Dimensionamento de reactores isotérmicos

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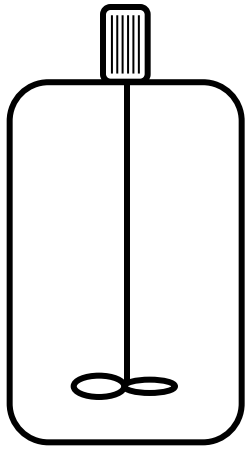
Reactor Batch



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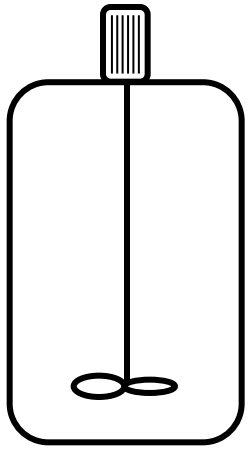
Balanço molar $r_A V = \frac{dN_A}{dt}$

$N_A = N_{A0}(1 - X)$



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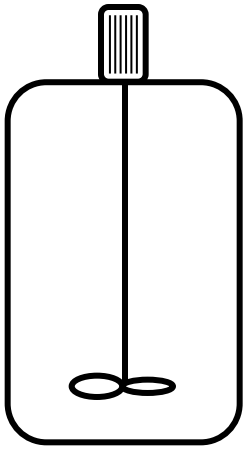

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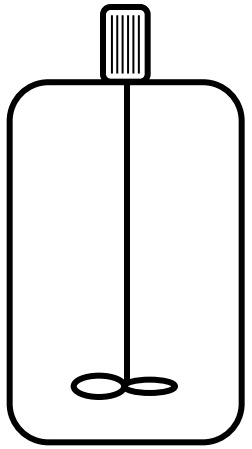

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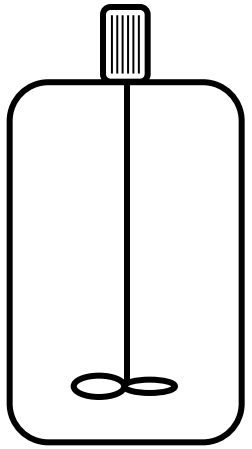

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Lei cinética

Reacção de ordem n, Volume constante:

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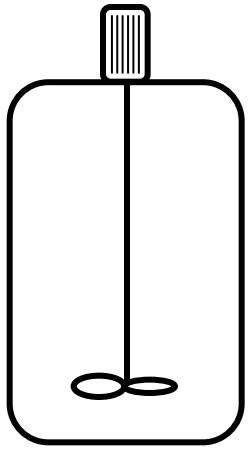

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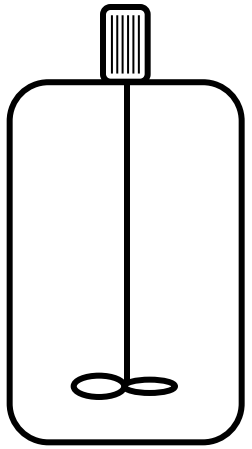

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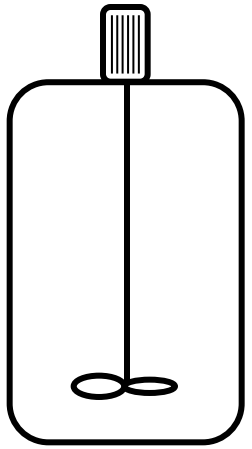

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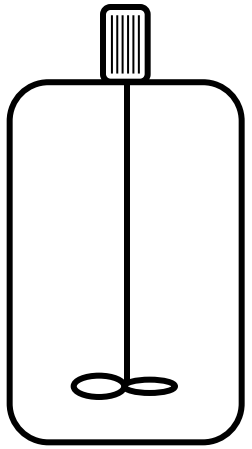

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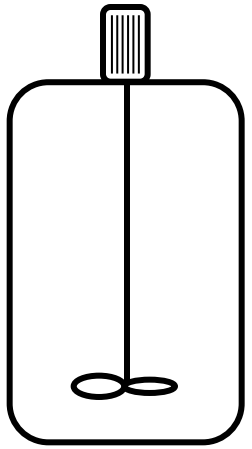

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Exemplo

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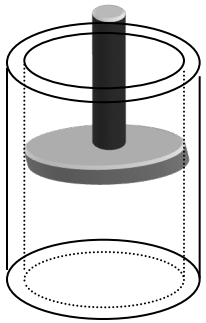

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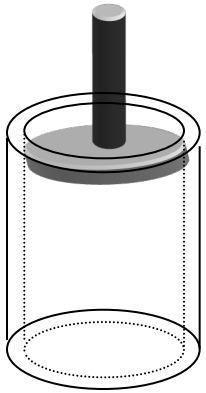

