Example 1

The initial infiltration capacity f_o of a watershed is estimated as 3.9 in/hr, and a time constant k of 0.29 hr^{-1}. The infiltration capacity f_c is 0.5 in/hr. If the watershed are is 90 sq. Mile, find using Horton equation:

1. The values of f at t = 20 min, 30 min, 1 hr, 2 hr, and 8 hr.
2. The total volume of water infiltrated over the 8-hour period.

1. $f = f_c + (f_o - f_c)\, e^{-kt}$

$$f = 0.5 + (3.9 - 0.5)\, e^{-0.29t}$$

2

t (hr)	f (in/hr)
0.333	3.59
0.50	3.44
1	3.04
2	2.40
8	0.83

Example 1

$$. F = f_c t + \frac{(f_o - f_c)(1 - e^{-kt})}{k}$$

$$F = 0.5 \times 8 + \frac{(3.9 - 0.5)(1 - e^{-0.29 \times 8})}{0.29} = 14.57 \text{ in}$$

Volume of water =90*(**63 360*63 360)***14.57=5.26*10 ^{12} in^3

Example 2

Use the Green-Ampt equation to evaluate the infiltration rate and cumulative infiltration depth for a silty clay soil at 0.2 hr increments for the first hour and the 0.5 hr increments five additional hours. The initial effective saturation is 24 percent and assume ponding.

$$F(t) = Kt + \psi\Delta\theta \ln(1 + \frac{F(t)}{\psi\Delta\theta})$$

s_e = 0.2

From table, For a silty clay soil, $\theta_e = 0.423$, $\psi = 29.22$ cm, and $K = 0.05$ cm/hr.

Example 2

$$\Delta\theta = (1 - s_e)\,\theta_e = (1 - 0.24) \times 0.423 = 0.321$$

$$\psi\,\Delta\theta = 29.22 \times 0.321 = 9.37 \text{ cm}$$

$$F(t) = Kt + \psi\Delta\theta \ln\left(1 + \frac{F(t)}{\psi\Delta\theta}\right)$$

$$= 0.05\,t + 9.37 \ln\left(1 + \frac{F(t)}{9.37}\right)$$

At $t = 0.1$ hr, $F = 0.28$ cm

$$f(t) = K\left(1 + \frac{\psi\Delta\theta}{F(t)}\right) = 0.05\left(1 + \frac{9.37}{0.28}\right) = 1.72 \text{ cm/hr}$$

Example 2

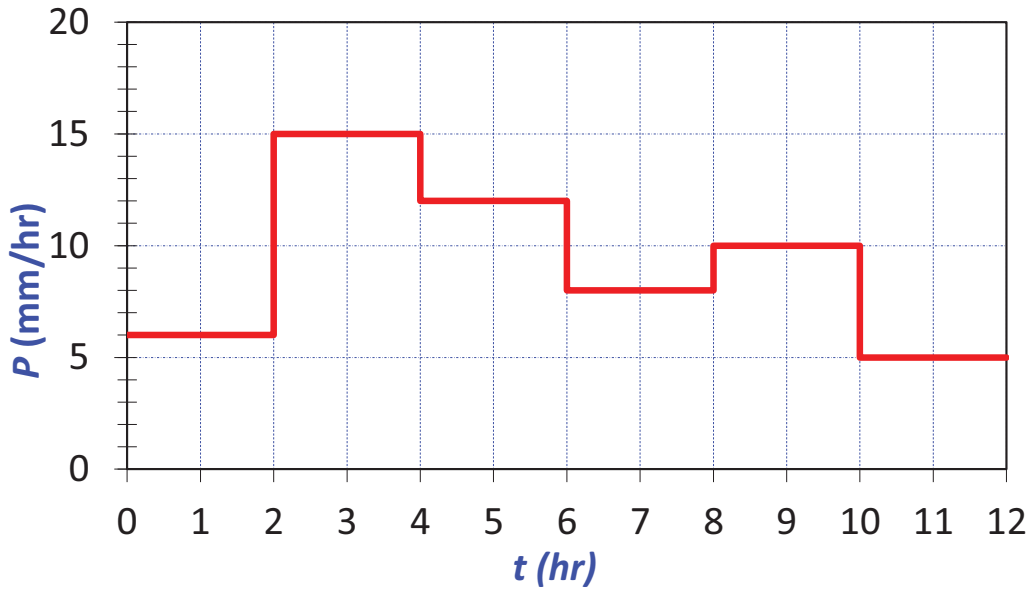
At $t = 0.2$ hr, $F = 0.42$ cm $f(t) = 1.17$ cm/hr

t (hr)	F (cm)	f (cm/hr)	t (hr)	F (cm)	f (cm/hr)
0.1	0.28	1.72	2.5	1.61	0.34
0.2	0.42	1.17	3	1.78	0.31
0.3	0.53	0.93	3.5	1.93	0.29
0.4	0.61	0.82	4	2.07	0.27
0.5	0.69	0.72	4.5	2.21	0.26
1	1	0.51	5	2.34	0.25
1.5	1.23	0.43	5.5	2.46	0.24
2	1.43	0.37	6	2.58	0.23

Example 3

The rates of rainfall for the successive 2 hours period of a 12-hour storm are shown in the following table. The corresponding surface runoff is estimated to be 3.6 cm. Establish the **ϕ-** index.

