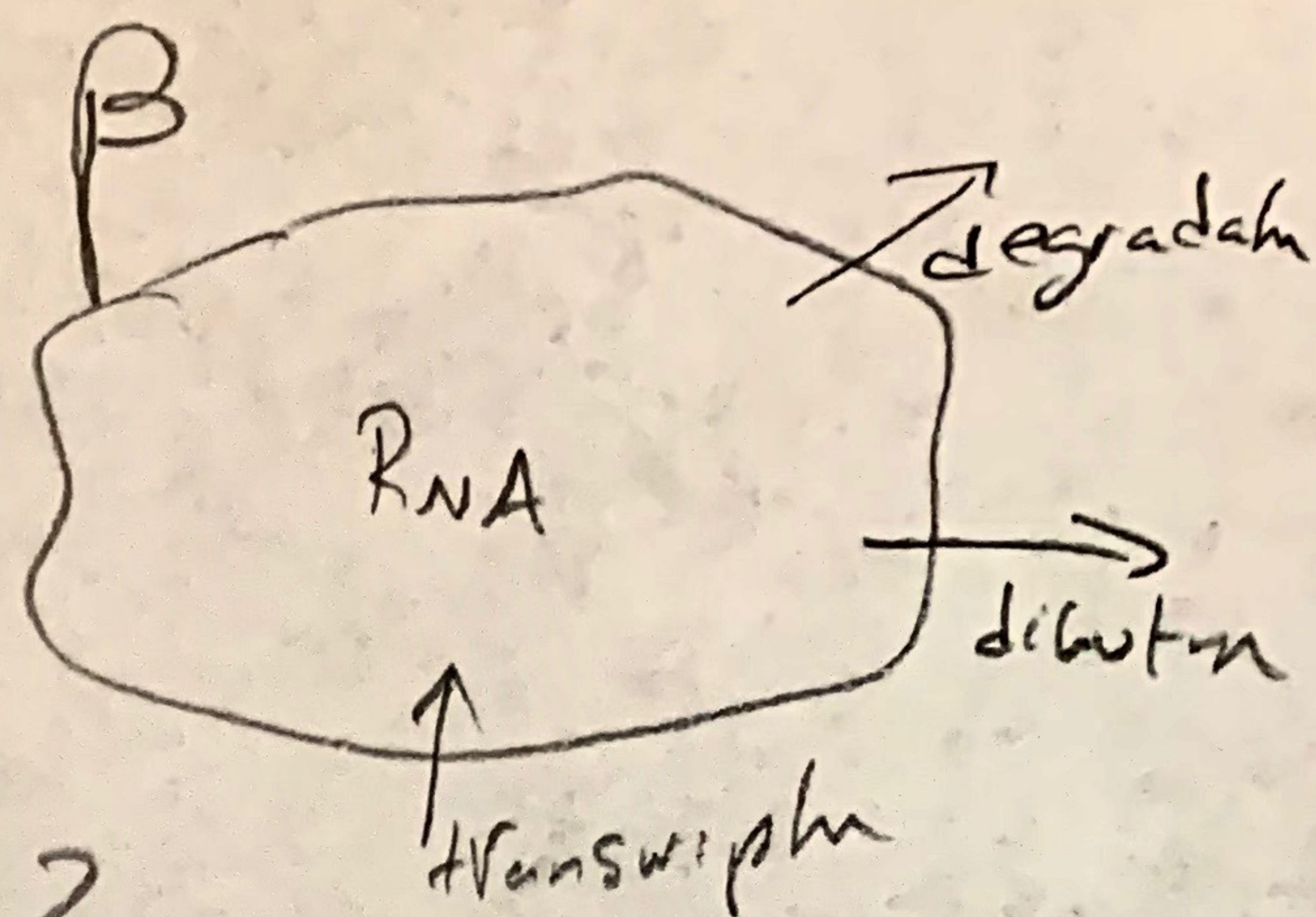


# Problem - Set 2

A.) for Volume  $\beta$



$$\dot{m} = \{ \text{rate}_{\text{in}}^{\text{RNA}} \} - \{ \text{rate}_{\text{out}}^{\text{RNA}} \}$$

produced by transcription

dilution, degradation

$$\dot{m} = \underbrace{r_{x_i} u_i}_{\text{rate of transcription (of particular gene)}} - (\underbrace{\mu_i}_{\text{rate dilution}} + \underbrace{\phi_{m_i}}_{\text{rate degradation}}) \underbrace{m_i}_{\text{amount of mRNA}} + \underbrace{\lambda_i}_{\text{leakage + smoothing term}}$$

for a constant  $V$  system with no cells or growth,  $\beta = V_c$ ,  $\frac{dV}{dt} = 0 \Rightarrow \mu = 0$

so  $\dot{m} = r_{x_i} u_i - \phi_{m_i} m_i + \lambda_i$

Similarly,

$$\dot{p} = \underbrace{r_p w}_{\text{translation}} - (\underbrace{\mu}_{\text{dilution}} + \underbrace{\phi_{p_i}}_{\text{degradation}}) \underbrace{p_i}_{\text{amount protein}}$$

$$\frac{dV}{dt} = 0 \quad \mu = 0$$

$$\dot{p} = r_p w - \phi_{p_i} p_i$$