

Homework #2

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1. a) The standard material balance eqn for conc. of mRNA m_i , and translated protein p_i is

$$\dot{m}_i = \delta_{X,i} u_i - (\mu + \theta_{m,i}) m_i + \tau_i$$

$$\dot{p}_i = \delta_{L,i} w_i - (\mu + \theta_{p,i}) p_i$$

where $i = 1, 2, \dots, N$

where μ is the intracellular dilution given by

$$\mu = \beta^{-1} \dot{\beta}$$

where

$$\beta = X V_R$$

$$\dot{\beta} = X \dot{V}_R + \dot{X} V_R$$

$$\therefore \beta^{-1} \dot{\beta} = V_R \dot{V}_R + X \dot{X}$$

For a cell-free system, X is a cell mass conc. in culture, $= 0$ &

V_R , or volume of culture, is constant.

2c

Siddharth

$$\dot{V}_R = 0$$

$$\therefore \underline{\underline{\dot{\beta} = 0}}$$

$$\therefore \underline{\underline{\mu = 0}}$$

Substituting in our standard eqn gives us

$$\dot{m}_i = \delta_{x,i} u_i - \theta_{m,i} m_i + r_i$$

$$\dot{p}_i = \delta_{h,i} w_i - \theta_{p,i} p_i$$

\therefore For all species,

$$\begin{aligned} \dot{m} &= \delta_x u - \theta_m m + r \\ \dot{p} &= \delta_L w - \theta_p p \end{aligned} //$$

Hence Proved

Part b, c in GitHub repository.

