table Q4(c): Hydraulic conductivity values

Material	K (cm/sec)
Gravel	10^{-1} to 100
Clean sand	10^{-4} to 1
Silty sand	10^{-5} to 10^{-1}
Silt	10^{-7} to 10^{-3}
Glacial till	10^{-10} to 10^{-4}
Clay	10^{-10} to 10^{-6}

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EQUATIONS

$$Q = qA \quad \mathrm{Re} = \frac{\rho VD}{\mu} \quad v = \frac{q}{n_e} \quad t = \frac{distance}{velocity}$$

$$K = \frac{Q}{\pi\left(h_2^2 - h_1^2\right)} \ln\left(\frac{r_2}{r_1}\right)$$

$$T = \frac{Q}{2\pi(h_2 - h_1)} \ln\left(\frac{r_2}{r_1}\right)$$

$$A = \frac{\pi D^2}{4} \quad Q_s = -K_s \frac{dh}{ds} A$$

$$d = \frac{L}{2} - \frac{K}{W} \frac{\left(h_1^2 - h_2^2\right)}{2L}$$

$$h_{\max}^2 = h_1^2 - \frac{\left(h_1^2 - h_2^2\right)d}{L} + \frac{W}{K}(L-d)d$$

$$V_a = \frac{K}{n_e} \frac{\Delta h}{\Delta x} \quad t = \frac{L_A}{V_A} \quad K_{eq} = \frac{\Sigma H}{\Sigma \frac{H}{K}}$$

$$Q = \frac{\pi K({h_2}^2 - {h_1}^2)}{\ln \frac{r_2}{r_1}}$$

$$Q = \frac{\pi K({H_1}^2 - {h_w}^2)}{\ln \frac{r_1}{r_w}}$$

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