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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	HYDROLOGY
COURSE CODE	:	BFC 32002
PROGRAMME	:	BACHELOR OF CIVIL ENGINEERING WITH HONOURS
EXAMINATION DATE	:	JUNE /JULY 2015
DURATION	:	2 1/2 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY.

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

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Q1 (a) Explain **THREE (3)** the importances of hydrology in water reseources development.

(6 marks)

(b) "Continues process in which water is evaporated from water surfaces and oceans, moves inland as moist air masses and produce precipitation and repeated". Based on this statement:

(i) Illustrate with added sketch in term of hydrologic process.
(ii) Describe the relationship between hydrologic cycle and water balance equation.

(12 marks)

(c) An amount of 5.5 cm of water evaporated from a 200 hectare vertical walled reservoir during two days. Storm water was added to the reservoir at a constant rate is 7.5 m^3/s during this period. Compute the volume of water released during the period if the water level in the reservoir was the same at the beginning and at the end of the day. Give your answer in hectare-cm (1ha = 10000 m^2).

(7 marks)

Q2 (a) Define the form of:

(i) Precipitation

(ii) Hyetograph

(iii) Intensity

(6 marks)

(b) Stations A to H are gauge stations. Rain gauge at station C was out of area. Calculate the rainfall depth at station C with coordinate (0,0) using **<u>TABLE Q2(b).</u>**

(6 marks)

(c) After 3 years from 1979 to 1981as shown in **<u>TABLE Q2(c)</u>** , Gage O was permanently relocated to a new location. By using double mass curve, find the values of precipitation (cm) for the adjusted years.

(13 marks)

Q3 (a) Identify **THREE (3)** methods that might be used to estimate evaporation from a small lake.

(3 marks)

(b) Create a simple experiment of transpiration process and briefly explain with added skectch of transpiration occurs.

(6 marks)

(c) Illustrate with added sketch the relationship between infiltration and surface runoff during stormwater event.

(4 marks)

(d) Using the Panman method, estimate ET given the following data: temperature at water suface = 20°C, temperature of air = 32°C, relative humidity = 45% and wind velocity = 3 mph. The month is June at latitute 30° North, r is given as 0.08 and n/D is found to be 0.73.

(12 marks)

Q4 (a) Differentiate between the following terms:

(i) Surface runoff

(ii) Streamflow

(4 marks)

(b) Based on data are given in **TABLE Q4(b).**

(i) Decide the method will be used to estimate the discharge at the river cross section.

(ii) Solve the field measurement of width, depth and velocity to determine the discharge rate.

(12 marks)

(c) A river discharge was measured using a standard current meter and an average velocity method. The data of river measurement is listed in **TABLE Q4(c)** and **FIGURE Q4(c)**. Determine the discharge of the river using mean section method if the equation of the current meter is $V = 0.5N + 0.05$ m/s.

(9 marks)

Q5 Discharge rates for 2 hours unit hydrograph as shown in **TABLE Q5(a).**

(a) Construct the UH 1 mm/hr and UH 2mm/hr during 2 hour storm events.

(i) Determine the peak discharge for a net rain of 1 mm/hour and a duration of 2 hour.

(ii) Analyse a total design hydrograph with added sketch the hydrograph.

(iii) Identify the peak discharge during this storm event.

(10 marks)

(b) The streamflow data for a basin with an area of 7500 km^2 are given in the **TABLE Q5(b).**

(i) Separate the baseflow using recession method.

(ii) Find the equivalent depth of the direct flow.

(iii) Determine the unit hydrograph for the basin.

(15 marks)

Q6 (a) The flow hydrograph at the channel section is given in **TABLE Q6 (a)**. Use the Muskingum method to estimate the hydrograph 1200 m downstream from the channel section. Assume that X = 0.25, K = 35 min and Δt = 30 min.

(i) Sketch the inflow and outflow channel routing.

(ii) Estimate the storage capacity.

(15 marks)

(b) A 35 cm well was drilled penetrating straight into the aquifer at the depth of 80 m. Two other wells were drilled at the distance of 30 m and 90 m from the initial well which have the decrease in the water level of 10 m and 8 m from the initial groundwater level. If the aquifer has a permeability value of 180m/day,

(i) Determine the pumping rate of the groundwater well.

