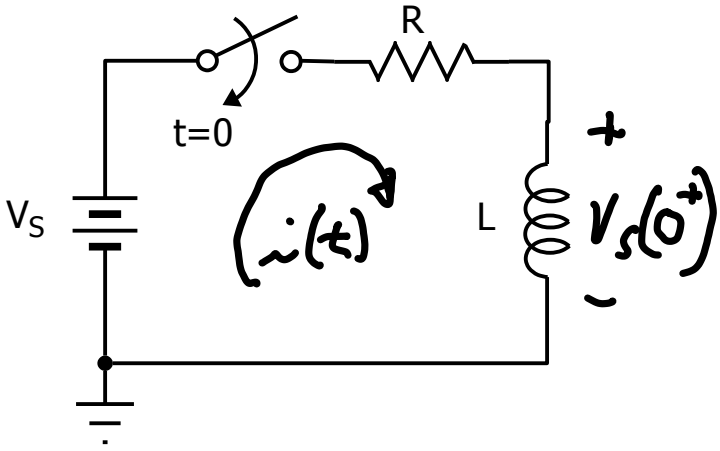
R-L TRANSIENTS

$$-V_S + iR + L\frac{di}{dt} = 0$$

$$\frac{di}{dt} + \left(\frac{R}{L}\right)i = \frac{V_S}{L}$$

$$P = \frac{R}{L}\,;\; Q = \frac{V_S}{L}$$

$$e^{\int_0^t P\,dx} = e^{\frac{R}{L}\int_0^t dx} = e^{\frac{R}{L}t}$$



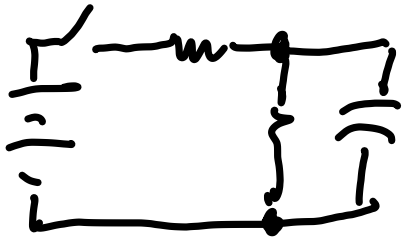
$$i(t) = \frac{V_S}{R}\left(1 - e^{-t/\frac{L}{R}}\right)$$