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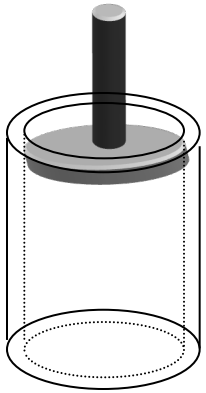

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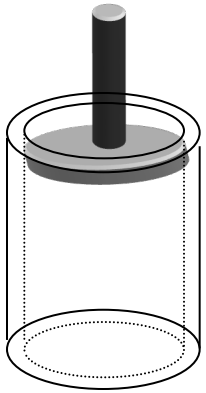

$$\therefore \quad dt = \frac{dX}{k\,\dfrac{N_{A0}^{(n-1)}(1-X)^{\alpha}\left(\theta_B - \dfrac{b}{a}\cdot X\right)^{\beta}}{V^{(n-1)}}}$$

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$$\therefore \quad dt = \frac{1}{k}\cdot\frac{\left(1+\varepsilon X\right)^{(n-1)}}{C_{A0}^{(n-1)}(1-X)^{\alpha}\left(\theta_B - \dfrac{b}{a}\cdot X\right)^{\beta}}\,dX$$

$$\therefore \quad dt = \frac{dX}{k \dfrac{N_{A0}^{(n-1)} (1-X)^{\alpha} \left(\theta_B - \dfrac{b}{a} \cdot X \right)^{\beta}}{V^{(n-1)}}}$$

$$T = T_0$$

$$V = V_0 (1 + \varepsilon X) \cdot \frac{P_0}{P}$$

$$\varepsilon = y_{A0}\, \delta$$

Reactor isobárico: $P = P_0 \quad \Rightarrow \quad V = V_0 (1 + \varepsilon X)$

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$$t = \frac{1}{k C_{A0}^{(n-1)}} \cdot \int_0^X \frac{(1 + \varepsilon X)^{(n-1)}}{(1-X)^{\alpha} \left(\theta_B - \dfrac{b}{a} \cdot X \right)^{\beta}} dX$$

$$\therefore \quad dt = \frac{1}{k} \cdot \frac{(1 + \varepsilon X)^{(n-1)}}{C_{A0}^{(n-1)} (1-X)^{\alpha} \left(\theta_B - \dfrac{b}{a} \cdot X \right)^{\beta}} dX$$

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Exemplo

Reactor não isobárico: $V = V_0 (1 + \varepsilon X) \cdot \frac{P_0}{P}$

$$\frac{P}{P_0} = f(V)$$

$$\frac{P}{P_0} = \gamma V$$

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Dimensionamento de reactores isotérmicos

Reactor Batch

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Reactor Batch $A \longrightarrow B$

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Velocidade de produção:

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t_{oper}

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A conversão óptima e o tempo de operação óptimo correspondem à velocidade de produção máxima

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Equação de uma recta

$$\frac{dv_{prod}}{dt} = 0$$

$$\frac{d}{dt}\left(\frac{N_{A0} X}{t_{oper}} \right) = 0$$

Inclinação

$$\therefore \quad \frac{\frac{dX}{dt}\left(t + t_d\right) - X}{t_{oper}^2} = 0$$

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Equação de uma recta

$$\frac{dv_{prod}}{dt} = 0$$

$$\frac{d\left(N_{A0}\,X\right)}{dt} = \frac{\left(t + t_d\right) - X}{t_{oper}}$$

Inclinação

Ordenada na origem

$$\therefore \quad \frac{\frac{dX}{dt}\left(t + t_d\right) - X}{t_{oper}^2} = 0$$

