#1) $H_{PT} = 820 - 513 = 305\ mm$ $V_{PT} = 0{,}305 \cdot 25600 = 7808\ hm^3$

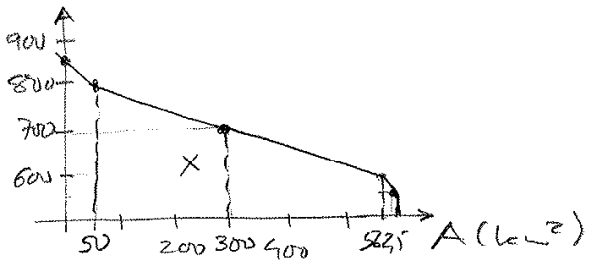
$H_{ES} = 665 - 415 = 250\ mm$ $V_{ES} = 0{,}25 \cdot 55700 = 13925\ hm^3$

$V_{TOTAL} = 21733\ hm^3$ $Q = 21733 \cdot 10^6 / 24 \cdot 365 \cdot 3600 = 689{,}1\ m^3/s$

#2)

z	#	A (km^2)	ΣA
> 850	0	0	0
800 - 850	2	50	50
700 - 800	10	250	300
600 - 700	10,5	262,5	562,5
550 - 600	0,5	12,5	575
	23	575 km^2	

$\#sq = 23$ $A_{sq} = 25\ km^2$



$X = 50 \cdot \frac{800+850}{2} + 250 \frac{700+800}{2} + (562{,}5 - 300) \cdot \frac{700+600}{2} + (575 - 562{,}5) \cdot \frac{600+550}{2}$

$= 50 \cdot 825 + 250 \cdot 750 + 262{,}5 \cdot 650 + 12{,}5 \cdot 575 = 406\,562{,}5$

$z_{avg} = \frac{406\,562{,}5}{575} = 707{,}1\ m$ $h_{avg} = 707{,}1 - 550 = 157{,}1\ m$

#3) $E = \frac{\Delta}{\Delta+\gamma} A + \frac{\gamma}{\Delta+\gamma} B$

A - Capacity of the atmosphere to evaporate water. Dependent on the energy available (radiation) and of temp.

B - Capacity of the atmosphere to hold water. Dependent on water deficit ($e_z^* - e_a$) and wind (v)

#4) $Q_N = \bar{Q} + z \cdot S_Q$

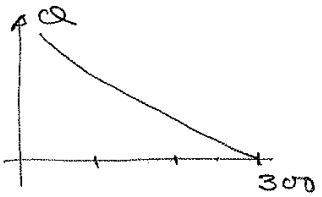
$z = 0 \rightarrow \bar{Q} = 250\ m^3/s$ $z = 1 \rightarrow 325 = 250 + 1 \cdot S_Q \rightarrow S_Q = 75$

$K_G = -\frac{\sqrt{6}}{\pi} \left(0{,}5772 + \ln(-\ln(0{,}98))\right) = 2{,}59$

$T = 50$ $F = 1 - \frac{1}{T} = 0{,}98 \rightarrow K_G = 2{,}59$ $Q = 250 + 2{,}59 \cdot 75 = 444\ m^3/s$

#5) $H = \frac{120}{800} = 0{,}15 = 150\ mm$; $\bar{Q} = \frac{120 \cdot 10^6}{365 \cdot 24 \cdot 3600} = 3{,}81\ m^3/s$

$Q_{180}/\bar{Q} = 0{,}25$ — $Q_{180} = 0{,}25 \cdot 3{,}81 = 0{,}95\ m^3/s$



$1/3{,}81 = 0{,}26 \simeq 180\ d$

$2/3{,}81 = 0{,}52 \simeq 150\ d.$

The power plant works 150 d at full power and 30 d. at a range between 1 and 2 m^3/s

$V_{02} = 150 \cdot 3600 \cdot 24 \cdot 2 + 30 \cdot 3600 \cdot 24 \cdot \frac{1+2}{2}$

$= 298\,080\,000\ m^3$

#6) $t_c = 15' = \frac{15}{60} h = \frac{50\left(0,5 - \frac{100}{500}\right)}{30\left(\frac{30}{k_s} - 1\right)} \rightarrow \frac{30}{k_s} = 1 + \frac{60}{15} \cdot \frac{1}{30} \cdot 50 \cdot 0,3$

$\frac{30}{k_s} = 1 + \frac{30}{15}$ $\quad k_s = \frac{30}{3} = 10 \text{ mm/h}$ ✓