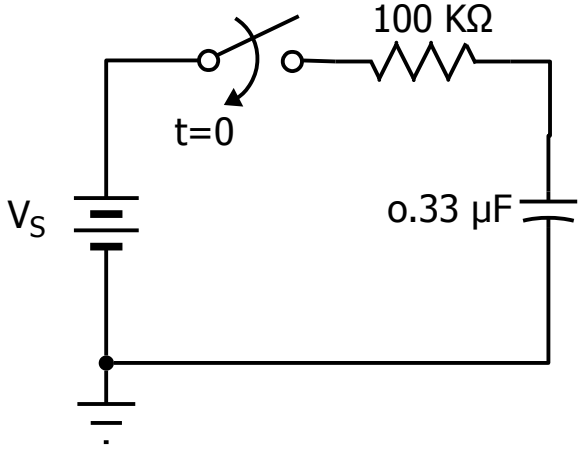
TIME CONSTANTS

$\tau = RC$

$= (100e3)(.33e-6)$

$= 33e-3 = 33\,ms$



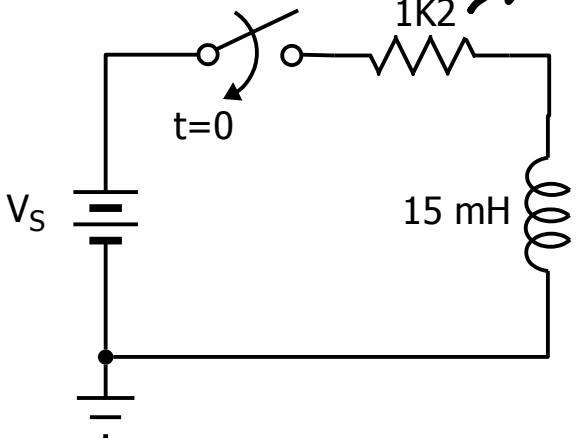


$\tau = L/R$

$= \frac{15e-3}{1.2e3}$

3V3

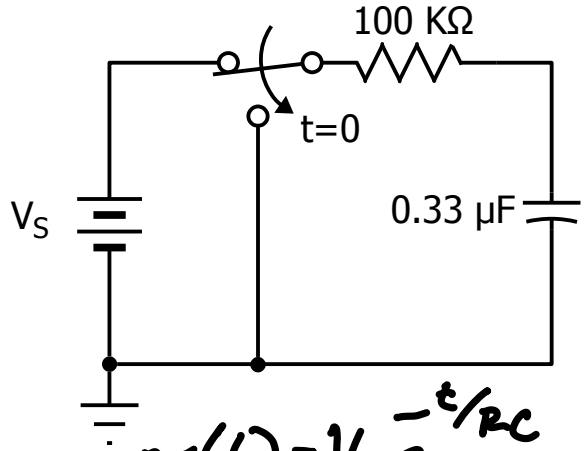
1.2k Ω



1M2

TIME CONSTANT EQUATIONS

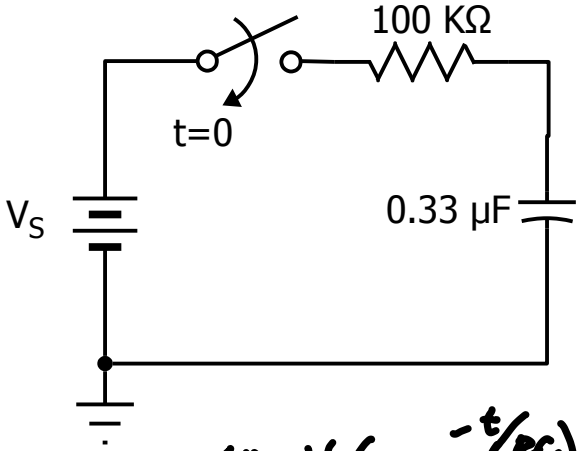
NATURAL RESPONSE



$$v_c(t) = V_s e^{-t/RC}$$

$$i(t) = \frac{V_s}{R} e^{-t/RC}$$

STEP(FORCED) RESPONSE

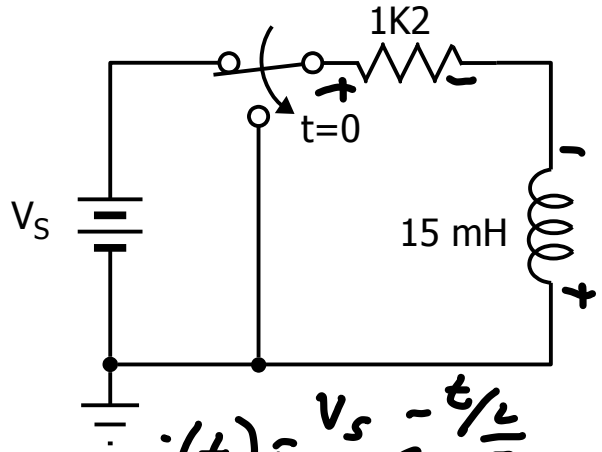


$$v_c(t) = V_s(1 - e^{-t/RC})$$

if $v_c(0) = 0$

$$v_c(t) = V_s - [V_s - v_c(0)]e^{-t/RC}$$

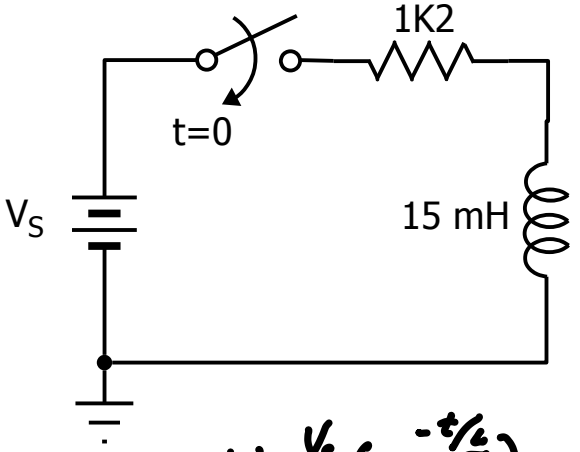
if $v_c(0) \neq 0$



$$i(t) = \frac{V_s}{R} e^{-t/\frac{L}{R}}$$

$$v_L(t) = R\left(\frac{V_s}{R}\right)e^{-t/\frac{L}{R}}$$

$$v_L(t) = V_s e^{-t/\frac{L}{R}}$$



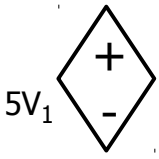
$$i(t) = \frac{V_s}{R}(1 - e^{-t/\frac{L}{R}})$$