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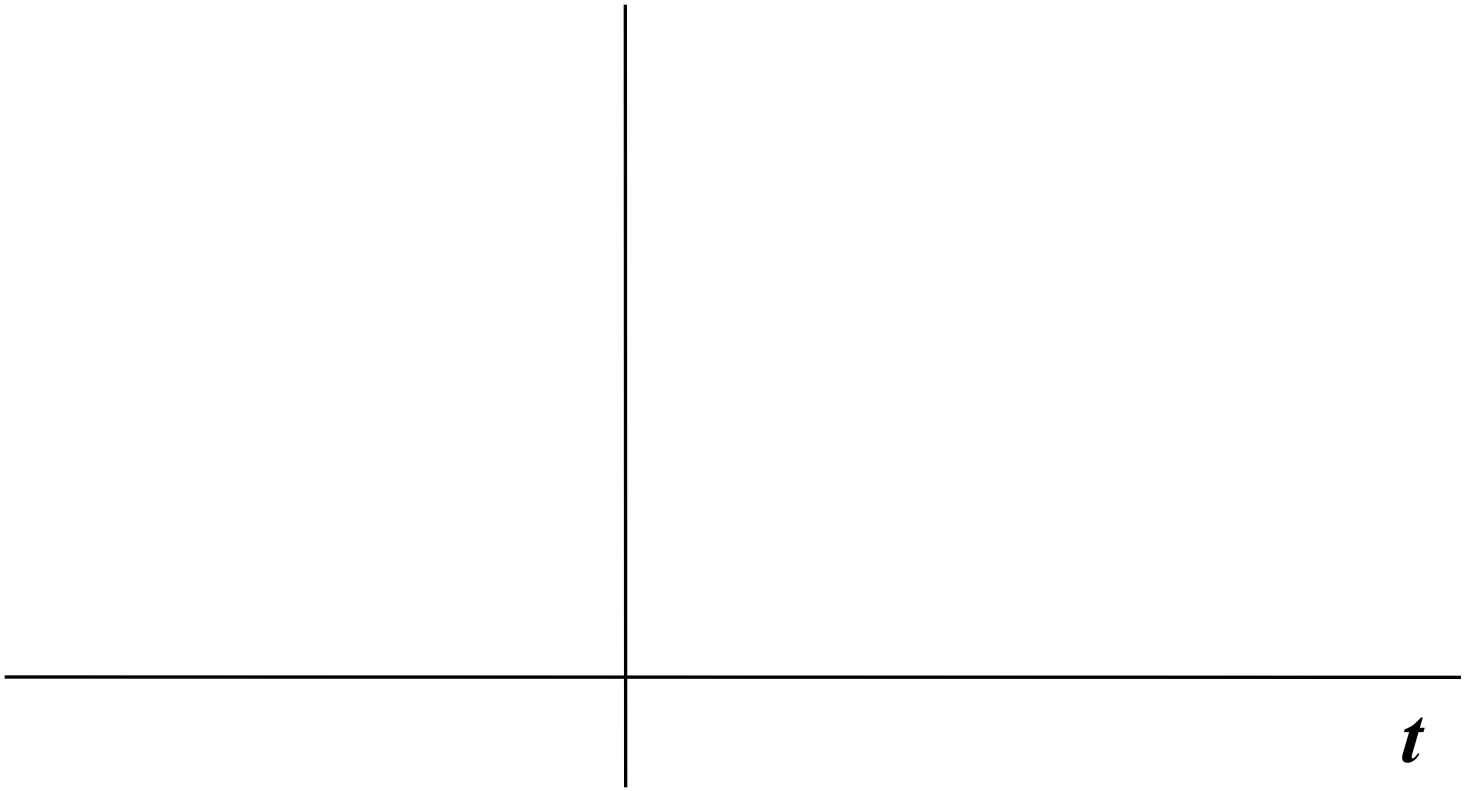

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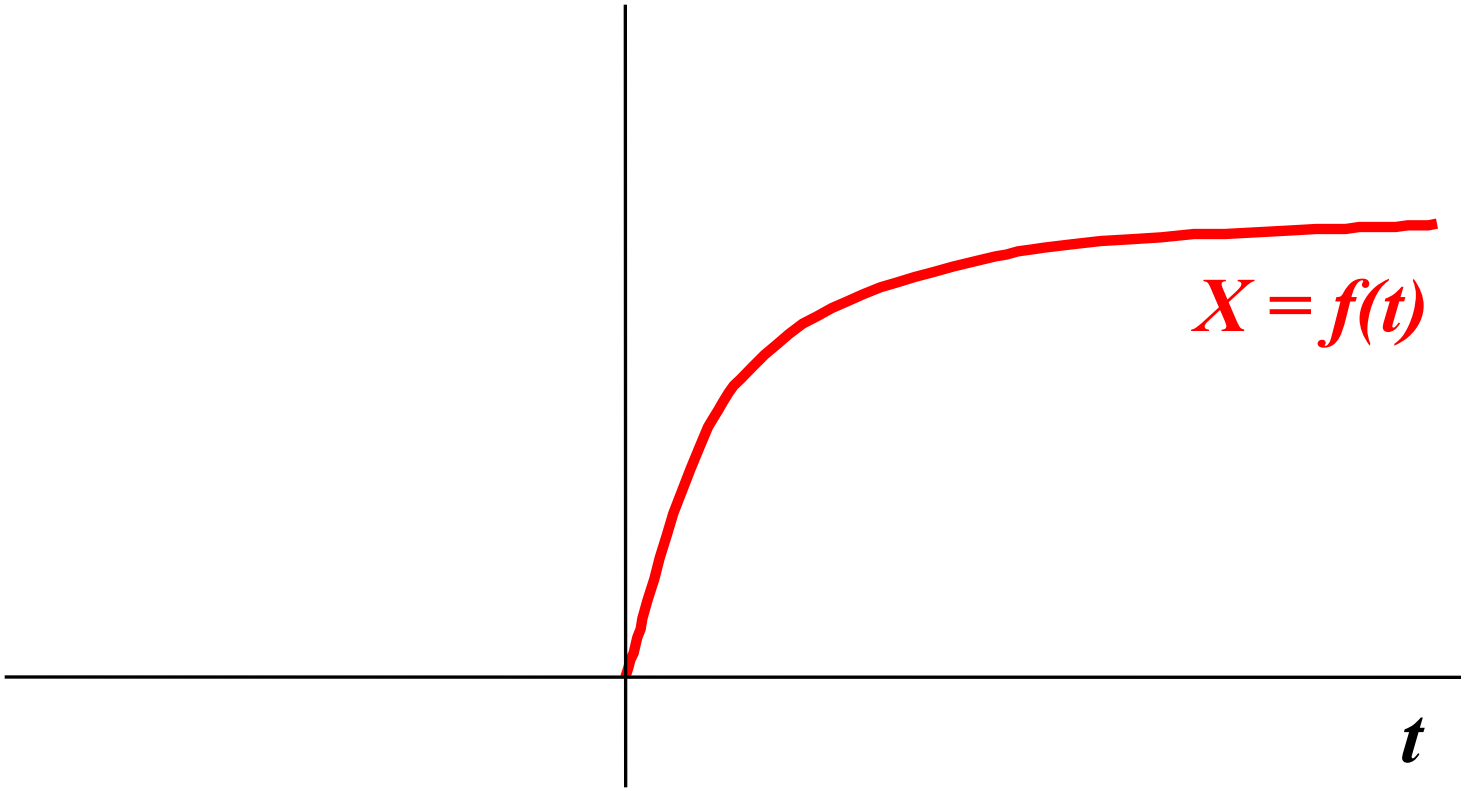

