CONFIDENTIAL

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023

COURSE NAME	:	HYDROLOGY
COURSE CODE	:	BFC 32002
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	FEBRUARY 2023
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTIONS	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.

TERBUKA

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

CONFIDENTIAL

Q1 (a) Describe and illustrate the process of hydrologic cycle.

(5 marks)

(b) Infiltration is the process whereby water enters the surface strata of the earth and moves down towards the water table. Discuss briefly **five (5)** factors affecting infiltration capacity.

(5 marks)

(c) Define isohyet and explain the advantages of applying an isohyetal map to estimate rainfall area.

(5 marks)

(d) Isohyets of different rainfall are shown in **Figure Q1(d)**. The rainfall and areas of adjacent isohyets are given in **Table Q1(d)**. Calculate the average rainfall of that area.

(10 marks)

Q2 (a) Define flood routing and with the aid of sketch, show the process of flood routing.

(6 marks)

(b) Describe briefly the Muskingum method of routing.

(6 marks)

(c) Route the hydrograph through a river reach as in **Table Q2(c),** for which K = 22.0 hour and x = 0.25. At the start of the inflow flood, the outflow discharge is 40 m^3/s. Use a routing period $\Delta t = 12$ hours and assume that inflow equals outflow for the first day.

(13 marks)

TERBUKA

Q3 (a) Define catchment area in hydrology field perspective.

(2 marks)

(b) Explain clearly with an aid of diagram, the typical hydrograph characteristics.

(4 marks)

(c) A stormwater drain is proposed at the outlet location as shown in **Figure Q3(c)(i)**. The outlet elevation is 377 ft. The drainage basin area is measured to be 2.10 acres covering 58.10% (woods), 6.66% (impervious area) and 35.24% (grass). Runoff coefficient is provided in **Table Q3(c)**. Assume the hilly hydraulic path as 160 ft long overland flow (average grass surface) and the gentle hydraulic path as 500 ft long shallow concentrated flow designed as lined drain with cross section as shown in **Figure Q3(c)(ii)**.

(i) Delineate the catchment area tributary to the point of analysis from **Figure Q3(c)(i)**. Trace the obtained of delineated catchment area tributary on your answer booklet.

(4 marks)

(ii) Compute the peak runoff, Q_p (in ft^3/s) using the Rational Method as outlined in the Urban Stormwater Management Manual for Malaysia (MSMA) for a 10-year storm using the proposed stormwater drain as the point of analysis.

Note: Take the fitting constants of λ, κ, θ, η as 64.099, 0.174, 0.201 and 0.826 respectively and the necessary data can be obtained from **Figure Q3(c)(iii)**.

(5 marks)

(d) The 12 hours rainfall data for a particular catchment having an area of 3.82 km^2 is presented in **Figure Q3(d)**. Based on the figure given:

(i) Determine the direct runoff that will be produced by the rainfall.

(5 marks)

(ii) Derive the unit hydrograph for the catchment.

Note: Separate the base flow using the straight-line method.

(5 marks)

TERBUKA

Q4 (a) With your own opinion, discuss the occurrence and movement of groundwater in the ground.

(6 marks)

(b) Explain the difference between confined and unconfined aquifer.

(6 marks)

(c) A confined aquifer has a source of recharge as shown in **FIGURE Q4(c)**. The hydraulic conductivity of the aquifer is 50 m/day and its porosity is 0.2. The piezometric head in two wells 1000 m apart is 55 m and 50 m, respectively, from a common datum. The average thickness of the aquifer is 20 m and the average width is 5 km. Estimate the rate of flow through the aquifer and the travel time from the head of the aquifer to a point 4 km downstream (assume no dispersion or diffusion).