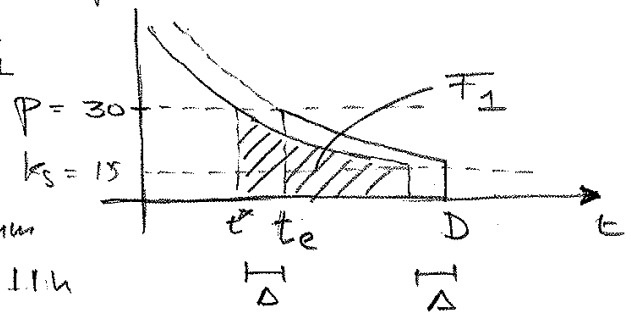
IT NEEDED TO SOLVE THE PROBLEM

Data on total runoff is not need. But:

$H = 1,4 \text{ m} \rightarrow F^{TOTAL} = p \cdot D - 1,4 = 30\ 0,5 - 1,4 = 13,6 \text{ mm}$

$F^{TOTAL} = p \cdot t_c + F_1$

$F^{TOTAL} = F(D - \Delta)$



$F(t^*) = p \cdot t_c = 7,5 \text{ mm}$

$t^* = 0,14 \text{ h}$ $\quad \Delta = 0,11 \text{ h}$

$F(D - \Delta) = F(0,39) = 13,6 \text{ mm}$

$H = p \cdot D - 13,6 = 30 \cdot 0,5 - 13,6 = 1,4 \text{ mm}$

#7)

$i = 30 \text{ mm/h}$ $\quad \Theta_i = 100 \text{ mm}$

$t = 5 \text{ min}$ $\quad \Delta p = \Delta i = 2,5 \text{ mm}$ $\quad \Theta = 102,5 \text{ mm} = 0,205 \text{ m/m}$ ✓

$t = 10 \text{ min}$ $\quad \Delta p = \Delta i = 5 \text{ mm}$ $\quad \Theta = 105,0 \text{ mm} = 0,21 \text{ m/m}$

$t = 15 \text{ min}$ $\quad \Delta p = \Delta i = 7,5 \text{ mm}$ $\quad \Theta = 107,5 \text{ mm} = 0,215 \text{ m/m}$

all $< \Theta_{fc}$ ✓

#9) $T_c = 2,5 \text{ h}$; $T = 50 \text{ y}$ $\quad i = 305 \cdot 150^{-0,49} = 26,18 \text{ mm/h}$

$Q = C \cdot i \cdot A = 0,6 \cdot 26,18 \cdot 120 / 3,6 = 523,6 \text{ m}^3/\text{s}$

#10) a) $T_c = 6 - 2 = 7 - 3 = 4 \text{ h}$

b) $V_A = 1 \cdot 3600 \cdot 1050 = 3'780'000 \text{ m}^3$ $\quad P_A = 15 \text{ mm}$ $\quad A = V_A / P_A = 252 \text{ km}^2$

$V_B = 1 \cdot 3600 \cdot 3150 = 11'340'000 \text{ m}^3$ $\quad P_B = 45 \text{ mm}$ $\quad A = V_B / P_B = 252 \text{ km}^2$

c) The precipitation event = Event B − Event A

t (h)	0	1	2	3	4	5	6	7
Q (m^3/s)	0	100	400	600	600	300	100	0

$= Q_B - Q_A$

#10) LONG WAY: Compute UH and the the flood hydrograph

Event A

$Q_1 = 50 = P_1 \cdot U_1 = 3 \cdot U_1 \rightarrow U_1 = 10$

$Q_2 = 250 = P_1 \cdot U_2 + P_2 \cdot U_1 \rightarrow U_2 = 30$

$Q_3 = 400 = P_1 \cdot U_3 + P_2 \cdot U_2 + P_3 \cdot U_1 \rightarrow U_3 = 20$

$Q_4 = 250 = P_1 U_4 + P_2 \cdot U_3 + P_3 \cdot U_2 + P_4 \cdot U_1 \rightarrow U_4 = 10$

Same UH, as expected

Event B

$Q_1 = 150 \rightarrow U_1 = 10$

$Q_2 = 650 \rightarrow U_2 = (650 - 10 \cdot 20)/15 = 30$

$Q_3 = 1000 \rightarrow U_3 = (1000 - 30 \cdot 20 - 10 \cdot 10)/15 = 20$

$Q_4 = 850 \rightarrow U_4 = (850 - 20 \cdot 20 - 10 \cdot 30 - 0)/15 = 10$

	30 mm			
U_i	10	10	10	
0	0			0
10	100	0		100
30	300	100	0	400
20	200	300	100	600
10	100	200	300	600
0	0	100	200	300
		0	100	100
			0	0

← SAME ANSWER.