ENGINEERING HYDROLOGY

ANSWERS FOR THE PROBLEMS TO BE SOLVED

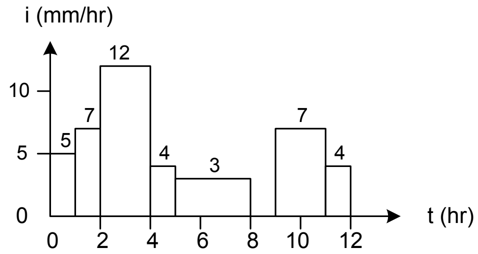
(For the ones included in CE 378 course content)

Chapter 1

1.3. E= 198.8 mm
E_{pan}= 284 mm
1.4. ΔS= -17.513*10^6 m^3
1.5. Surface runoff depth = 68 mm
Surface runoff volume = 4.964*10^6 m^3
Ave. rate = 1915 lt/s
1.6. Surface runoff volume = 315*10^3 m^3
1.7. E = 950 mm
E = 674745 m^3

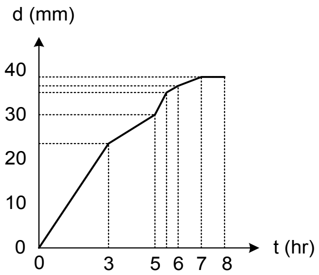
Chapter 3

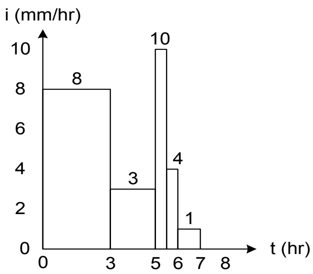
3.6.



Volume = 8.04 * 10^6 m^3

3.7. Mass curve Hyetograph





V= 1.596*10^6 m^3

3.9. Plot Thiessen polygons and isohyetal map and find areas as %, then average values will be as follows:
Thiessen polygons method P_{ave} = 28.85 mm
Isohyetal map method P_{ave} = 26.62 mm

3.10. Intensities in mm/hr for the durations are given below.

Duration (hr)	0-2	2-3	3-4	4-6	6-8
Arithmetic mean	7.0	12.5	14.0	13.75	14.5
Thiessen polygons	7.35	11.52	12.72	13.68	13.99

3.14. Q_p= 18.57 m^3/s
3.15. Q_p= 2.16 m^3/s

Chapter 4

4.3. **a)** b = 1.29 **b)** Q = 1400 m^3/s

4.4. $\sum Q = 13.74\ m^3/s$

4.5. Q = 3.29 m^3/s, v_{ave} = 1.08 m/s

4.6.
a) 63.1 m^3/s
b) 24.5 m^3/s
c) 30.74 m^3/s
d) 100.94*10^6 m^3
e) 4.65 mm
f) 0.00142 $m^3/s/km^2$

4.7.
a) 202.6 m^3/s
b) 40.8 m^3/s
c) 101.5 m^3/s
d) 675.57*10^6 m^3
e) 31.15 mm
f) 4.68 lt/s/km^2

4.8.
a) 47.23 m^3/s
b) 32.87 m^3/s
c) tabular solution
d) 100.3 m^3/s

4.9.
e) 43.25 m^3/s
f) Number of strips is not adequate.
g) There will be erosion in the first six strips.

Chapter 6

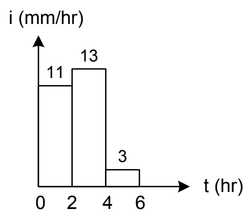
6.4.
a) Plot the histogram
b) d = 26 mm
c) Φ-index = 6.92 mm/hr

6.5.
a) Plot the infiltration curve.
b) f_0 = 93 mm/hr, f_f = 7.5 mm/hr, k = 0.036 1/min

6.6.
a) d = 71.17 mm
b) Φ-index = 19.58 mm/hr
c) 39.16 mm

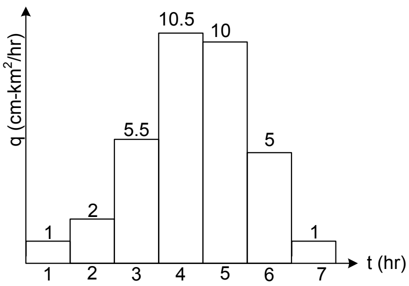
6.7.