(8 marks)

(d) A fully penetrating 30 cm diameter well has its bottom 24.4 m below the static water table. After 24 hr of pumping at 0.07 m^3/s, the water level in the test well stabilizes to 3 m below the static water table. A draw-down of 1.11 m is noticed in an observation well 97.5 m away from the pumped well. Calculate the hydraulic conductivity of the aquifer **FIGURE Q4(d).**

(5 marks)

– END OF QUESTIONS –

TERBUKA

FINAL EXAMINATION

SEMESTER / SESSION : I/2022/2023 PROGRAMME CODE : BFF

COURSE NAME : HYDROLOGY COURSE CODE : BFC 32002

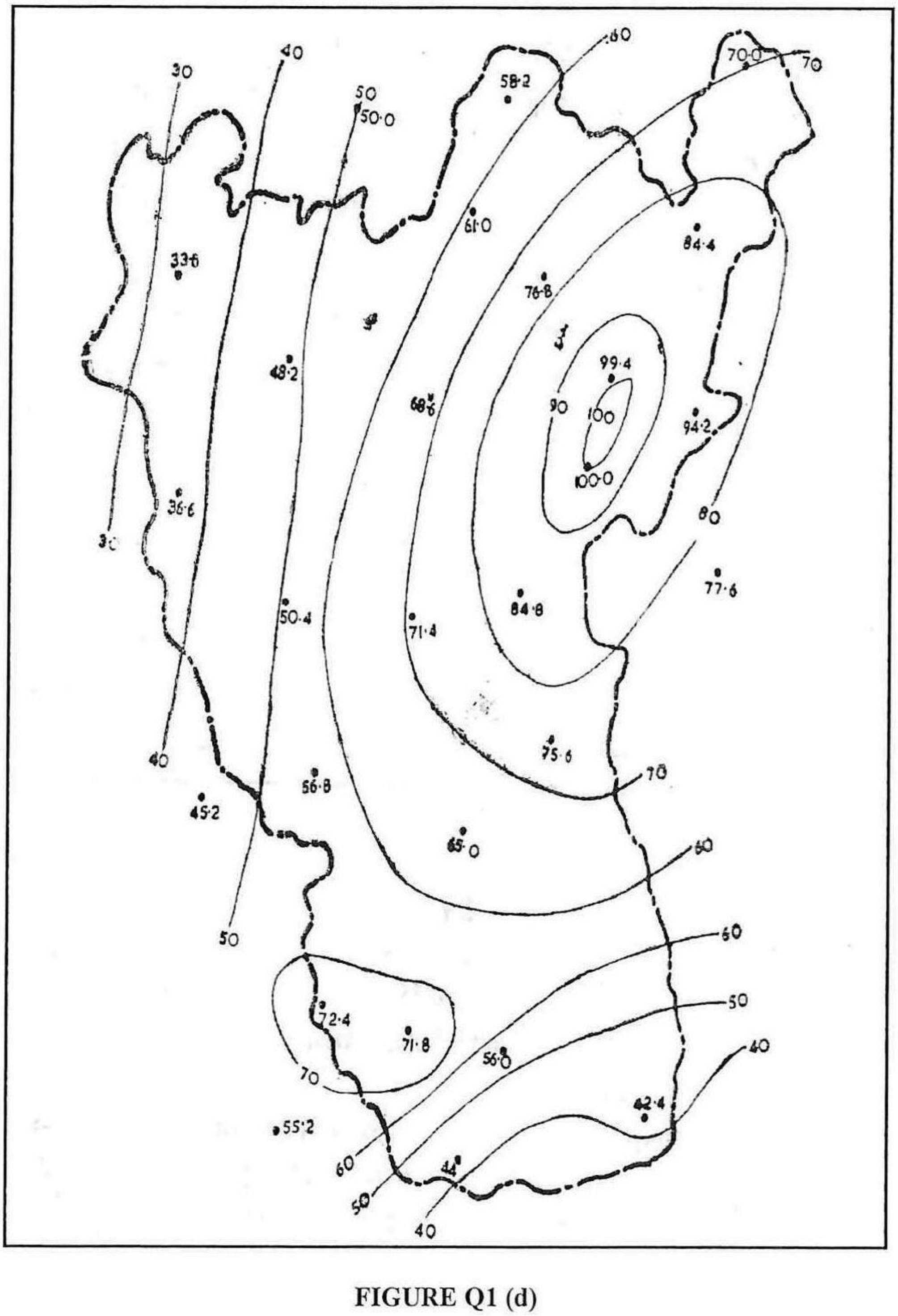

FIGURE Q1 (d)

TERBUKA

FINAL EXAMINATION

SEMESTER / SESSION : I/2022/2023 PROGRAMME CODE : BFF
COURSE NAME : HYDROLOGY COURSE CODE : BFC 32002

TABLE Q1(d)

