NATIONAL EXAMINATION MAY 2003

98 - CIV – B4

Engineering Hydrology

3 Hours Duration

Notes:

1. Questions have the value shown.
2. If doubts exist as to the interpretation of any question, clearly sate 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.

---

1. The amounts of water added to (or removed from) a Class A evaporation pan at noon, on each of five consecutive days, to bring the water back to its original level in the pan, are tabulated below. The amount of rain fallen in the area is also tabulated.

Day	Rain (inches)	Water added in evap. pan (inches)
1	0.6	1.0
2	0.1	-0.2
3	0	0.7
4	0	0.4
5	0.5	0.7

The average infiltration rate in the area is 0.04 in/h. A nearby reservoir received 190 acre-feet of water from its influent streams during that period of five days. The flow rate in the stream leaving the reservoir was maintained at 4.5375 ft^3/s. If the level of water in the reservoir was the same at the end of the five day period than it was at the beginning, what is the surface area of the reservoir (in acres)?

(Value 10%)

2. A city has dug a well to the aquitard (elevation of the aquitard: 115 m above sea level) in an aquifer where the water table was at 129.1 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%)

3. The mean, standard deviation, and asymmetry coefficient of the logarithms of the flow rates (in m^3/s) of an annual maxima series are 1.723, 0.0815, and -2.667, respectively.
a. If the log Pearson III distribution describes this series well, calculate the flow rate that has a 5 year return period.

b. According to the flow-duration curve constructed from the flow rates measured at the same point for 10 years, the flow rate that has 20% chances of being exceeded is 4.17 m^3/s. Explain (concisely) why the flow rate that has a return period of 5 years, predicted by the log Pearson III distribution is different from the flow rate that has 20% chances of being exceeded according to the flow-duration curve. Should they be the same?
c. What is the risk that the 5 year flow rate predicted above will occur at least once in the next 5 years?

(Value 10%)

4. 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

(Value 20%)

5. a. Tabulated below are data for a flood at a point on a river with a drainage area of 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	1.0	05	1200	7.8
	0600	1.2		1800	7.0
	1200	1.6	06	2400	5.4
	1800	1.8		0600	4.3
03	2400	2.5		1200	3.5
	0600	4.5		1800	3.0
	1200	7.2	07	2400	2.4
	1800	9.5		0600	2.4
04	2400	12.0		1200	2.1
	0600	12.5		1800	1.9
	1200	13.0	08	2400	1.6
	1800	10.8	09	2400	1.4
05	2400	9.6	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, predict the maximum flow rate of a complex storm composed of 3 consecutive 12-hour storms with runoff values of 0.1, 0.5 and 0.3 inches respectively.

(Value 20%)

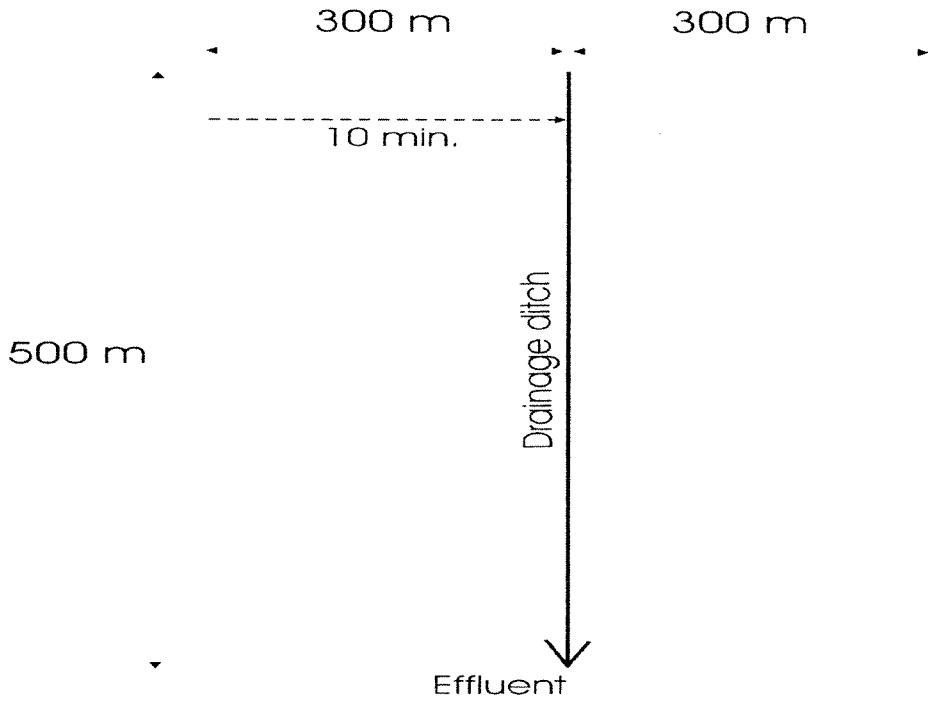
6. Explain the concepts associated with the Muskingum routing procedures. How can the constants be evaluated. What useful information can be obtained when this procedure is performed on a lake. The data presented in question 6 can be used to demonstrate. In that case, the hydrograph presented would be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