(ii) Show the detail with added sketch the diagram of aquifer.

(10 marks)

- END OF QUESTIONS -

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FIGURES

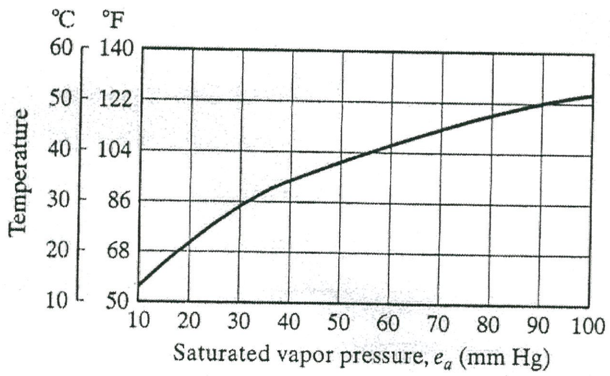

Figure Q3(d): Values of saturated vapor pressure

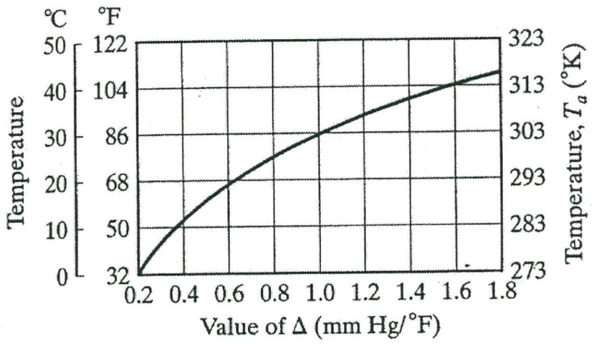

Figure Q3(d): Values of slope of the saturation vapor pressure

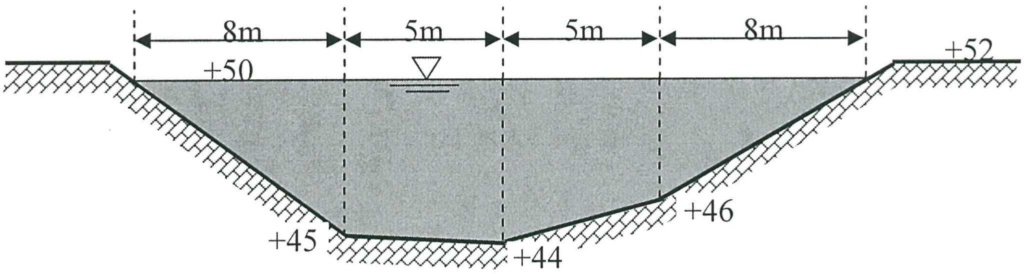

Figure Q4(c): River cross-section

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TABLES

Table Q2(b): Station rainfall records

Quadrant	Station	Depth, P(mm)	Distance (L^2) (m)
I	G	20	20
II	E	22	10
	F	19	16
	A	35	5
III	D	27	13
IV	B	30	6
	H	18	11

Table Q2(c): Annual rainfall for each station

Year/Rainfall Gage	L	M	N	O
1979	22	26	23	28
1980	21	26	25	33
1981	27	31	28	38
1982	25	29	29	31
1983	19	22	23	24
1984	24	25	26	28
1985	17	19	20	22
1986	21	22	23	26

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TABLES

Table Q3(d): Values of Temperture-Dependent Coefficient B for use in the Penman Equation

T_a (°K)	B (mm H_2O/day)	T_a (°F)	B (mm H_2O/day)
270	10.73	35	11.48
275	11.51	40	11.96
280	12.40	45	12.45
285	13.20	50	12.94
290	14.26	55	13.45
295	15.30	60	13.96
300	16.34	65	14.52
305	17.46	70	15.10
310	18.60	75	15.65
315	19.85	80	16.25
320	21.15	85	16.85
325	22.50	90	17.46
		95	18.10
		100	18.80

Note: $B = \sigma T_a^4$ where σ is the Boltzmann constant, 2.01×10^{-9} mm/day.

Source: After Criddle [23].

