NATIONAL EXAMINATION DEC 2002

98 - CIV – B4

Engineering Hydrology

3 Hours Duration

Notes:

1. Questions have the value shown.
2. If doubt exists as to the interpretation of any question, clearly state all your assumptions and the question will be marked accordingly.
3. Any non-communicating calculator is allowed.
4. The exam is open book.
5. Graph paper (6 sheets) is provided.

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1. Explain the following methods used to compute the average precipitation:

   Thiessen Network,
   Isohyetal Map,
   Weighted Average

   What are the advantages and disadvantages of each one, which would be the most accurate, and why.

   (Value 10%)

2. A wall is constructed to protect from floods many houses constructed in the floodplain of a river. The wall can contain a flood with a return period of 25 years. The floods of this river, recorded in m^3/s, follow the log Pearson III distribution, and the logarithms (base 10) of the flows have the following statistics : average = 2.5, standard deviation = 0.3, and skewness coefficient = – 0.6. The houses will be relocated, and the wall destroyed, in 3 years

   a. What is the magnitude of the design flood for the wall?
   b. If the wall was constructed to contain a flood of 1040 m^3/s, what would be the design return period of the wall?
   c. What is the probability that the water will rise above the wall in the next year?
   d. What is the probability that the water will rise above the wall at least once before the houses are relocated?
   e. If you can accept a 10% risk that the water will rise above the wall at least once before the houses are relocated, what return period must the design flood have?

   (Value 15%)

3. A city has dug a well to the aquitard (elevation of the aquitard: 105 m above sea level) in an aquifer where the water table was at 119.1 m. The city draws 3 L/s of water from the well. The water levels, at equilibrium, in three wells located in proximity of the city's well are presented in the Table below.

Well	1	2	3
Radial distance (m)	5	50	100
Water elevation (m)	116.5	118.3	118.9

   a, Calculate the hydraulic conductivity (K) and the transmissivity (T) of this aquifer. Indicate units. Justify briefly your approach, i.e., formula, data used, hypotheses, ...
   b. Well No. 3 is the well of a neighboring town, and well No. 2 is an observation well for an experimental station. If the water table drawdown in these wells must not exceed 25 cm (well 3) and 1 m (well 2), respectively, what is the maximum flow rate at which the city can pump water from its well?

   (Value 15%)

4. To design a hydroelectric dam, you must know the flow of a river located in a remote area, establish hydrographs over the full year and predict future flows. There is no direct data available. How will you achieve these tasks? What are the main factors that you must consider and why? What accessory information will you have to find and use?

(Value 10%)

5. What will be the maximum flow at the effluent of the parking lot shown on Figure 1 for the following rain event:

00 – 10 min: 10.0 cm/h
10 – 20 min: 12.0 cm/h
20 – 30 min: 8.0 cm/h

(Value : 20%)

6. a. Tabulated below are data for a flood at a point on a river with drainage area 2500 mi^2. Separate the groundwater flow and compute the direct runoff volume in second-foot-days, acre feet, inches over the drainage area and cubic meters. NB: the resulting hydrograph is from a 12 hours storm.

Date	Hour	Flow, 1000 cfs	Date	Hour	Flow, 1000 cfs
02/1/00	2400	1.2	05	1200	8.3
	0600	1.4		1800	7.0
	1200	1.6	06	2400	5.8
	1800	1.8		0600	4.0
03	2400	2.6		1200	3.6
	0600	4.8		1800	3.1
	1200	7.6	07	2400	2.5
	1800	9.9		0600	2.5
04	2400	12.8		1200	2.1
	0600	13.2		1800	1.9
	1200	13.1	08	2400	1.6
	1800	11.2	09	2400	1.4
05	2400	9.7	10	2400	1.2
	0600	9.0	11	2400	0.9

b. Construct the unit hydrograph for the previous storm.