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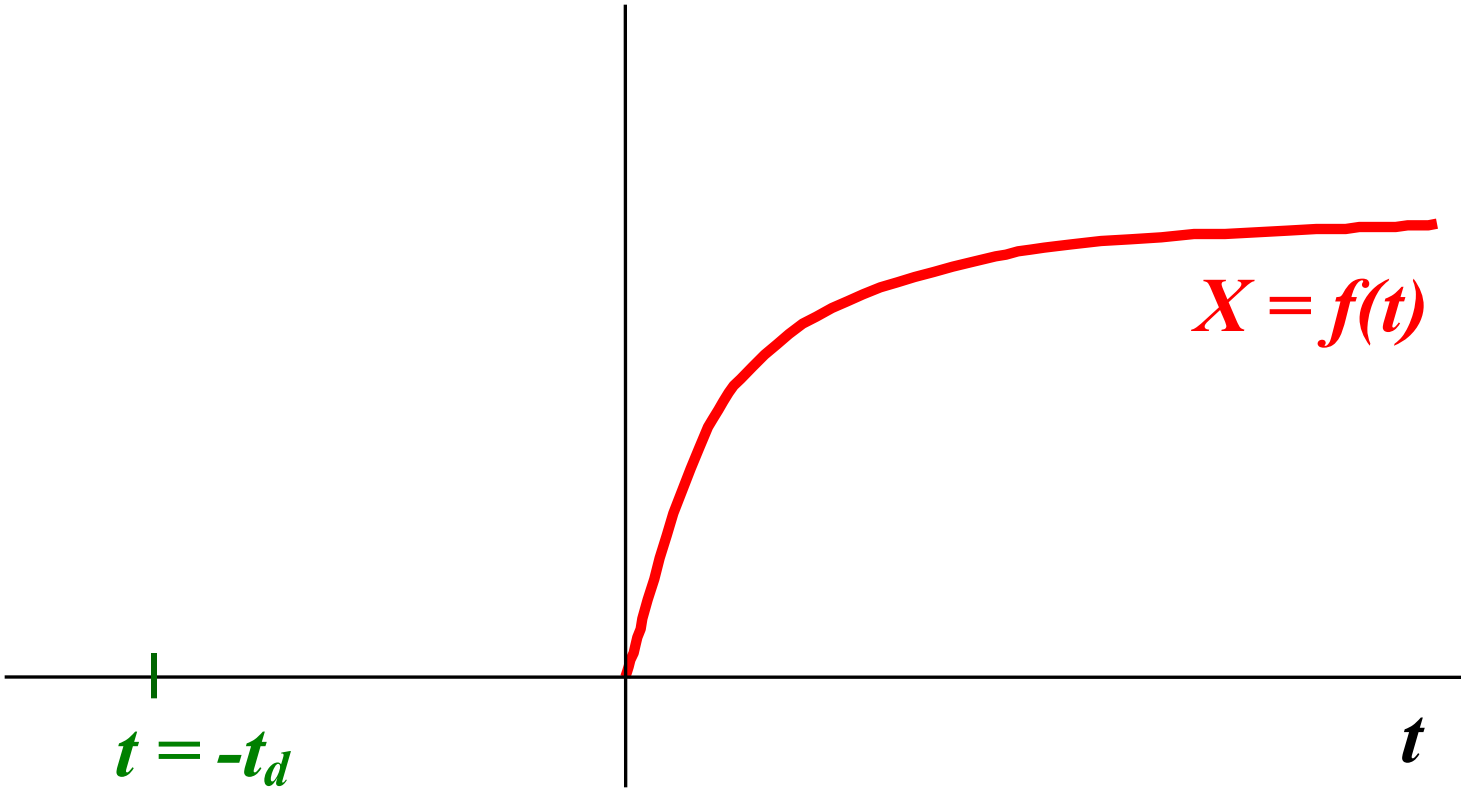

