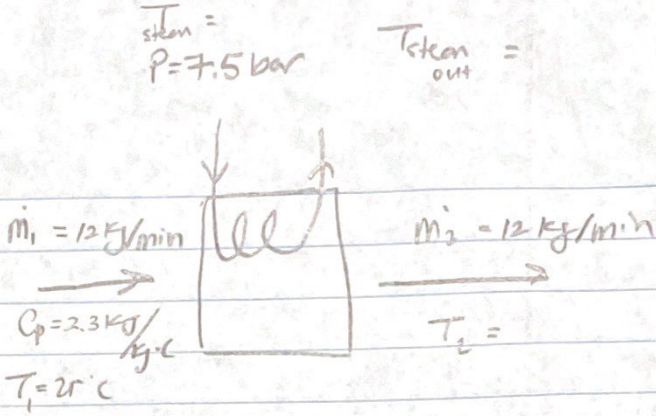
3) $\dot{Q} = UA(T_{steam} - T)$ ✓ 167.8 °C

$\dot{Q} = 11.5$ kJ/min·°C



M_{Tank} at $T(0) = 760$ kg

$T(0) = 25$ °C

a) $T(0) = 25$ °C

$$M C_v \frac{dT}{dt} = \dot{m} C_p (T_{in} - T_{out}) + UA(T_{steam} - T)$$

$$\frac{dT}{dt} = \frac{(12)(2.3)}{(760)(2.3)}(25 - T_{out}) + \frac{11.5}{(760)(2.3)}(167.8 - T_{out})$$

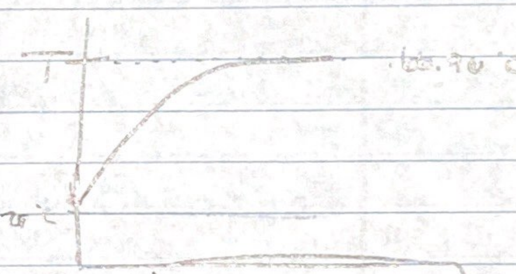
$$\boxed{\frac{dT}{dt} = 1.50 - 0.0224T}$$

b)

$$\frac{dT}{dt} = 0 = 1.50 - 0.0224T$$

$$\boxed{T = 66.96\text{ °C}}$$

steady state



$\boxed{T(0) = 25\text{ °C}}$

initial

c) $\frac{dT}{dt} = 1.50 - 0.0224T$

$$\frac{dT}{1.50 - 0.0224T} = dt$$

$$\frac{-1}{0.0224}\left(\frac{du}{u}\right) = dt \quad + c$$

$$\frac{-1}{0.0224}(\ln|1.50 - 0.0224T|) = t + c$$

$$\ln|1.5 - 0.0224T| = -0.0224t - 0.0224c$$

$$1.5 - 0.0224T = (e^{-0.0224t})(e^{-0.0224c})$$

$$\frac{1.5 - e^{-0.0224t}(k)}{0.0224} = T(t)$$

$k = 0.94$

$$\frac{1.5 - e^{-0.0224t}(0.94)}{0.0224} = T(t)$$

$$\boxed{T(40) = 49.83\text{ °C}}$$

3d continued

$$\frac{dT}{dt} = \frac{12\,(2.3)}{760\,(2.3)}\,(25 - T) + \frac{C}{(760)(2.3)}\,(169.8 - T)$$

→ when integrated with WolframAlpha...

let $UA = C$, after integrating $\int_{25}^{25} \ldots = dt$

$$40 = \frac{9911994835\,[illegible]\,770\left(\log C - \log\left(\frac{94C}{119}\right) - \frac{[illegible]}{[illegible]}\right)}{567044\,[illegible]\,C + [illegible]}$$

$$\boxed{C = UA = 8.996}$$

$$\boxed{\frac{11.5 - 8.996}{11.5} = 21.7}$$