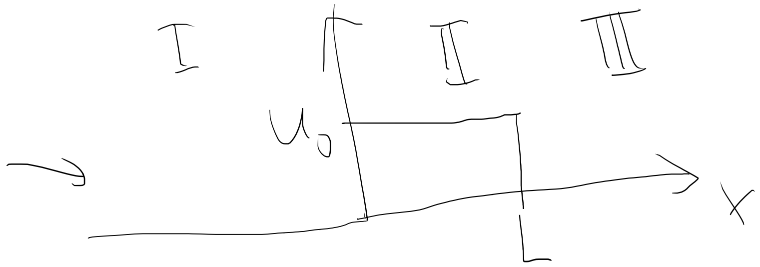
$$u = \begin{cases} U_0 & 0 < x < L \\ 0 & \text{otherwise} \end{cases}$$



$E < U_0$

$$a = \tau \dot{a} + \frac{F}{m} = \tau \dot{a} + \frac{1}{m}\left[-U_0\,\delta(x) + U_0\,\delta(x-L)\right]$$

$x < 0$ $\qquad 0 < x < L$ $\qquad x > L$

$$a = \tau \dot{a} \Rightarrow a(t) = a(t=0)\, e^{+t/\tau}$$

$$x(t=0) = 0$$

$$x(t=t_1) = L$$

$t < 0 \qquad a^{I}(t) = 0$

$0 < t < t_1 \qquad a^{I}(t) = a(t=0)\, e^{+t/\tau}$

$$a = \tau \dot{a} + \frac{1}{m}\left[-U_0\,\delta(x) + U_0\,\delta(x-L)\right]$$

$$\dot{a} = \frac{da}{dx}\frac{dx}{dt} = \frac{da}{dx}\,v$$

$$\frac{da}{dx}\cancel{v}\,\tau = a - \frac{1}{m}\left[-U_0\,\delta(x) + U_0\,\delta(x-L)\right]$$

$$\int_{0^-}^{0^+} dx\,\frac{da}{dx} = \int_{0^-}^{0^+} dx\left[\frac{a}{v\tau} - \frac{1}{mv\tau}\left[-U_0\,\delta(x) + \delta(x-L)\,U_0\right]\right]$$

$$a(x=0^+) - a(x=0^-) = \frac{U_0}{mv_0\tau}$$

$$a(t=0^+) = \frac{U_0}{mv_0\tau}$$

$$\boxed{a^{II}(t) = \frac{U_0}{mv_0\tau}\,e^{+t/\tau}}$$

$$\int_{L^-}^{L^+} dx \frac{da}{dx} = \int_{L^-}^{L^+} dx \left[\frac{a}{v\tau} - \frac{1}{mv\tau} \left[-U_0 \delta(x) + \delta(x-L) U_0 \right] \right]$$

$$a^{\text{III}}(t) = a^{\text{III}}(t_1) e^{\frac{(t-t_1)}{\tau}}$$

$$a(L^+) - a(L^-) = -\frac{U_0}{mv_1\tau}$$

$$a(t_1^+) - a(t_1^-) = -\frac{U_0}{mv_1\tau}$$

$$a^{\text{III}}(t_1) = a^{\text{II}}(t_1) - \frac{U_0}{mv_1\tau}$$

$$a^{\text{III}}(t_1) = \frac{U_0}{mv_0\tau} e^{+\frac{t_1}{\tau}} - \frac{U_0}{mv_1\tau}$$

$$a^{\text{III}}(t) = \frac{U_0}{m\tau} \left(\frac{1}{v_0} e^{\frac{t_1}{\tau}} - \frac{1}{v_1} \right) e^{\frac{t-t_1}{\tau}}$$

$$a^{II}(t) = \frac{U_0}{mV_0 \tau} e^{+t/\tau} = \frac{dv}{dt}$$

$$v^{II}(t) = \frac{U_0}{mV_0} e^{t/\tau} + C$$

$$v^{II}(t=0) = v^{I}(t=0) = v_0$$

$$v^{II}(t=0) = \frac{U_0}{mV_0} + C = V_0$$

$$\boxed{C = -\frac{U_0}{mV_0} + V_0}$$

$$v^{II}(t) = \frac{U_0}{mV_0} e^{t/\tau} - \frac{U_0}{mV_0} + V_0$$

$$v^{II}(t) = \frac{U_0}{mV_0}\left(e^{t/\tau} - 1\right) + V_0$$

$$v_1 = v^{II}(t=t_1) = \frac{U_0}{m v_0}\left(e^{\frac{t_1}{\tau}} - 1\right) + v_0$$

$$a^{III}(t) = \frac{U_0}{m\tau}\left(\frac{1}{v_0} e^{\frac{t_1}{\tau}} - \frac{1}{v_1}\right) e^{\frac{t-t_1}{\tau}}$$

assume $a^{II}(t) = 0 \Rightarrow v_1 = v_0 e^{-\frac{t_1}{\tau}}$

$$\frac{U_0}{m v_0}\left(e^{t_1/\tau} - 1\right) + v_0 = v_0 e^{-\frac{t_1}{\tau}}$$

$$v^{II}(t) = \frac{U_0}{m v_0}\left(e^{\frac{t}{\tau}} - 1\right) + v_0$$

$$L = \int_0^{t_1} v^{II}(t)\,dt = \frac{U_0}{m v_0}\left[\tau\left(e^{\frac{t_1}{\tau}} - 1\right) - t_1\right]$$

$$+ v_0 t_1$$