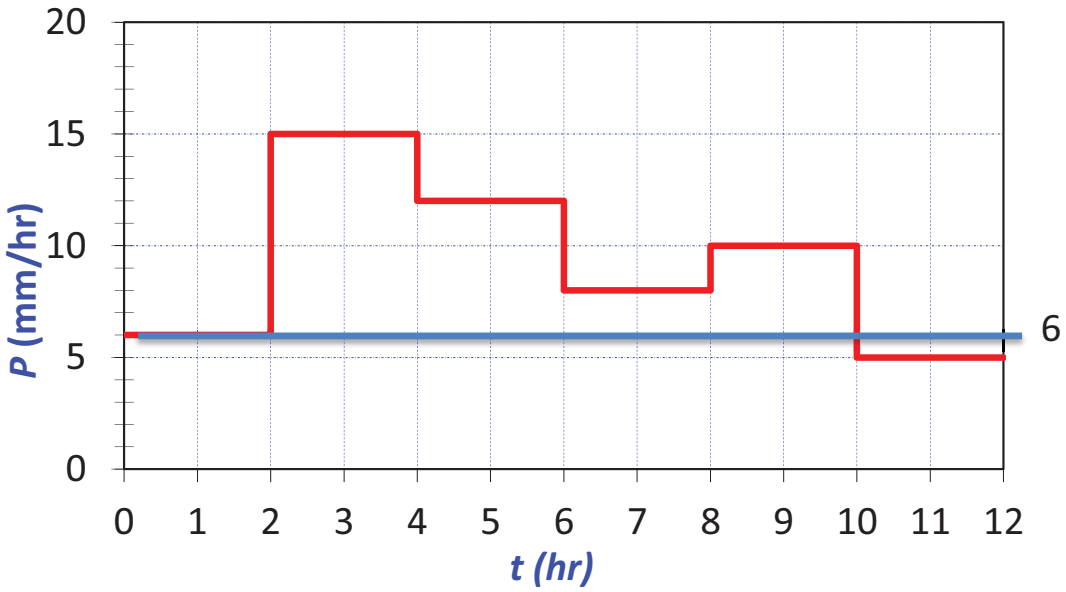
Time (hr)	0 -2	2 - 4	4 - 6	6 - 8	8 -10	10 - 12
Rainfall intensity (mm/hr)	6	15	12	8	10	5



Example 3

Trial #1: assume ϕ-Index = 6 mm/hr

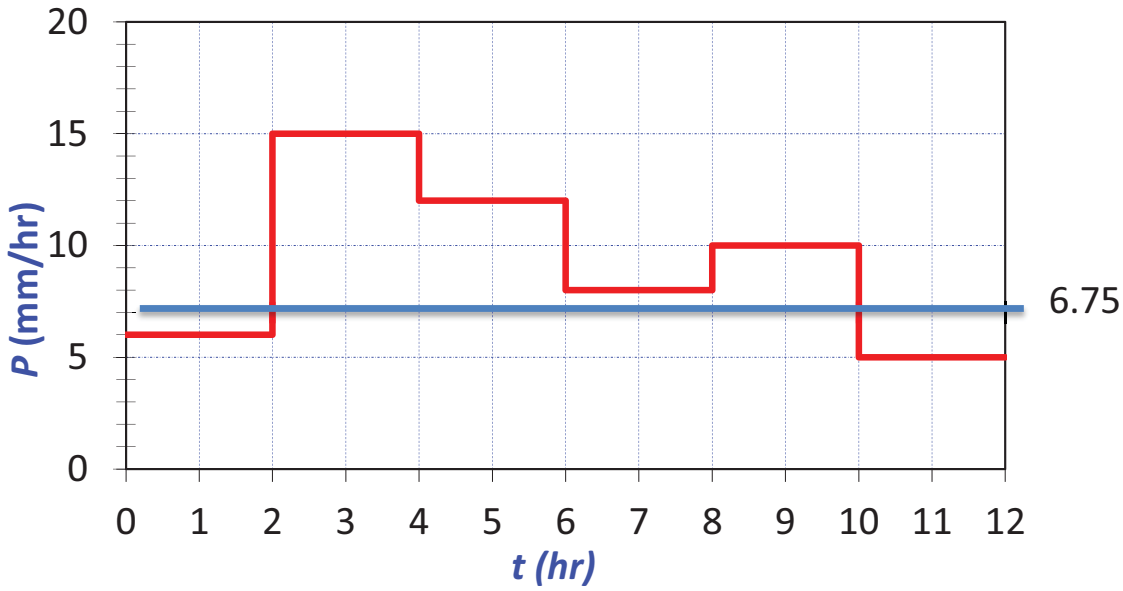
The runoff = $(15 - 6) \times 2 + (12 - 6) \times 2 + (8 - 6) \times 2 + (10 - 6) \times 2 = 42\text{mm} \neq$ the given runoff (36 mm).



Example 3

Trial #2: assume ϕ-Index = 6.75 mm/hr

The runoff = $(15 - 6.75) \times 2 + (12 - 6.75) \times 2 + (8 - 6.75) \times 2 + (10 - 6.75) \times 2 = 36\text{mm}$ = the given runoff (36 mm).



The runoff = $(15 - \phi) \times 2 + (12 - \phi) \times 2 + (8 - \phi) \times 2 + (10 - \phi) \times 2 = 36$