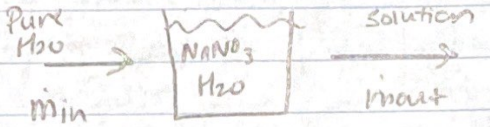
①

$NaNO_3 = 90$ kg

$H_2O = 110$ kg



} over time $C_{NaNO_3 + H_2O}$ decreases

a) $\dot{m}_{accumulation} = \dot{m}_{in} - \dot{m}_{out}$

$\frac{dm}{dt} = \dot{m}_{in} - \dot{m}_{out}$ * $\dot{m}_{in} = \dot{m}_{out}$

$\boxed{\frac{dm}{dt} = 0}$

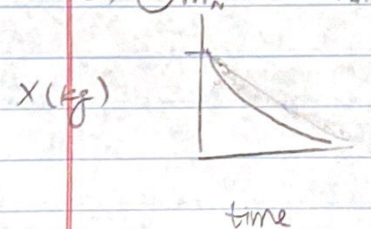
b) $x(t, \dot{m})$ = mass fraction of $NaNO_3$ in tank

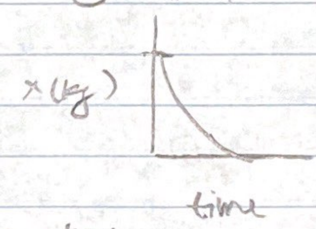
$$\boxed{\frac{d(m_{tot} \cdot X_{tank})}{dt} = \left(-\dot{m}_{out}\right)\left(X_{NaNO_3,\,out}\right)}$$

* $X(t, \dot{m})$ = kg $NaNO_3$ / kg tank

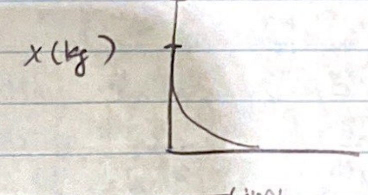
$\boxed{\text{* initial condition} \quad t = 0, \ m_{total} = 200 \text{ kg}}$

c) ① $\dot{m}_N = 50$ kg/min ② $\dot{m}_N = 100$ kg/min





③ $\dot{m}_N = 200$ kg/min



* Integrating (b) will result in exponential decreasing curve. $\frac{d(X_{tank})}{X_{NaNO_3}} = \frac{-\dot{m}_{out}}{m_{tank}} \rightarrow \ln|X_{NaNO_3}| = \frac{-\dot{m}_{out}}{m_{tank}} t$

$\boxed{X_{NaNO_3} = e^{-\dot{m}_{out}/m_{tank} \cdot t}}$