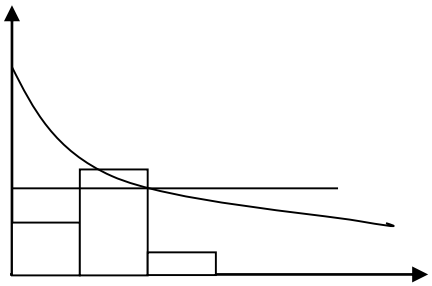
CIVIL ENGINEERING FACULTY HYDRAULICS DIVISION
HYDROLOGY

Examples –5 Groundwater Flow

1- a)



$t=2 \Rightarrow f=10+(82-10)e^{-0.3*2}=49,5$ mm/hr
$t=4 \Rightarrow f=10+(82-10)e^{-0.3*4}=31,7$ mm/ hr
$t=6 \Rightarrow f=10+(82-10)e^{-0.3*6}=21,9$ mm/ hr
$t=8 \Rightarrow f=10+(82-10)e^{-0.3*8}=16,53$ mm/ hr

b) $F_{2-4}=\int_2^4 f dt=\int_2^4 (10+72)e^{-0,3t}dt=10t-\frac{72}{0,3}e^{-0,3t}\Big|_2^4=20-240(e^{-1,2}-e^{-0,6})=79,47\text{mm}$

Effective precipitation = 2*70-79,47 = 60,53mm

c) $\Phi=\frac{2*70-60,53}{4-2}=39,74\text{mm}$

Solution-2)

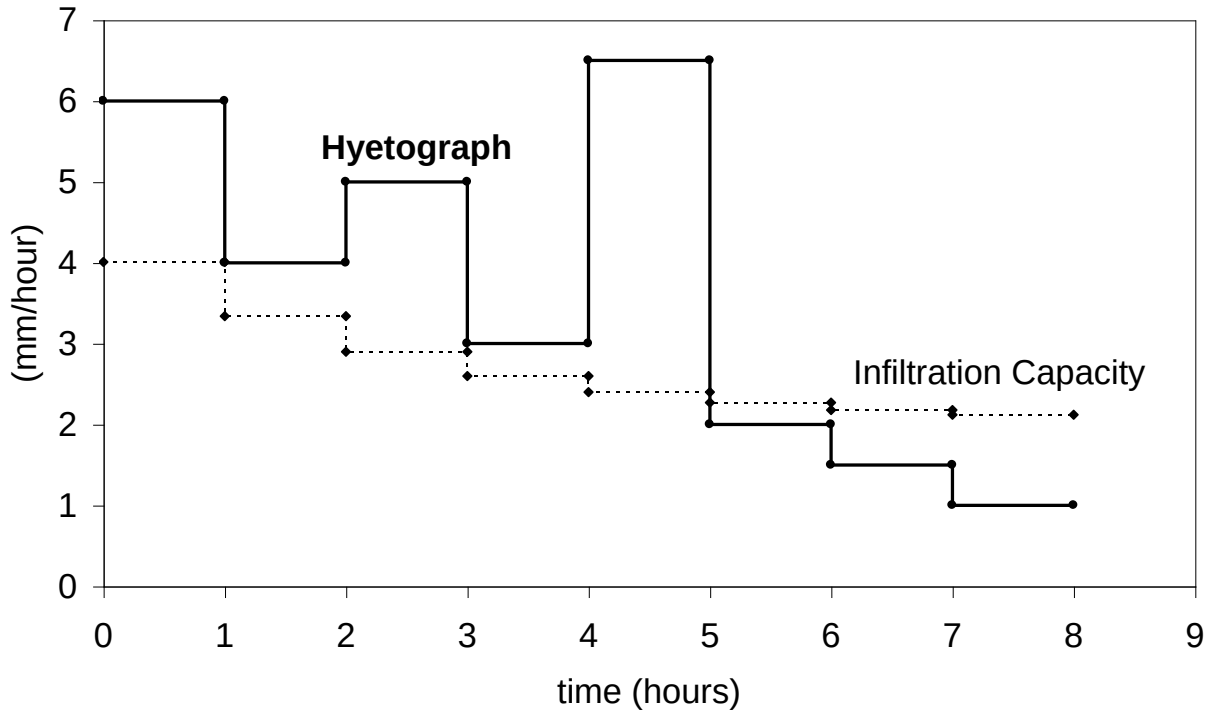
a-)

t(hour)	P (mm)	Δt(hour)	ΔP(mm)	i=ΔP/Δt (mm/hour)
0	0			
		1	6	6
1	6			
		1	4	4
2	10			
		1	5	5
3	15			
		1	3	3
4	18			
		1	6.5	6.5
5	24.5			
		1	2	2
6	26.5			
		1	1.5	1.5
7	28			
		1	1	1
8	29			