(Value 10%)

7. To achieve an urban subdivision project, numerous aspects of hydrology have to be considered. Should you have to carry out a feasibility study for a 150 houses subdivision, what parameters would you consider and why? What information is already available and how do you interpret it? Would you have to carry out any field measurements? List and explain all your assumptions.

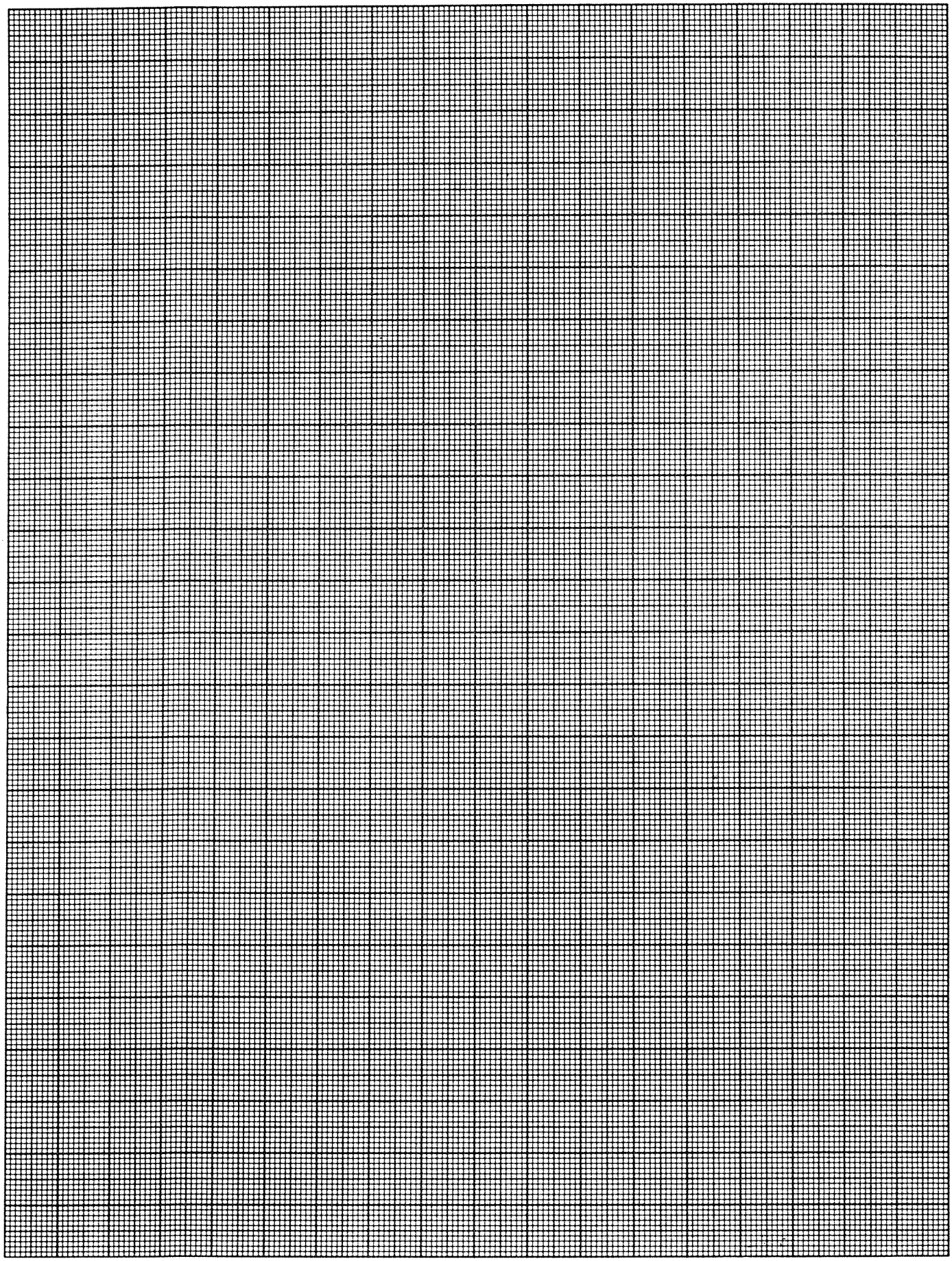
(Value 15%)

