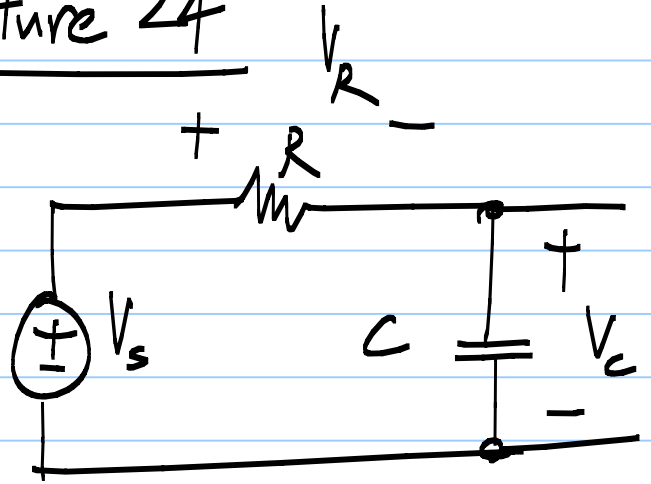
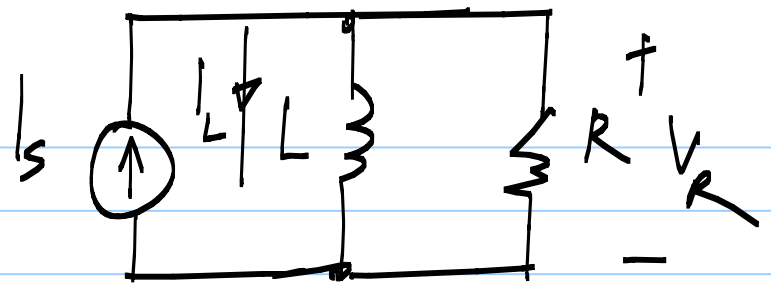
Lecture 24



$$RC\frac{dV_c}{dt} + V_c = V_s$$

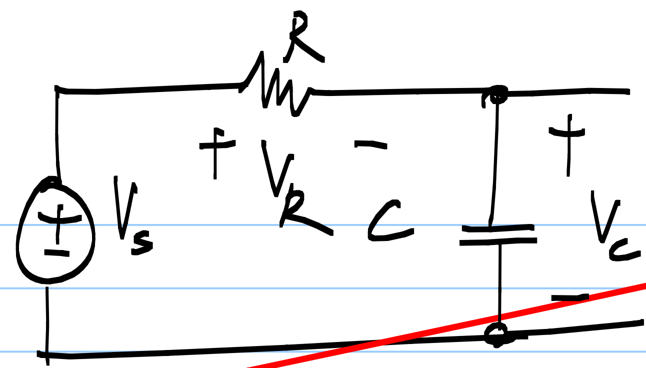
$$RC\frac{dV_R}{dt} + V_R = RC\cdot\frac{dV_s}{dt}$$

characteristic of the ckt.

