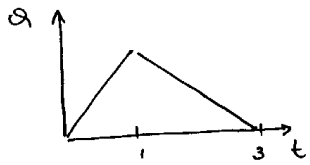
P2) Por continuidad, tenemos:

a) $\frac{\partial \forall}{\partial t} = Q_e - Q_s$ ⇒ $\frac{d\forall}{dz} \cdot \frac{dz}{dt} = Q_e(t)$ → dado por el hidrograma.

$\forall = 5 \times 10^6 \cdot e^{0,0558 \cdot (z-20)}$ ⇒ $\frac{d\forall}{dz} = 5 \times 10^6 \cdot 0,0558 \cdot e^{0,0558\,(z-20)}$

$\therefore \; 279000 \cdot e^{(0,0558 z - 1,1160)} \cdot \frac{dz}{dt} = Q_e(t)$

Del hidrograma, tenemos:



para la curva 1: $Q = 0,0029 \cdot t + 156$

curva 2: $Q = -0,0014 \cdot t + 531$.

$$\int_{z_0}^{z_{max}} 279000 \cdot e^{(0,0558 z - 1,1160)}\, dz = \int_0^t (0,0029 \cdot t + 156)\, dt$$

a) Si $z_0 = 56$ m ⇒ $0,5 \times 10^7 \cdot e^{(0,0558 z - 1,1160)} \Big|_{56}^{60} = 0,00145 \cdot t^2 + 156\, t$

$0,00145\, t^2 + 156\, t - 0,932059 \times 10^7 = 0$

$t_1 = 42755,79$ [s]

$t_2 = -150342,00$ [s]

b) Si $z_0 = 45$ m ⇒ $0,5 \times 10^7 \cdot e^{(0,0558 z - 1,1160)} \Big|_{45}^{60} = \left(0,00145\, t^2 + 156\, t\right)\Big|_0^{86400} + \left(-0,0007\, t^2 + 531\, t\right)\Big|_{86400}^{t}$

⇒ $-0,0007\, t^2 + 531\, t - 0,427679 \times 10^8$

$t_1 = 91604,16$ [s]

$t_2 = 666967,26$ [s]