Figure 1 Parking lot

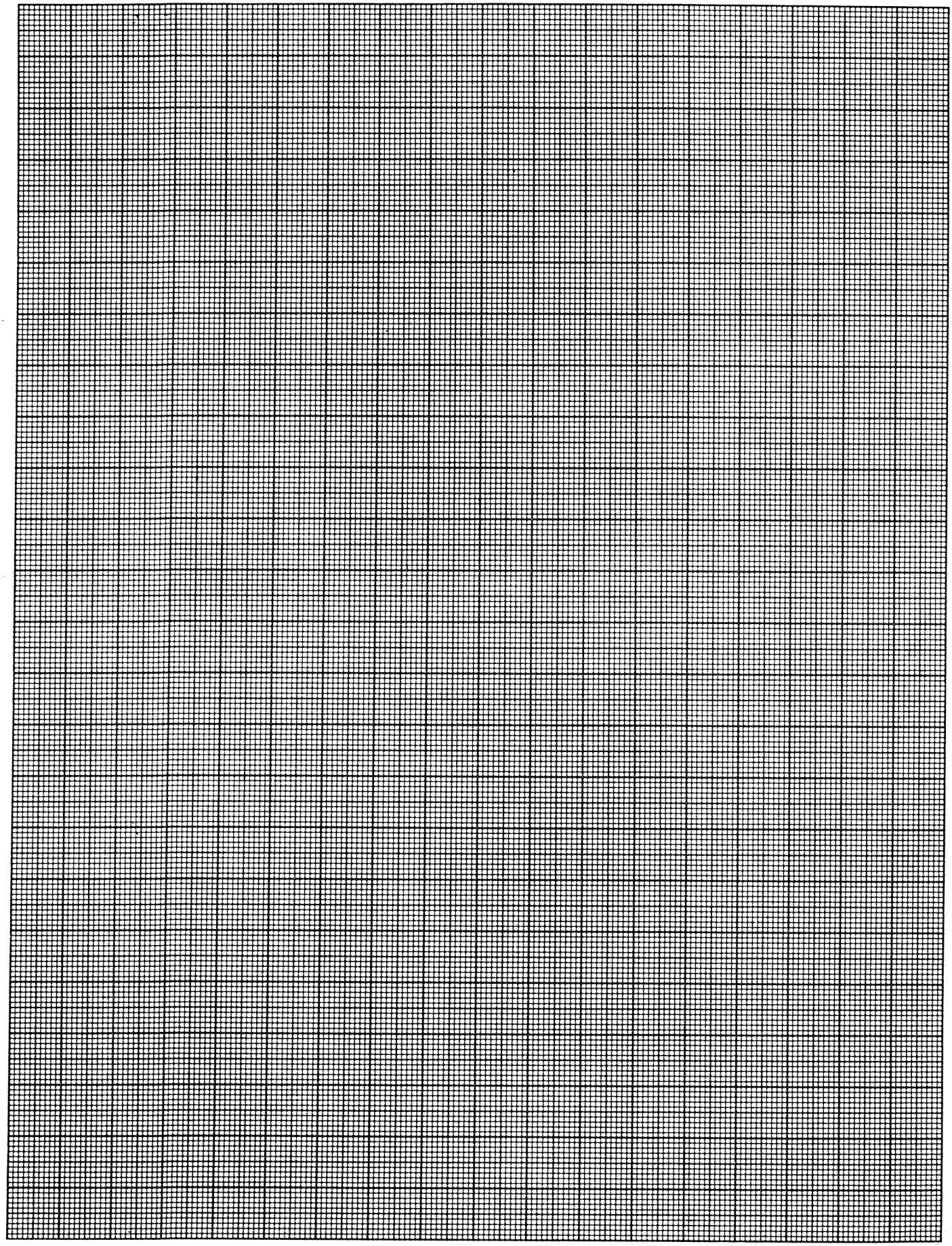


Concentration time: 40 min.
Runoff coefficient: 0.9
Lateral water runoff time

Not to scale



10 MM/CM



10 MM/CM