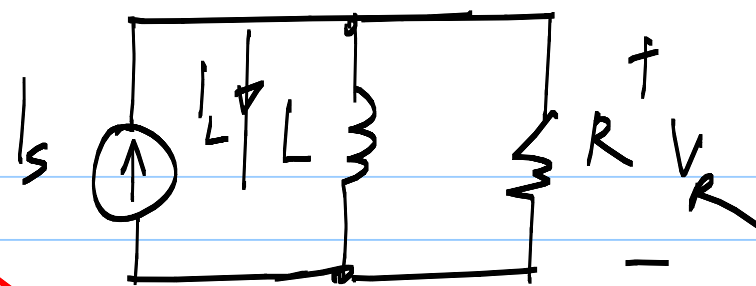


$$\frac{L}{R}\frac{dI_L}{dt} + I_L = I_s$$

$$\frac{L}{R}\frac{dV_R}{dt} + V_R = L\cdot\frac{dI_s}{dt}$$

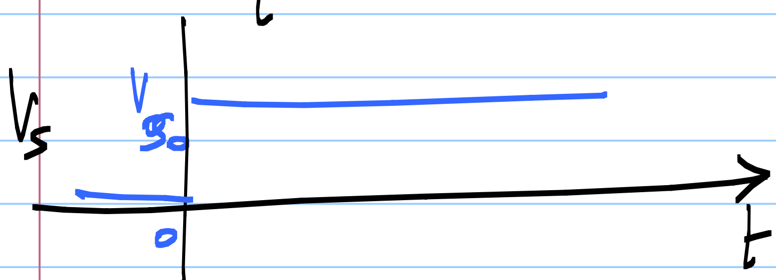


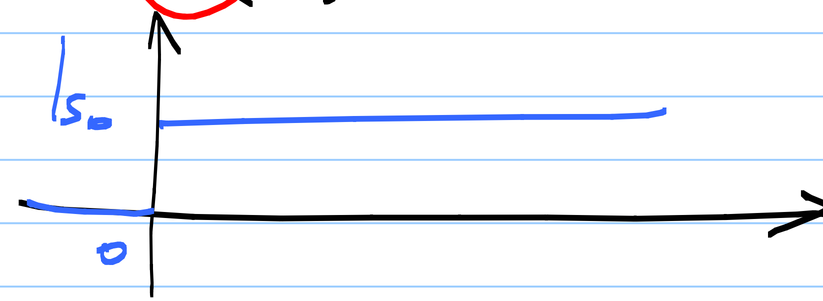
Time constant



$$RC\frac{dV_c}{dt} + V_c = V_s$$

$$\frac{L}{R}\frac{dI_L}{dt} + I_L = I_s$$

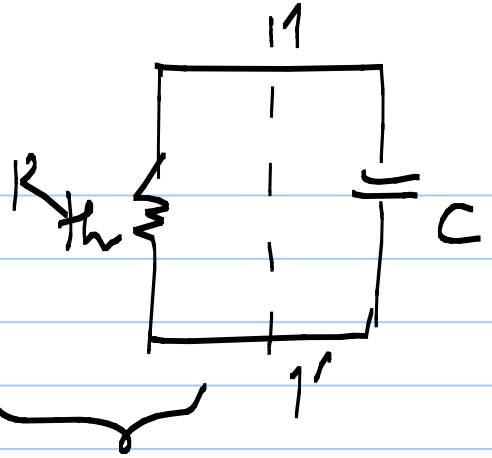




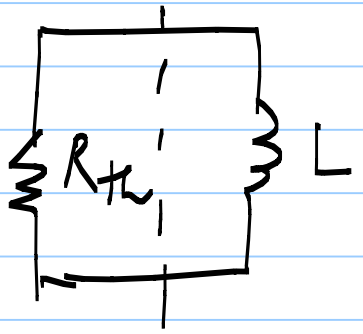
$$V_c(t) = V_{s_0} + \left(V_c(0) - V_{s_0}\right)\exp\left(-\frac{t}{RC}\right)$$

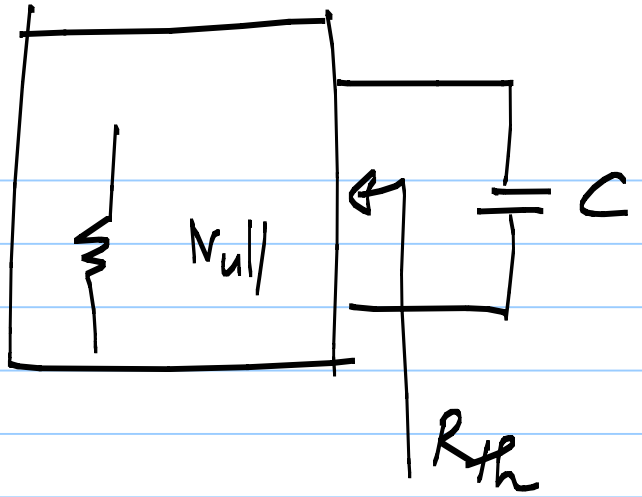
$$I_L(t) = I_{s_0} + \left(I_L(0) - I_{s_0}\right)\exp\left(-\frac{t}{L/R}\right)$$

Determining time constants



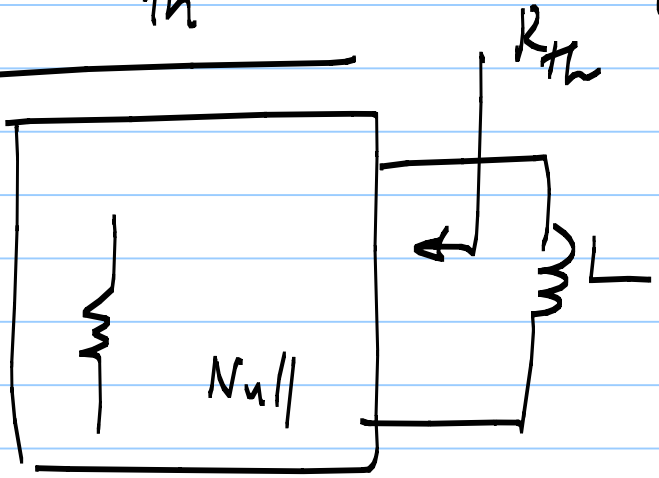
Thevenin eq. resistance looking into 1-1'