Values of isohyets (cm)	30-40	40-50	50-60	60-70	70-80	80-90	90-100
Area (cm^2)	32	162	155	92	228	120	65

TABLE Q2: Data of inflow hydrograph through a river

Time(hours)	0	12	24	36	48	60	72	84
Inflow(m^3/s)	40	65	165	250	240	205	170	130

TERBUKA

FINAL EXAMINATION

SEMESTER / SESSION : I/2022/2023 PROGRAMME CODE : BFF

COURSE NAME : HYDROLOGY COURSE CODE : BFC 32002

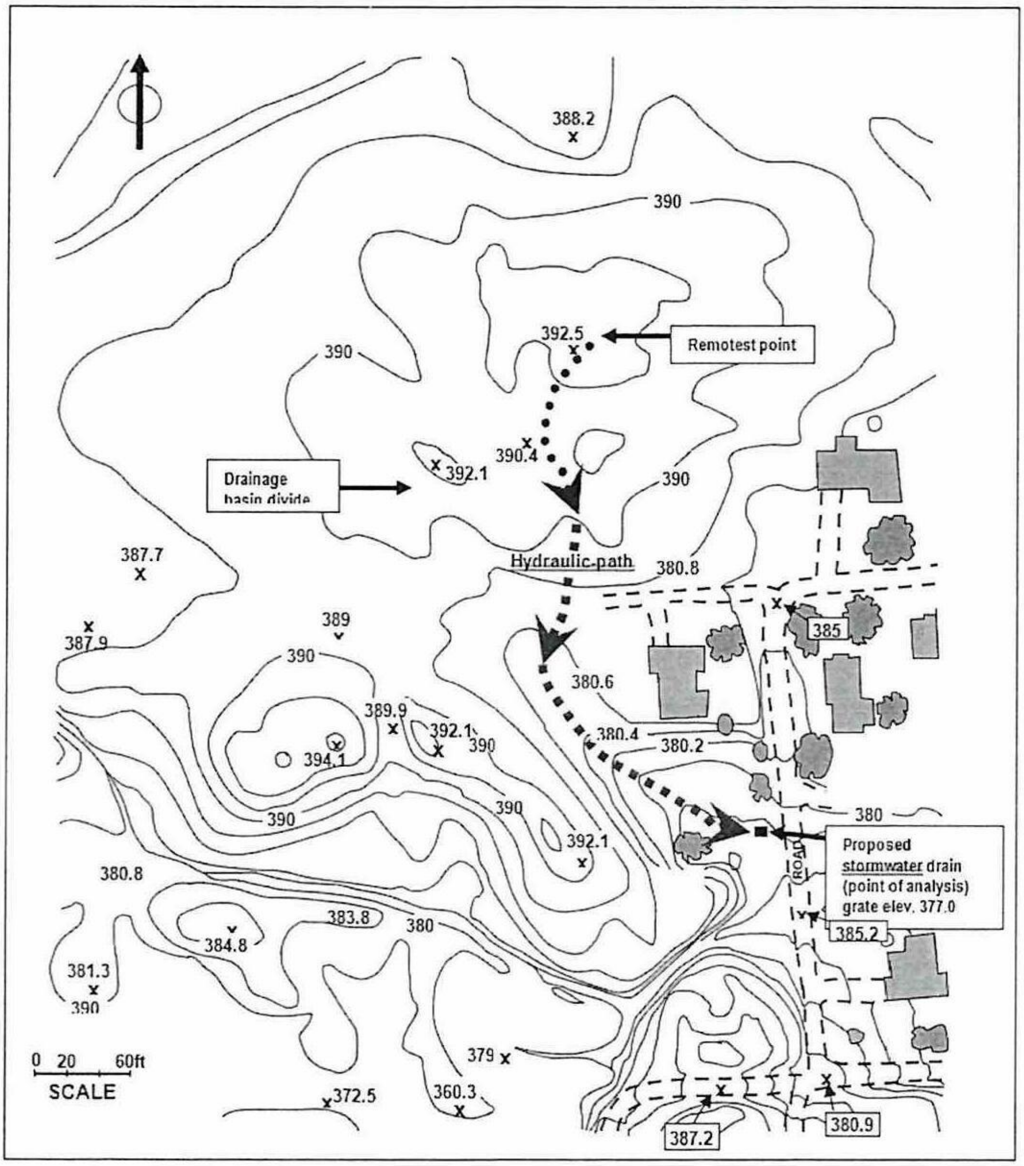

FIGURE Q3(c)(i): Proposed Lawn Drain of Parit Karjo

Legend: Overland flow path; Shallow concentrated flow path

TERBUKA

FINAL EXAMINATION

SEMESTER / SESSION : I/2022/2023 PROGRAMME CODE : BFF