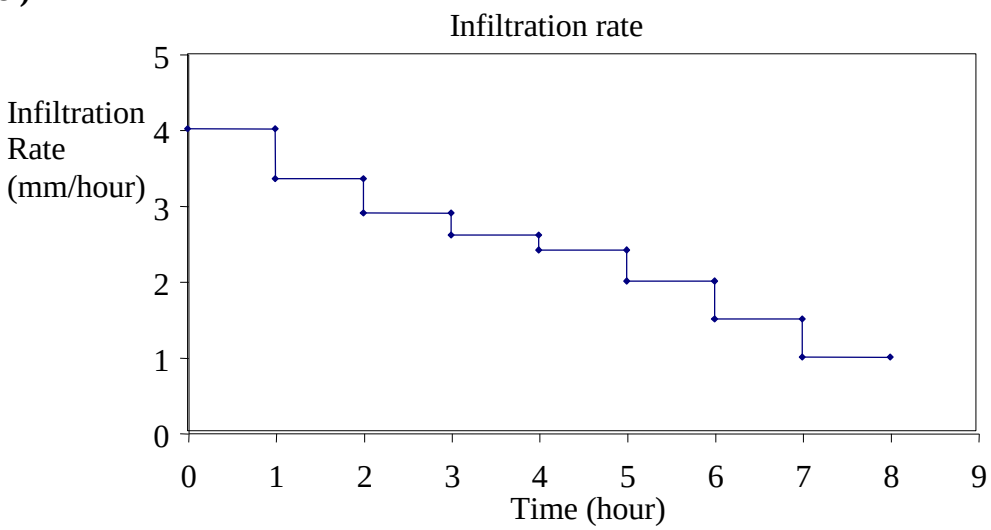
b-) Horton's expression for standart infiltration curve:

$f=f_c+(f_0-f_c)e^{-kt}$ (when the soil reaches the infiltration capacity, the value of infiltration rate is percolation.)
According to this:

$t=1 \Rightarrow f=2+(5-2)e^{-0.4*1}=4.01$ mm/hour
$t=2 \Rightarrow f=2+(5-2)e^{-0.4*2}=3.35$ mm/hour
$t=3 \Rightarrow f=2+(5-2)e^{-0.4*3}=2.90$ mm/hour
$t=4 \Rightarrow f=2+(5-2)e^{-0.4*4}=2.61$ mm/hour
$t=5 \Rightarrow f=2+(5-2)e^{-0.4*5}=2.41$ mm/hour
$t=6 \Rightarrow f=2+(5-2)e^{-0.4*6}=2.27$ mm/hour
$t=7 \Rightarrow f=2+(5-2)e^{-0.4*7}=2.18$ mm/hour
$t=8 \Rightarrow f=2+(5-2)e^{-0.4*8}=2.12$ mm/hour



c-)



d-) Infiltration depth at 8th hour = the area under the inf. rate vs. time curve

= F =4.01*1+3.35*1+2.90*1+2.61*1+2.41*1+2*1++1.5*1+1*1=19.78mm

e-) Total precipitation depth – infiltered water depth = flow depth

Precipitation Depth = P = the area under hyetograph

P=6*1+4*1+5*1+3*1+6.5*1+2*1+1.5*1+1*1=29mm

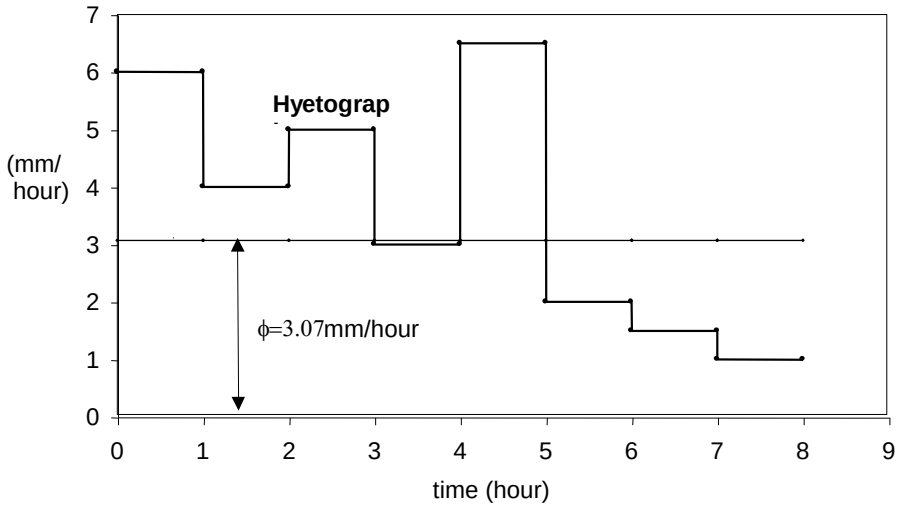
So,
Flow depth=R=P-F 29-19.78=9.22mm

f-)

ϕ İndex

We should search a value between the 3 mm/hour and the 4 mm/hour hour of the hyetograph to find out ϕ index. So:

R=9.22=(6-ϕ)*1+(4-ϕ)*1+(5-ϕ)*1+(6.5-ϕ)*1 and **ϕ=3.07 mm/hour**



The graph is like:

W Index
P:Prec. depth
R:Flow Depth
S:Surface Accumulation
t_p:the duration when the prec. Intensity is higher than infiltration index.

$$W = \frac{P-R-S}{t_p} = \frac{29-9.22-0}{5} = 3.95 mm/hour$$

W=3.95mm/hour