As shown in the figure, an ordinary bathtub with given inlet volume flow rate and exit volume flow rate. The density of water is constant at 1000 kg/m³.

1. Identify the type of region enclosed by the dashed boundary in the figure, control volume or system? ______________

2. Determine the type of the boundary: Are all the boundaries real? ___________ (if not, please mark the imaginary boundary in the figure). Are all the boundaries fixed? ___________ (if not, please mark the moving boundary in the figure)

3. Please determine $\Delta M_{\text{bath tub}}$ within 10 minutes-time interval.

Known: $V_i$, $V_e$, $P_{\text{water}}$  
Final: $\Delta M_{\text{bath tub}}$

Assumption:

Analyze: from mass conservation

$$M_{\text{in}} - M_{\text{out}} + M_{\text{gain}} = \Delta M$$

Also we have $M = \rho V$

$$P_{\text{water}} (V_{\text{in}} - V_{\text{out}}) = \Delta M$$

$$M = M \Delta t, \ V = V \Delta t$$

$$\Rightarrow P_{\text{water}} (V_{\text{in}} - V_{\text{out}}) \Delta t = \Delta M$$

So $\Delta M_{\text{bath tub}} = 1000 \text{ kg/m}^3 \times (2 \times 10^{-3} - 1 \times 10^{-3}) \text{ m}^3/\text{s} \times 600 \text{ s} = 600 \text{ kg}$