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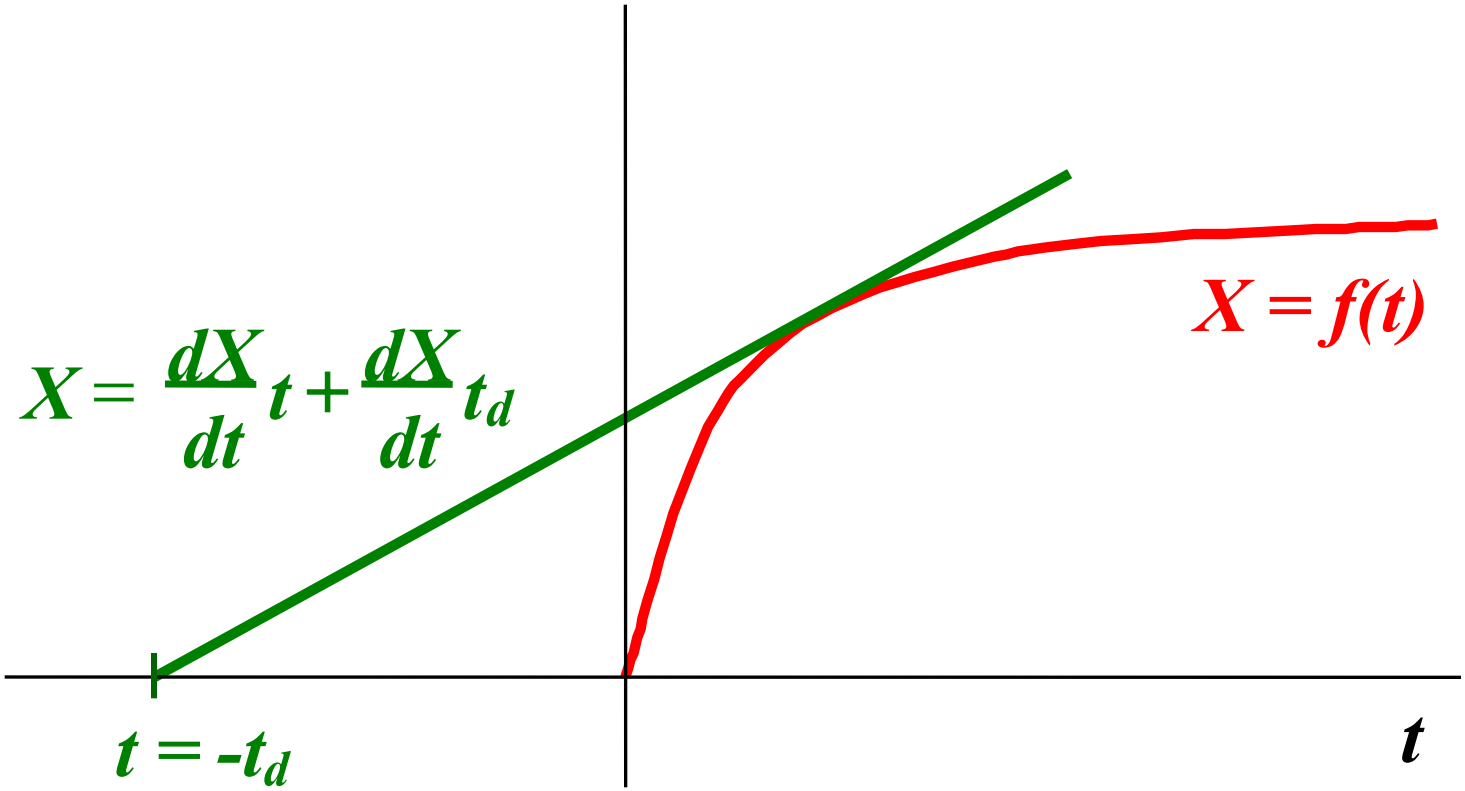