$\tau = R_{th} \cdot C$

$\tau = \frac{L}{R_{th}}$



$$V_c(t) = V_{s_0} + \left(V_c(0) - V_s\right)\exp\left(-\frac{t}{\tau}\right)$$

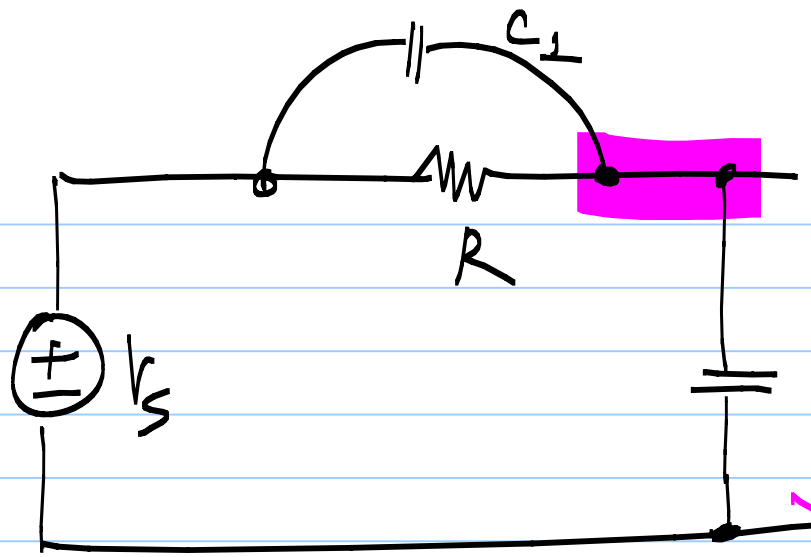
Steady state

Transient

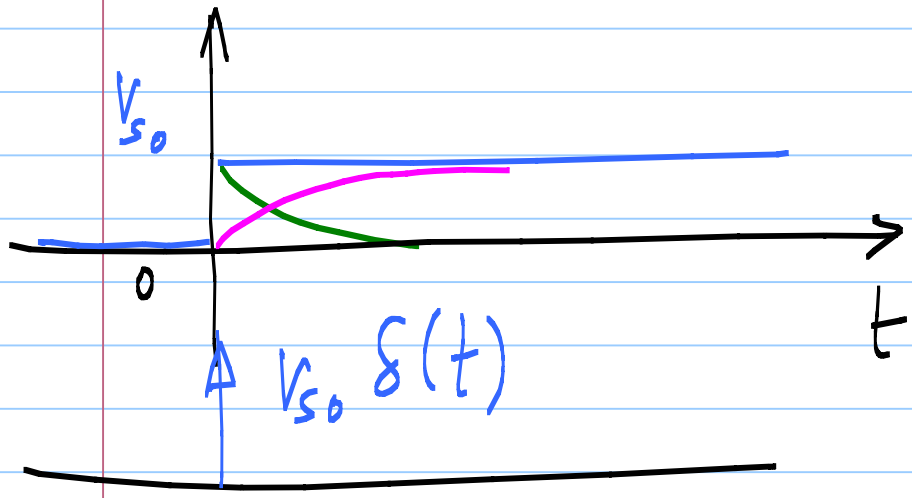
$$V_R(t) = 0 + V_R(0)\cdot\exp\left(-t/RC\right)$$

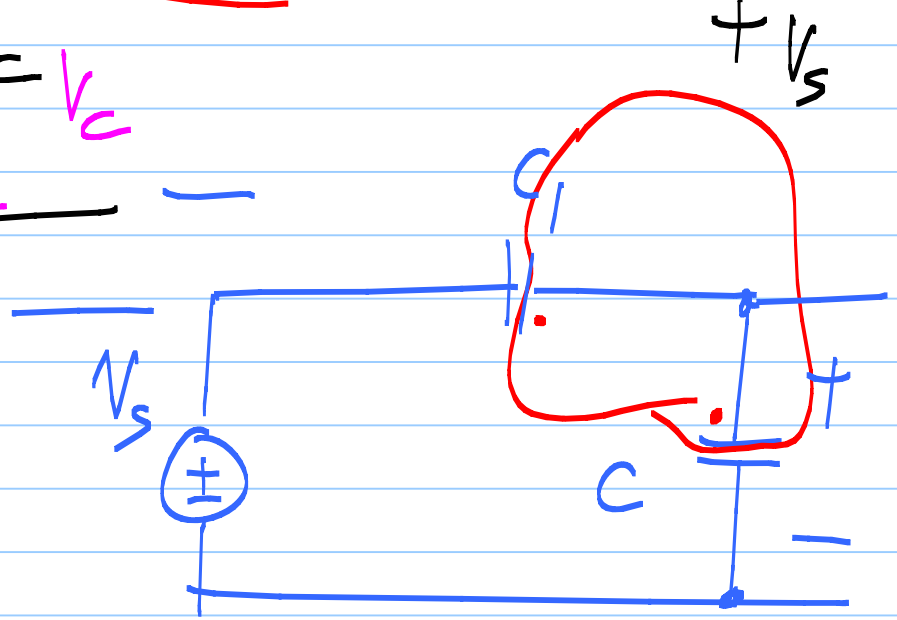
$$V_s - V_c(0)$$

$$\underbrace{V_{s_0}\left(1-\exp\left(-\frac{t}{RC}\right)\right)} + \underbrace{V_c(0)\exp\left(-\frac{t}{RC}\right)}$$