if $i(0) = 0$

$$i(t) = \frac{V_s}{R} - \left[\frac{V_s}{R} - i(0)\right]e^{-t/\frac{L}{R}}$$

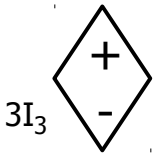
if $i(0) \neq 0$

DEPENDENT SOURCES

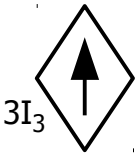


VOLTAGE-CONTROLLED
VOLTAGE SOURCE

VOLTAGE-CONTROLLED
CURRENT SOURCE



CURRENT-CONTROLLED
VOLTAGE SOURCE



CURRENT-CONTROLLED
CURRENT SOURCE

$$\frac{V_1-2}{6} - 4I_1 + \frac{V_1}{3} = 0$$

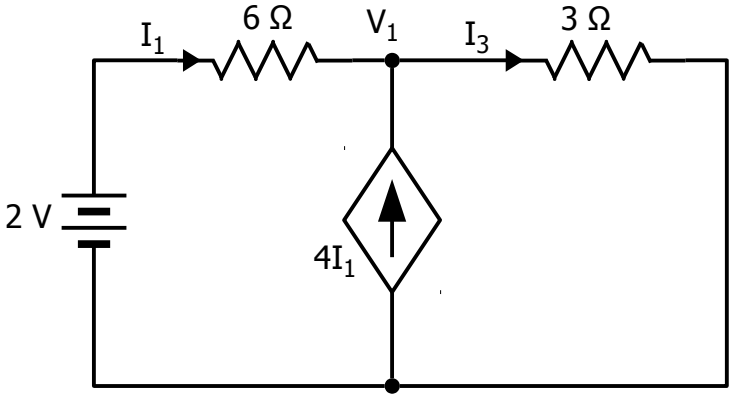
$$I_1 = \frac{2-V_1}{6}$$

$$I_3 = \frac{V_1}{3}$$

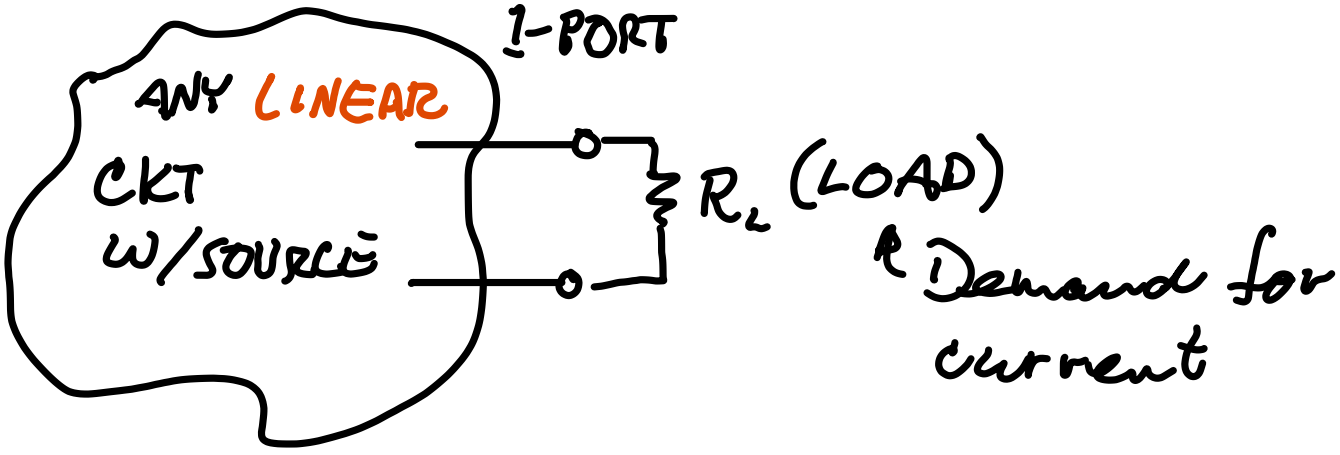
$V_1 = 1.43$

$I_1 = 95.2\,mA$

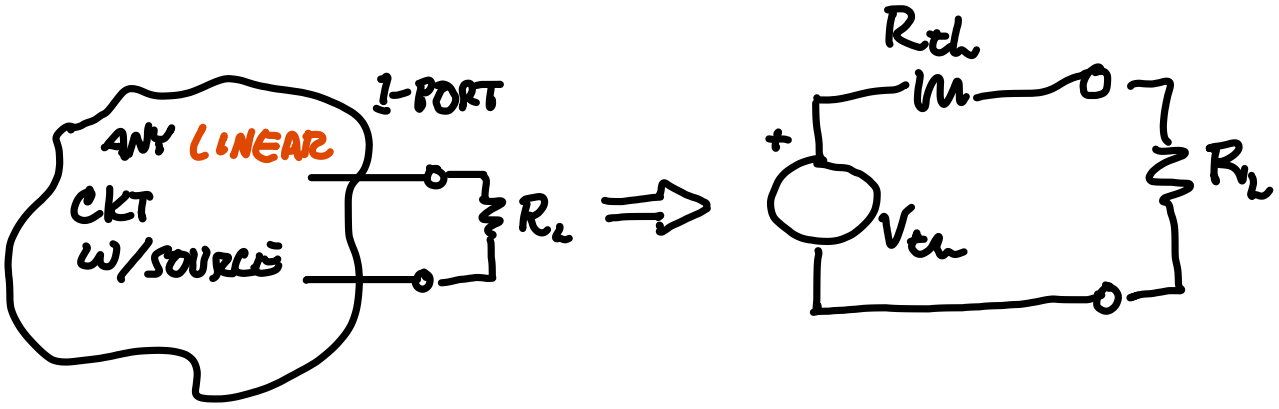
$I_3 = 476\,mA$



THÉVENIN EQUIVALENT CIRCUITS



THÉVENIN EQUIVALENT CIRCUITS



Any load applied to the Thévenin Eq Ckt experiences the same current as the original ckt.

