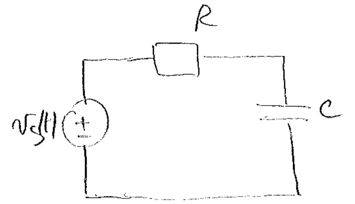
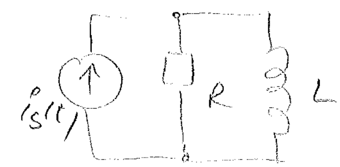
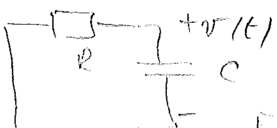
Summary (repeating is the mother of learning)

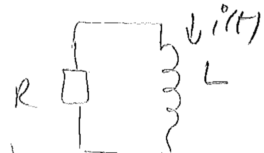




$\begin{cases} x(t) = v_s(t) \\ \tau = RC \end{cases}$ $\qquad \boxed{\tau \cdot \dfrac{dy(t)}{dt} + y(t) = x(t)} \qquad$ $\begin{cases} x(t) = i_s(t) \\ \tau = \dfrac{L}{R} \end{cases}$

I $\boxed{x(t) = 0}$ Force-free response; natural response





$$\boxed{y(t) = y(0) \cdot e^{-\frac{t}{\tau}}}$$

$$\boxed{v(t) = v(0^+) \cdot e^{-\frac{t}{RC}}} \qquad \boxed{i(t) = i(0^+) \cdot e^{-\frac{L}{R}t}}$$

We also saw examples of how to crack initial values/conditions!

II $\boxed{x(t) \neq 0}$

A $\boxed{x(t) = X_S}$ dc forcing function

Complete response

$$\boxed{y(t) = \underbrace{y(0) \cdot e^{-\frac{t}{\tau}}}_{= y_{natural}} + \underbrace{X_S\left(1 - e^{-\frac{t}{\tau}}\right)}_{= y_{forced}}} = y_{natural} + y_{forced}$$

$$\boxed{y(t) = \underbrace{\left[y(0) - y(\infty)\right] \cdot e^{-\frac{t}{\tau}}}_{= y_{xsient}} + \underbrace{y(\infty)}_{= y_{ss}} = y_{xsient} + y_{ss}}$$

"I cannot believe it's not butter!"

B $\boxed{x(t) = X_m \cdot \cos\omega t}$ ac forcing function.

Complete response.

$$\boxed{y(t) = \underbrace{y(0) \cdot e^{-\frac{t}{\tau}}}_{= y_{natural}} + \underbrace{\frac{X_m}{1 + (\omega\tau)^2}\left(\cos\omega t + \omega\tau \sin\omega t - e^{-\frac{t}{\tau}}\right)}_{= y_{forced}}}$$

$$\boxed{y(t) = \underbrace{\left[y(0) - \frac{X_m}{1 + (\omega\tau)^2}\right] e^{-\frac{t}{\tau}}}_{= y_{xsient}} + \underbrace{\frac{X_m}{\sqrt{1 + (\omega\tau)^2}} \cdot \cos\left(\omega t - \tan^{-1}\omega\tau\right)}_{= y_{ss} = Y_m \cdot \cos(\omega t + \phi)}}$$