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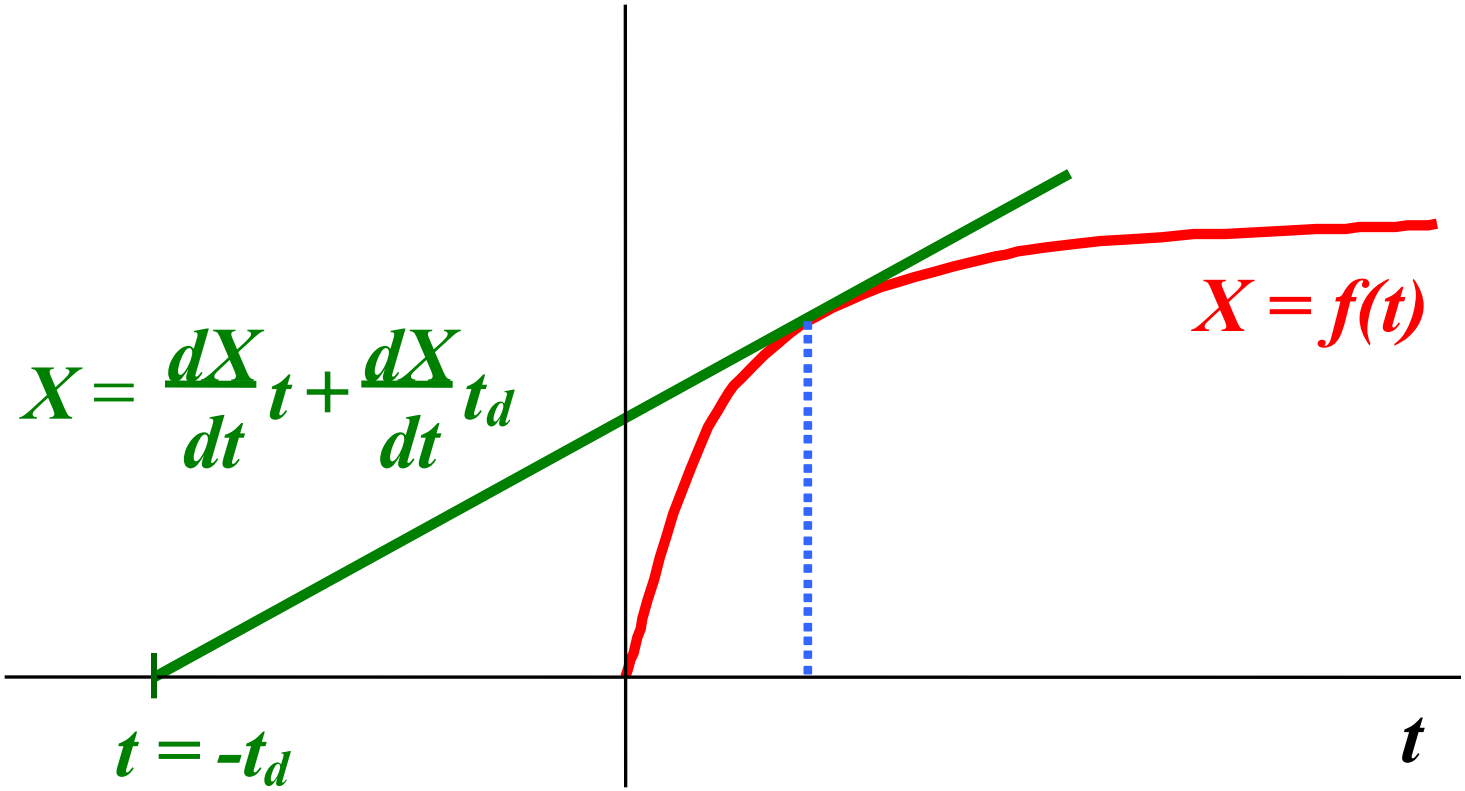