COURSE NAME : HYDROLOGY COURSE CODE : BFC 32002

TABLE Q3(c): Typical coefficients for use with the Rational Method

Surface Type	Runoff Coefficient	
	Range of Values	Typical Design
Impervious *(Pavement, roofs)*	0.75 – 0.95	0.90
Lawns	0.05 – 0.35	0.30
Unimproved (Woods, brush)	0.10 – 0.30	0.20

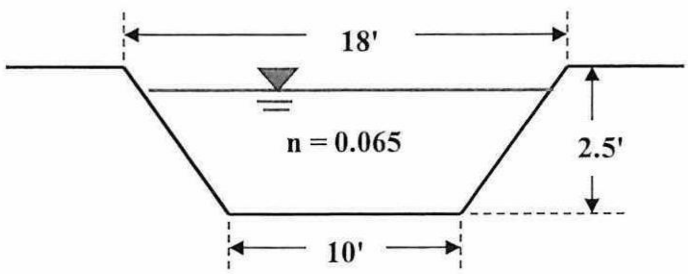

FIGURE Q3(c)(ii)

TERBUKA

FINAL EXAMINATION

SEMESTER / SESSION : I/2022/2023 PROGRAMME CODE : BFF

COURSE NAME : HYDROLOGY COURSE CODE : BFC 32002

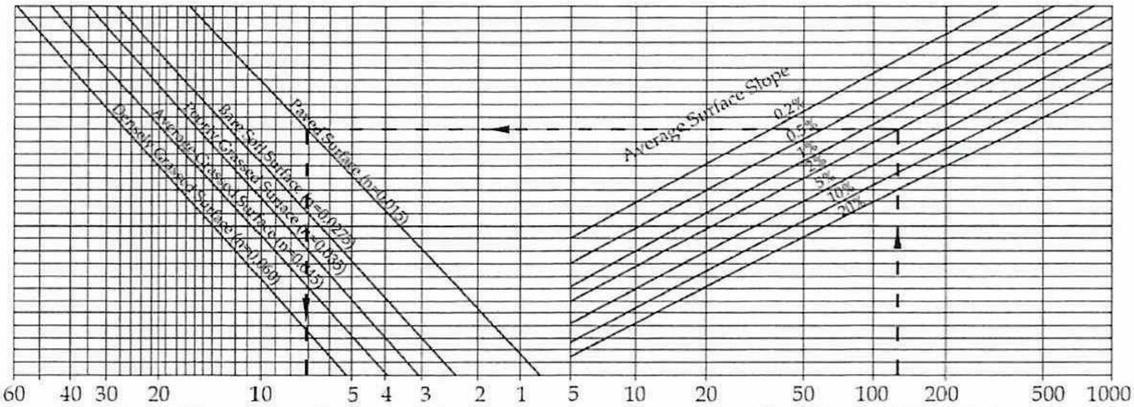

FIGURE Q3(c)(iii): Proposed Lawn Drain of Parit Karjo

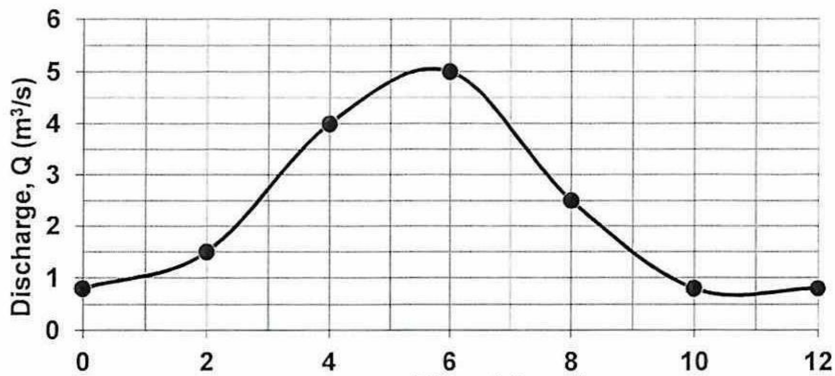

FIGURE Q3(d)