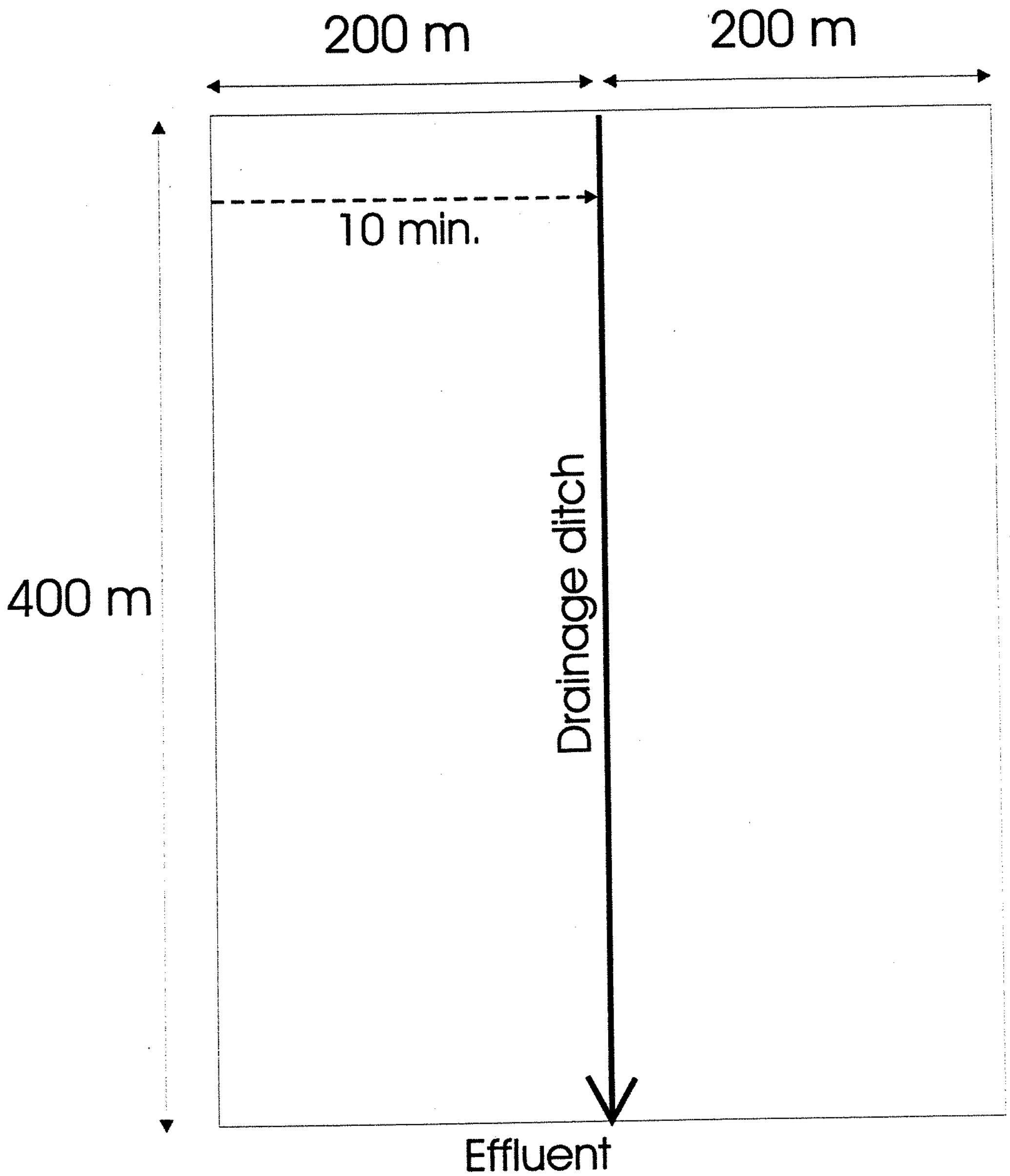
c. Using that unit hydrograph, what would be the maximum flow rate of a complex storm composed of 3 consecutive 12-hour storms with runoff values of 0.3, 1.2 and 0.6 inches respectively.

(Value 20%)

7. Explain the concepts associated with the Muskingum routing procedures. How can the constants be evaluated. What useful information can be obtained when this procedure is performed on a lake. The data presented in question 6 can be used to demonstrate. In that case, the hydrograph presented would be the inflow hydrograph of a large lake. The value of the factor K could be taken as 6 hours.

(Value 10%)

Figure 1 Parking lot



Concentration time: 40 min.
Runoff coefficient: 0.85
Lateral water runoff time: 10 min.

Not to scale

Date:

32nds 1 2 3 4 5 6 7 8