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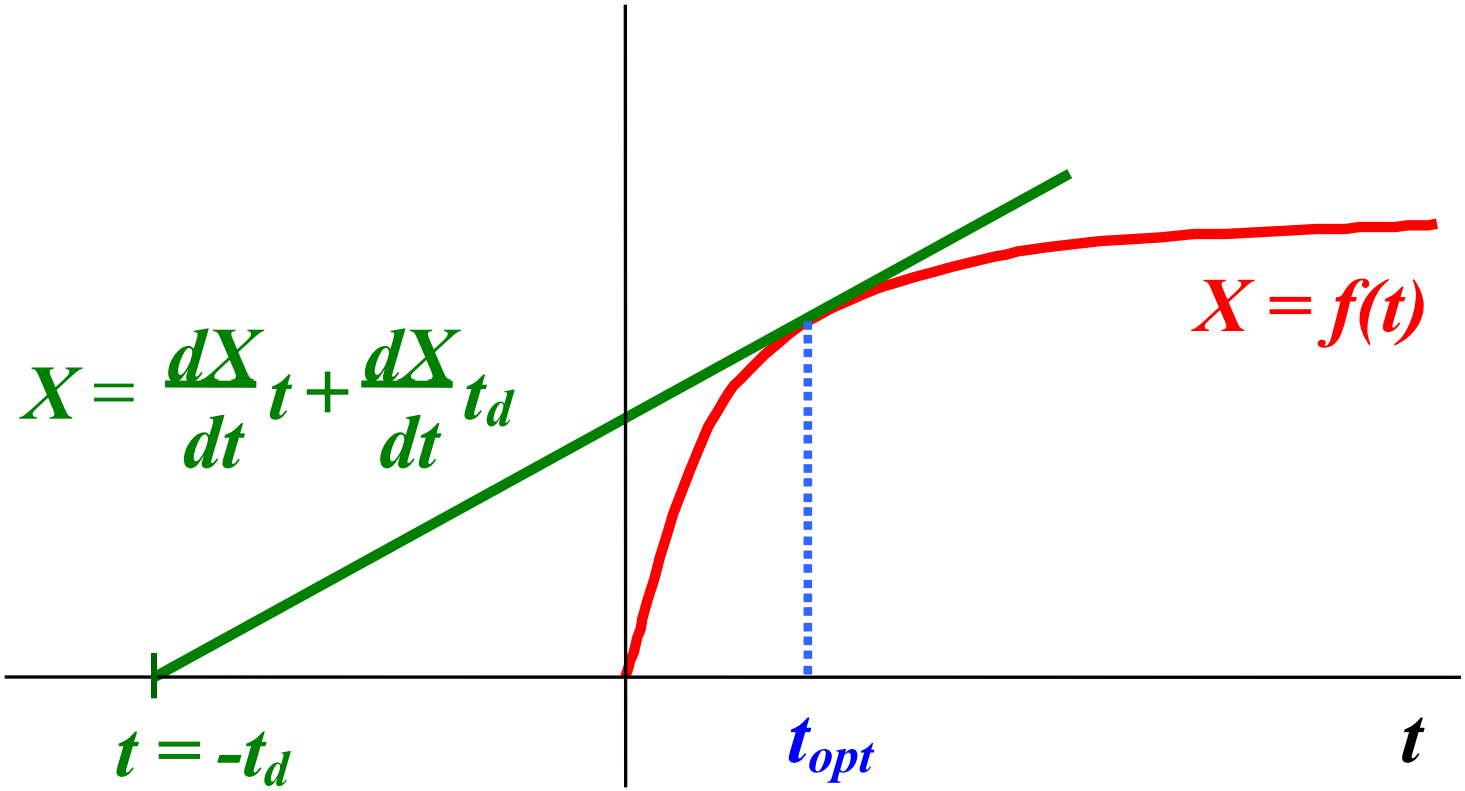

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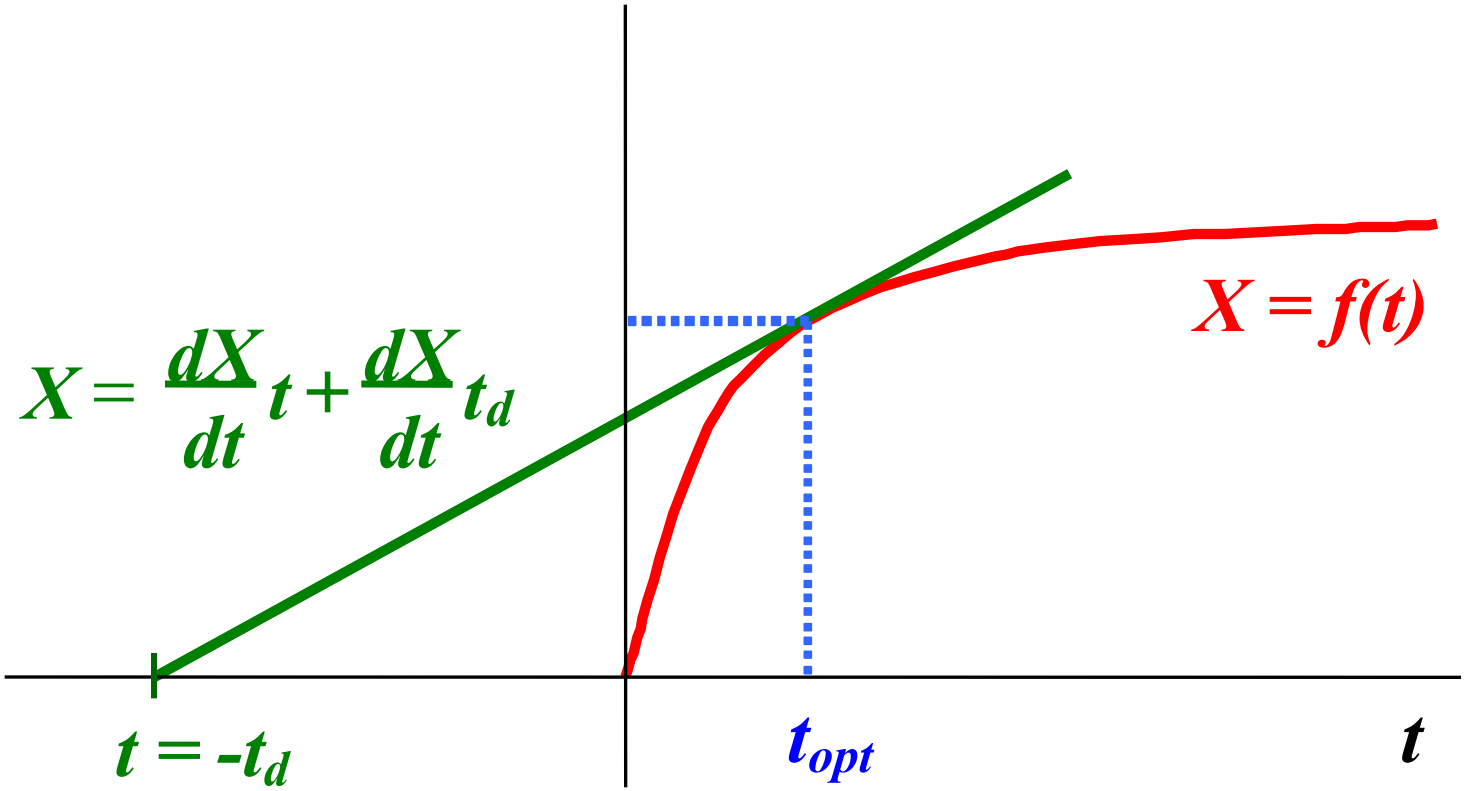