TERBUKA

FINAL EXAMINATION

SEMESTER / SESSION : I/2022/2023 PROGRAMME CODE : BFF

COURSE NAME : HYDROLOGY COURSE CODE : BFC 32002

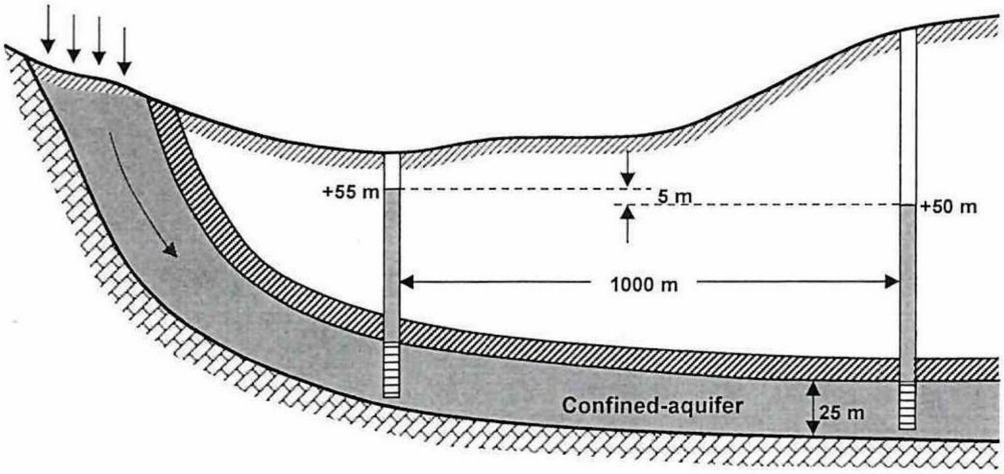

FIGURE Q4(c)

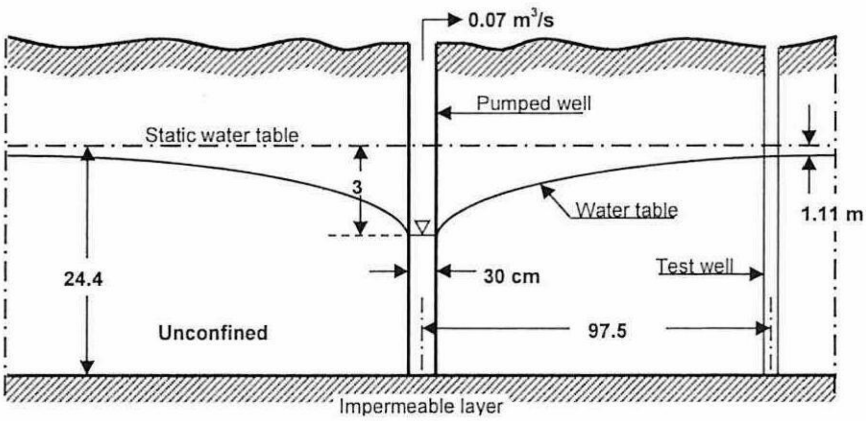

FIGURE Q4(d)

TERBUKA

FINAL EXAMINATION

SEMESTER / SESSION	: I/2022/2023	PROGRAMME CODE :	BFF
COURSE NAME	: HYDROLOGY	COURSE CODE	: BFC 32002

Equations :

$$C_{avg} = \frac{\sum_{j=1}^{m} C_j A_j}{\sum_{j=1}^{m} A_j} \qquad Q = CiA \qquad Q = \frac{CiA}{360} \qquad v = \frac{1.49}{n} R^{2/3} \sqrt{S_o}$$

$$v = \frac{1}{n} R^{2/3} \sqrt{S_o} \qquad i = \frac{\lambda T^{\kappa}}{(d+\theta)^{\eta}}$$

Unit equivalent:

1 ha = 10,000 m^2
1 acre = 4,047 m^2
1 m = 3.281 ft
1 m = 39.37 inch
1 m^3 = 35.2 cfs

TERBUKA