UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013

COURSE NAME	:	GROUNDWATER ENGINEERING
COURSE CODE	:	BFW4043 / BFW40403
PROGRAMME	:	4BFF
EXAMINATION DATE	:	JULY 2013
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** FROM FIVE (5) QUESTIONS

THIS QUESTION PAPER CONSISTS OF **ELEVEN (11)** PAGES

Q1 (a) Define aided with sketch diagrams the following.

(i) Static water level
(ii) Drawdown
(iii) Dynamic water level
(iv) Cone depression

(8 marks)

(b) Outline **FIVE (5)** explanations the importance of groundwater studies.

(10 marks)

(c) During one year, the water balance for a lake are 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. Compute the net groundwater flow for the lake.

(7 marks)

Q2 (a) Discuss **FOUR (4)** reasons why groundwater is not fully utilized in Malaysia.

(8 marks)

(b) A cylindrical field sample of an unconfined aquifer with length 50 cm and diameter 10 cm is tested for a period of 6 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 5.556×10^{-3} cm/min,

(i) Categorize the type of material of the aquifer.

(9 marks)

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

(5 marks)

(iii) Compute the volume of water (in litre) collected at the outlet of the test apparatus.

(3 marks)

Q3 An unconfined aquifer of clean sand and gravel is located between two fully penetrating rivers with hydraulic conductivity, $K = 1 \times 10^{-2}$ cm/s. The length of the aquifer, L= 460 m. The aquifer is subjected to a uniform recharge of 1.6 m/year. The water surface elevations in rivers *A* and *B* are 8.5 m and 10.7 m, respectively, above the bottom. Estimate:

(a) the Darcian velocity of the unconfined aquifer referring to the heads from rivers (Unit in m/day)

(5 marks)

(b) the maximum elevation of the water table and the location of groundwater , and

(10 marks)

(c) divide the travel times from groundwater divide to both rivers ($n_e = 0.38$),

(10 marks)

Q4 (a) Explain the main purpose of using the Theim Equation

(2 marks)

(b) Derive the Theim equation by using Darcy's law.

(15 marks)

(c) After a period of pumping at a rate 110 m^3/hour, the drawdowns in wells 15 m and 30 m from the pumped well were found to be 1.0 m and 0.75 m, respectively. If the diameter and depth of the pumped well are 0.5 m and 15 m below the static water table, respectively, determine the transmissivity of the aquifer.

(8 marks)

Q5 (a) Explain the differences between Theim and Theis equation in groundwater analysis.

(4 marks)

(b) As a result of a storm, a culvert beneath a road has become packed with sand from end to end. The culvert is 5 m long and 0.8 m in diameter. The sand in it is estimated to have a hydraulic conductivity K = 3 m/day and an effective porosity n_e = 0.38. The water level at one end of the culvert is 1.6 m higher than at the other end, and the entire culvert is below water. Compute the discharge and the average velocity through the culvert.

(5 marks)

(c) A 0.46 m diameter well was used to pump water from a confined aquifer at 0.38 m^3/min. The drawdowns recorded at observation wells located at 15.24 and 60.96 m from the pumping well were 3.05 m and 2.44 m, respectively.

(i) Determine the transmissivity value of the aquifer.
(ii) Determine the drawdown at the pumping well.

(16 marks)

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Typical Values of Hydraulic Conductivity

Material	Hydraulic conductivity (m/day)
Gravel, coarse	150
Gravel, medium	270
Gravel, fine	450
Sand, coarse	45
Sand, medium	12
Sand, fine	2.5
Silt	0.08
Clay	0.0002
Sandstone, fine-grained	0.2
Sandstone, medium-grained	3.1
Limestone	0.94
Dolomite	0.001
Dune sand	20
Loess	0.08
Peat	5.7
Schist	0.2
Slate	0.00008
Till, predominantly sand	0.49
Till, predominantly gravel	30
Tuff	0.2
Basalt	0.01
Gabbro, weathered	0.2
Granite, weathered	1.4

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Supplementary Equations

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

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

$$\mathrm{Re} = \frac{\rho V D}{\mu}$$

S1 (a) Definisi pernyataan di bawah dengan bantuan rajah seperti berikut.

(i) Paras air statik
(ii) Penyusutan
(iii) Paras air dinamik
(iv) Kon penyusutan

(8 markah)

(b) Nyatakan **LIMA (5) penjelasan kepentingan kajian airbumi.**

(10 markah)

(c) Dalam satu tahun, imbangan air bagi sebuah tasik ialah hujan $P = 1040$ mm/tahun, sejatan $E = 720$ mm/tahun, aliran permukaan masuk $I = 55$ mm/tahun, aliran permukaan keluar $O = 135$ mm/tahun, dan perubahan takungan $\Delta S = 60$ mm/tahun. Kira aliran air bumi bersih untuk tasik tersebut.