d = 26 mm
Φ-index = 5.5 mm/hr
t_r = 4 hr
F = 28 mm

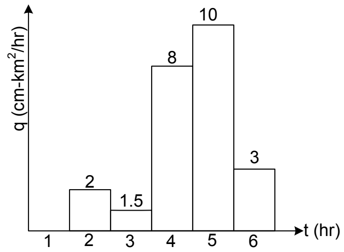


Chapter 7

7.11. Hydrograph in histogram form:



7.12 Hydrograph in histogram form:



7.13. **c)** $V = 68.14 * 10^6\ m^3$, **d)** $d = 17.8$ mm

7.14. Plot the hydrograph, and see that recession part is between 20 and 30 days.
$\alpha = 0.05822$ 1/day, $K_r = 0.9434$

7.15.

t (hr)	0	3	6	9	12	15	18	21	24
UH_3 (m^3/s)	0	24	46	40	34	22	14	4	0

7.16.

t (hr)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
a) UH_3 (m^3/s)	0	6.7	16.7	39.3	36.7	38	34.7	28	22.7	17.3	12.7	8	4.7	2.7	1.3	.7	0
b) UH_1 (m^3/s)	0	20	30	38	42	34	28	22	18	12	8	4	2	2	0		

d) $A = 93.6\ km^2$

7.17. a) A = 726 sq-mi

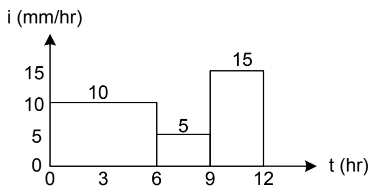
t (hr)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SH (m^3/s)	0	135	1040	3310	5935	5605	3560	2320	1715	1285	925	587.5	315	135	30	0

c) $Q_p = 3561$ cfs at 4th day

7.18. **a)** d = 16 mm, **b)** tr = 2 hr
c)

t (min)	0	15	30	45	60	75	90	105	120
UH_2 (m^3/s)	0	225	450	375	300	225	150	75	0

7.19 **a)**



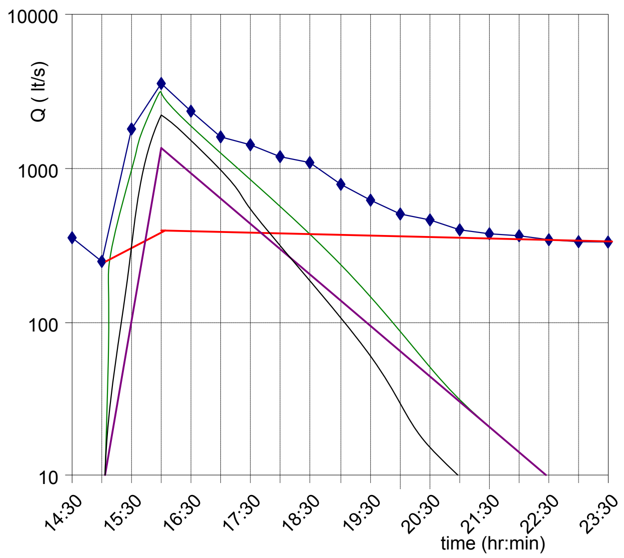
$\Phi_{index} = 5$mm/hr

b) SH = 3 UH_6 + (9 hr.lag.) 3 UH_3
c)

t (hr)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
SH (m^3/s)	10	13	22	40	55	67	76	78	73	55	46	52	79	97	100	82	64	46	28	16	10

d) $A = 54\ km^2$

7.20. Separation by simple method is not possible (all three ways), but it is possible with approximate and Barnes (given below) methods.