Table Q3(d): Tabulated values of R, Mean Monthly Intensity of Solar Radiation on a Horizontal Surface, for use in the Penman Equation

	Latitude (deg)	J	F	M	A	M	J	J	A	S	O	N	D
North	60	1.3	3.5	6.8	11.1	14.6	16.5	15.7	12.7	8.5	4.7	1.9	0.9
	50	3.6	5.9	9.1	12.7	15.4	16.7	16.1	13.9	10.5	7.1	4.3	3.0
	40	6.0	8.3	11.0	13.9	15.9	16.7	16.3	14.8	12.2	9.3	6.7	5.5
	30	8.5	10.5	12.7	14.8	16.0	16.5	16.2	15.3	13.5	11.3	9.1	7.9
	20	10.8	12.3	13.9	15.2	15.7	15.8	15.7	15.3	14.4	12.9	11.2	10.3
	10	12.8	13.9	14.8	15.2	15.0	14.8	14.8	15.0	14.9	14.1	13.1	12.4
	0	14.5	15.0	15.2	14.7	13.9	13.4	13.5	14.2	14.9	15.0	14.6	14.3
South	10	15.8	15.7	15.1	13.8	12.4	11.6	11.9	13.0	14.4	15.3	15.7	15.8
	20	16.8	16.0	14.6	12.5	10.7	9.6	10.0	11.5	13.5	15.3	16.4	16.9
	30	17.3	15.8	13.6	10.8	8.7	7.4	7.8	9.6	12.1	14.8	16.7	17.6
	40	17.3	15.2	12.2	8.8	6.4	5.1	5.6	7.5	10.5	13.8	16.5	17.8
	50	17.1	14.1	10.5	6.6	4.1	2.8	3.3	5.2	8.5	12.5	16.0	17.8
	60	16.6	12.7	8.4	4.3	1.9	0.8	1.2	2.9	6.2	10.7	15.2	17.5

[a]Measured in mm H_2O evaporated per day.

Source: After Criddle [23].

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Table Q4(b): Cross section data

Vertical section no.	Section width (m)	Depth (m)	Velocity (m/s)
0	0	0	0
1	4	3	2.1
2	4.5	5	2.4
3	5	6	3
4	3.8	2.7	2.2
5	4.2	0	0

Table Q4(c): River measurement data

Sub-section	I	II	III	IV
Rotation N at 0.6d	39.00	58.00	70.00	60.00
Observation time (sec)	100.00	120.00	180.00	120.00

Table Q5(a): Discharge rate for 2 hour unit hydrograph

Time (hour)	Discharge rate (m^3/s)
0	0
1	100
2	250
3	200
4	100
5	50
6	0

Table Q5(b): Total discharge rate in the stream

Time (days)	Discharge rate, Q (m^3/s)
1	1600
2	1500
3	5000
4	11000
5	8000
6	6500
7	5000
8	3800
9	2500
10	2000

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Table Q6(a): Hydrograph channel

Time (min)	Flow (m^3/s)
0	0
30	12
60	23
90	18
120	14
150	10
180	9
210	7
240	5
270	4
300	3
330	2
360	1
390	0

EQUATIONS

$$C_1 = \frac{\Delta t - 2KX}{2K(1-X)+\Delta t} \qquad C_2 = \frac{\Delta t + 2KX}{2K(1-X)+\Delta t} \qquad C_1 + C_2 + C_3 = 1$$

$$C_3 = \frac{2K(1-X)-\Delta t}{2K(1-X)+\Delta t} \qquad O_{j+1} = C_1 I_{j+1} + C_2 I_j + C_3 O_j \qquad \boldsymbol{ET} = \frac{\Delta H + 0.27\,E_0}{\Delta + 0.27}$$

$$H = \mathrm{R}\ (1\text{-r})(0.18 + 0.55\ \mathrm{S}) - \mathrm{B}\ (0.56 - 0.092\mathrm{e_a}^{0.5})(0.10 + 0.9\mathrm{S})$$

$$E = 0.35(e_s - e_a)(1 + 0.0098u_2 \qquad S = n/D \qquad S = KO + KX(I-O)$$

$$H - h = \frac{Q}{2\pi bK}\ln\frac{R}{r} \qquad d = v/A \qquad \mathrm{W} = (1/\mathrm{L}^2)/\sum(1/\mathrm{L}^2)$$

$$\mathrm{P_a} = \mathrm{P_x}\ [\mathrm{M_a}/\mathrm{M_o}]$$