(7 markah)

S2 (a) Huraikan **EMPAT (4)** sebab mengapa air bumi tidak digunakan sepenuhnya di Malaysia.

(8 markah)

(b) Satu sampel tanah akuifer tak terkurung dengan panjang 50 cm dan diameter 10 cm diuji selama 6 minit dengan perbezaan turus 15 cm secara malar. Diameter liang dan keliangan berkesan ialah 0.037 cm dan 0.1, masing-masing. Jika konduktiviti hidraulik K yang diperolehi ialah 5.556×10^{-3} cm/min,

(i) Kategorikan jenis bahan akuifer tersebut.

(9 markah)

(ii) Tentukan sama ada hukum Darcy boleh digunakan jika kelikatan dinamik dan ketumpatan air ialah 1.005×10^{-3} kg/ms dan 998.2 kg/m^3, masing-masing.

(5 markah)

(iii) Kira isipadu air (dalam liter) yang dikumpulkan di salur keluar peralatan ujikaji.

(3 markah)

S3 Akuifer tak terkurung yang berpasir dan berkelikir terletak diantara dua buah sungai yang dalam menerobosi lapisan akuifer tersebut dengan nilai kebolehtelapan $K = 1 \times 10^{-2}$ cm/s. Panjang akuifer, L= 460 m. Akuifer tersebut menerima imbuhan yang seragam sebanyak 1.6 m/tahun. Paras ketinggian air permukaan pada sungai A dan B adalah 8.5 m and 10.7 m daripada datum di bawah. Anggarkan:-

(a) halaju "darcian" bagi akuifer terkurung merujuk kepada turus dari sungai-sungai tersebut. (unit dalam m/hari)

(5 markah)

(b) Paras ketinggian maksima paras airbumi dan jarak lokasi maksima tersebut.

(10 markah)

(c) Masa pergerakan daripada pembahagian airbumi kepada sungai-sungai tersebut ($n_e = 0.38$)

(10 markah)

S4 (a) Terangkan tujuan utama penggunaan persamaan Theim.

(2 markah)

(b) Huraikan persamaan Theim dengan menggunakan hukum Darcy.

(15 markah)

(c) Selepas satu tempoh pengepaman pada kadar 110 m^3/jam, air yang surut dalam telaga-telaga yang berjarak 15 m dan 30 m daripada telaga yang dipam ialah 1.0 m dan 0.75 m, masing-masing. Jika diameter dan kedalaman telaga yang dipam ialah 0.5 m dan 15 m di bawah paras air statik, masing-masing, kira kebolehpindahan akuifer tersebut.

(8 markah)

S5 (a) Bincangkan perbezaan persamaan Theim dan Theis di dalam analisa airbumi.

(4 markah)

(b) Akibat daripada hujan ribut, pasir yang berada di dalam serombong bawah jalanraya menjadi lebih padat dengan pasir dari hujung ke hujung serombong tersebut. Serombong tersebut mempunyai 5 m panjang dan bergarispusat 0.8 m. Pasir di dalam serombong tersebut mempunyai kebolehtelapan K = 3 m/hari dan keporosan berkesan n_e = 0.38. Paras air yang berada pada hujung serombong adalah 1.6 m lebih tinggi daripada hujung serombong satu lagi. Keseluruhan serombong tersebut berada berada di bawah paras air. Anggarkan pengeluaran dan halaju purata air yang mengalir melalui serombong tersebut.

(5 markah)

(c) Sebuah telaga pengepaman berdiameter 0.46 telah mengeluarkan airbumi sebanyak 0.38 m^3/min di dalam akuifer terkurung. Penyusutan telah dicerap pada dua buah telaga pengawasan yang terletak 15.24 dan 60.96 m dari telaga pengepaman masing-masing sebanyak 3.05 m and 2.44 m.

(i) Tentukan nilai kebolehpindahan akuifer tersebut.
(ii) Tentukan penyustan telaga pengepaman tersebut.

(16 markah)

Appendik I

PEPERIKSAAN AKHIR

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NAMA KURSUS : KEJURUTERAAN AIRBUMI KOD KURSUS : BFW40403/BFW4043

Nilai Hidraulik Konduktiviti

Material	Hidraulik Konduktiviti (m/day)
Gravel, coarse	150
Gravel, medium	270
Gravel, fine	450
Sand, coarse	45
Sand, medium	12
Sand, fine	2.5
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Till, predominantly sand	0.49
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Appendiks II

PEPERIKSAAN AKHIR

SEMESTER/SESSION: II/2013/2012 PROGRAM : 4BFF

NAMA KURSUS : KEJURUTERAAN AIRBUMI KOD KURSUS : BFW40403/BFW4043

Persamaan

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

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

$$\mathrm{Re} = \frac{\rho V D}{\mu}$$