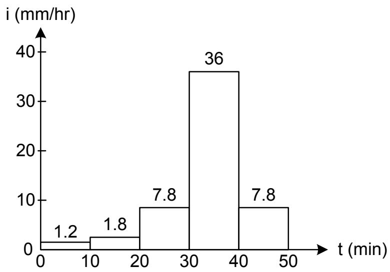
d = 0.254 mm, Φ = 13.492 mm/hr,
F = 10.479 mm, t_r = 30 min,
α = 0.02985 1/hr, q = 0.040 m^3/s

7.21. **a), b)**

t (hr)	0	1	2	3	4	5	6	7	8	9	10	11
SRH (m^3/s)	0	330	750	990	1107	1185	954	561	333	189	81	0
TRH (m^3/s)	30	360	780	1020	1137	1215	984	591	363	219	111	30

c) A = 97.2 km^2

7.23. **a)**



c) d = 0.375 mm

d) Φ = 33.75 mm/hr

e)

t (min)	0	10	20	30	40	50	60	70	80	90	100	110	120
UH_{10} (lt/s)	0	413.3	3893.3	9922.7	6296	3101.3	1586.7	872	429.3	178.7	5.33	2.67	0

Chapter 8

8.5. Plot the inflow and outflow values, and then plot the total storage values, which are given below.

t (hr)	0	6	12	18	24	30	36	42
ΣS (10^6 m^3)	0	0,54	4,86	16,74	27,54	34,02	31,86	27,00

48	54	60	66	72	78	84
21,60	15,66	9,18	4,86	2,16	0,54	0

d) $S_{max} = 34.02*10^6$ m^3

8.6.

t (hr)	0	2	4	6	8	10	12	14	16	18	20
Q (m^3/s)	5	5.5	7	9.5	12	13.5	14	14.5	14.5	14	13.5

22	24	26	28	30	32	34	36	38	...	62
13	12.5	12	11.5	11	10.5	10	9.5	9	...	5

8.7. a) $Q_p = 185$ m^3/s, $t_p = 48$ hr
b) H = 0.38 m
8.8. $Q_p = 815.6$ m^3/s, $t_b = 60$ hr
Attenuation = 434.4 m^3/s, Translation = 9 hr, Lengthening = 36 hr

Chapter 10

10.4. **a)** June – October
b) 7:4*10^6 m^3
d)

Mon.	10	11	12	1	2	3	4	5	6	7	8	9
Cont.	1.4	.2	0	.8	2.2	5	7.2	7.4	7.2	6.4	4.8	3

10.6. Res. Cap. = 21.717*10^6 m^3
10.7. Res. Cap. = 21.717*10^6 m^3

Chapter 12

12.9. $Q_v = 5.75$ lt/s/m
12.10. S = 0.001

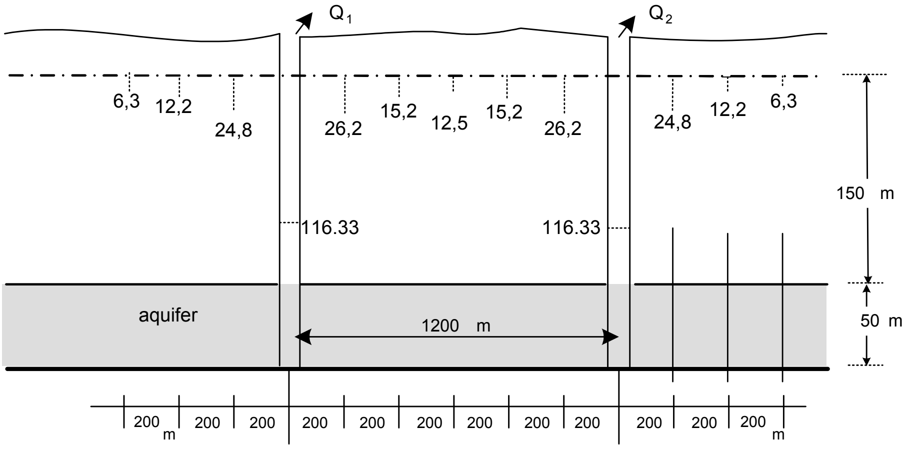
12.11. t = 176.68 hr
12.12. s = 7.456 m

12.13. **a)** impervious boundary, at t = 10.62 min
b) s = 4.62 cm

12.14. s = 0.165 m
12.15. s = 0.48 m

12.16. **a)** at OW_1, s = 0.29 m, at OW_2, s = 0.60 m
b) at PW_1, s = 0.01 m, at OW_2, s = 0.0

12.17. a)



12.18. $T = 8.36*10^{-4}\ m^2/min$, $S = 5.016*10^{-6}$

12.19. It can be used if pumping time is more than 67 min.