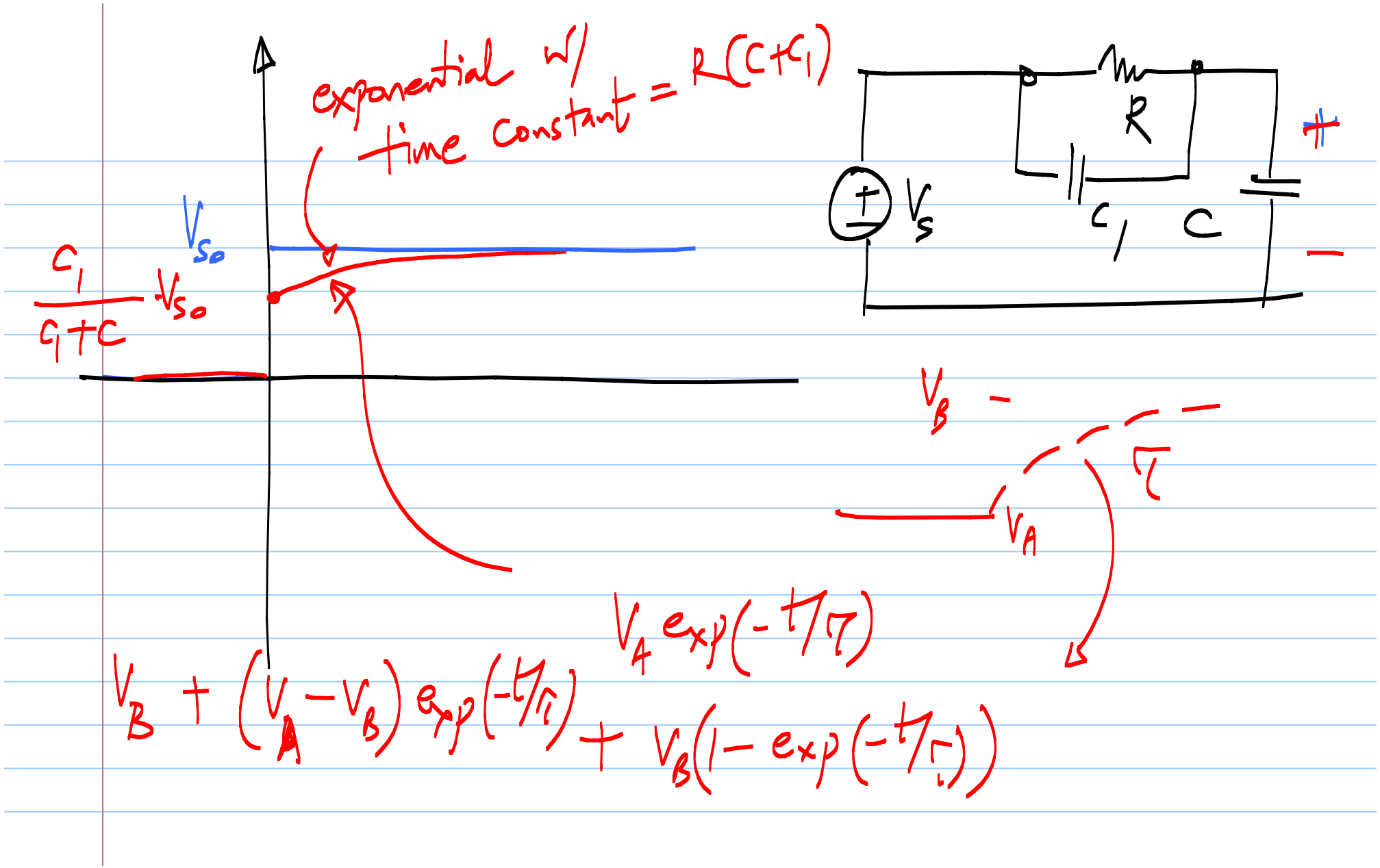


$$R(C+C_1)\frac{dV_c}{dt} + V_c = RC_1\frac{dV_s}{dt}$$





$$C \cdot V_c + C_1(V_c - V_s) = 0$$


exponential w/
time constant = R(C+C1)
R
Vs
C1
C
+
−
Vso
C1/(C1+C)
Vso
VB
VA
τ
VA exp(−t/τ)
VB + (VA − VB) exp(−t/τ1) + VB(1 − exp(−t/τ1))