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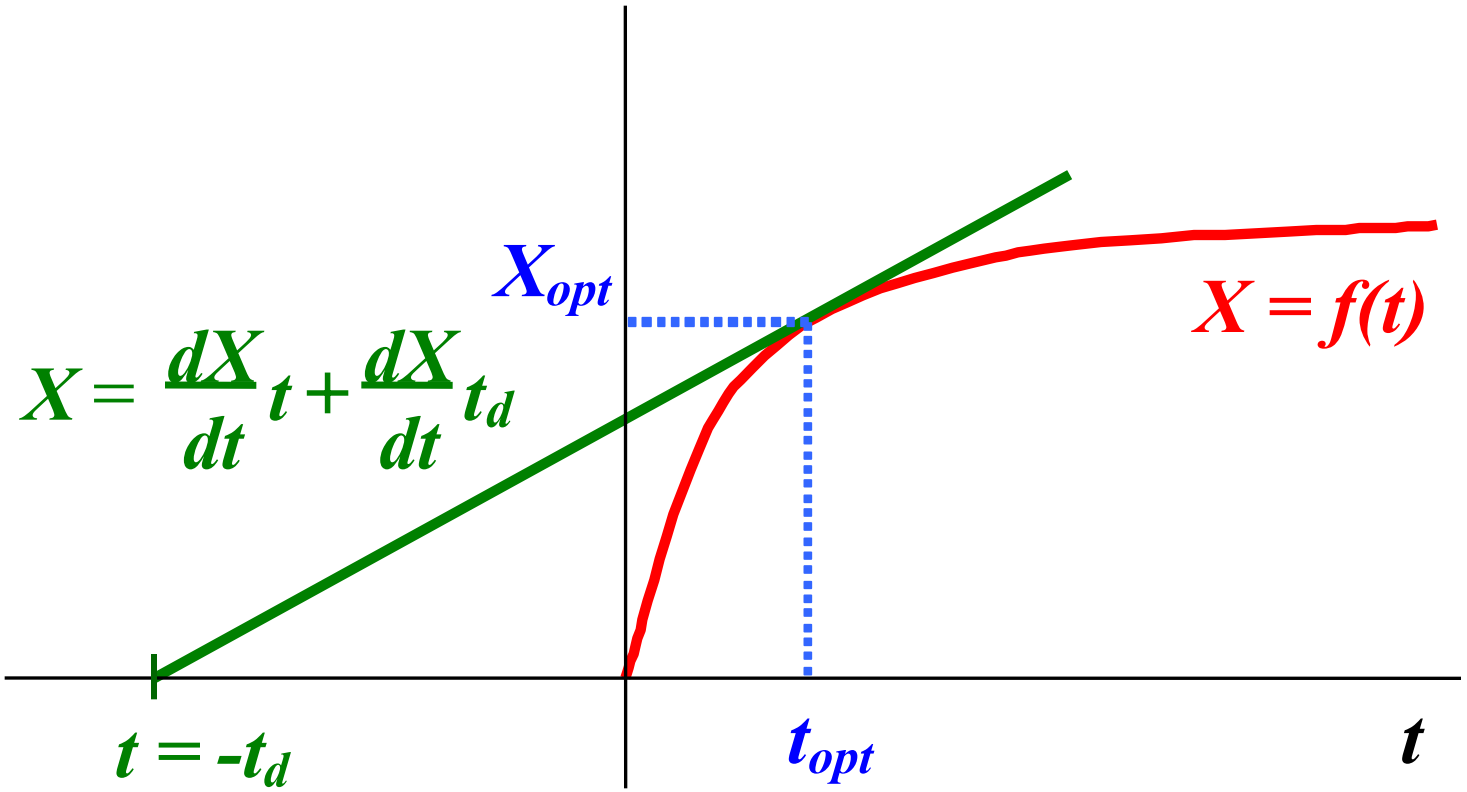

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