All information about the internal cktry is LOST.

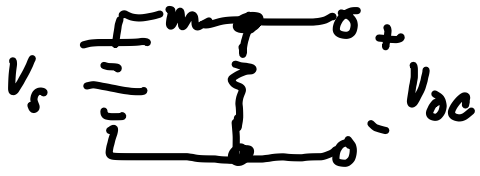
THÉVENIN EQUIVALENT CIRCUITS

CHRISTINA'S WORLD by ANDREW WYETH

LIGHT IN WINDOW. WHAT CAUSED IT?

FINDING THE THÉVENIN EQUIVALENT

1. Calculate V_{th}: $V_{th} = V_{OC}$ (OPEN CKT)



2. Calculate R_{th} (THREE WAYS)

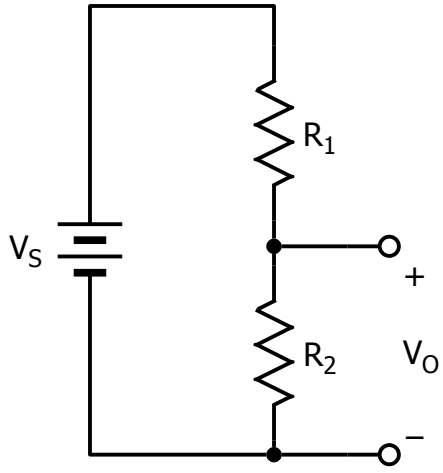
   a. V_{OC}-I_{SC} (SHORT CKT)

   b. Zero out indep. sources, attach known test source to port.

   c. Zero out indep, sources, look into port, calculate R_{th} *

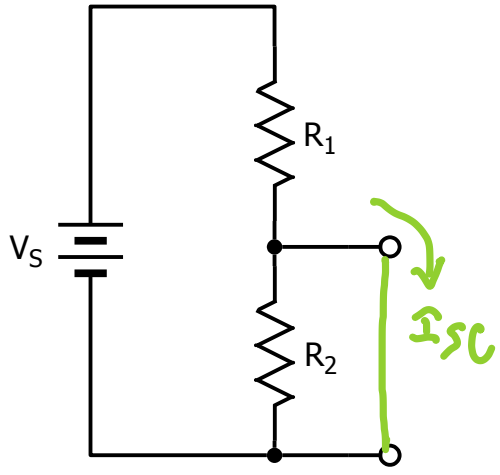
* Does not work in ckts with dependent sources!

FINDING THE THÉVENIN EQUIVALENT



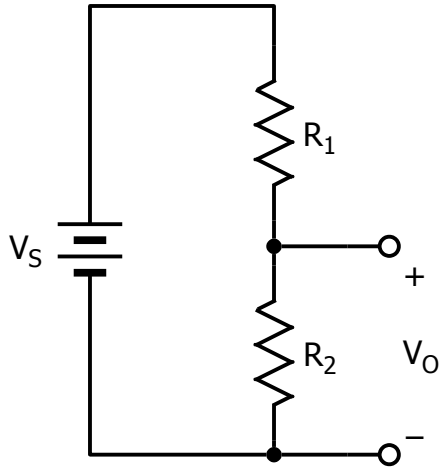
$$V_{th} = V_{OC} = V_S \frac{R_2}{R_1 + R_2}$$

Method A



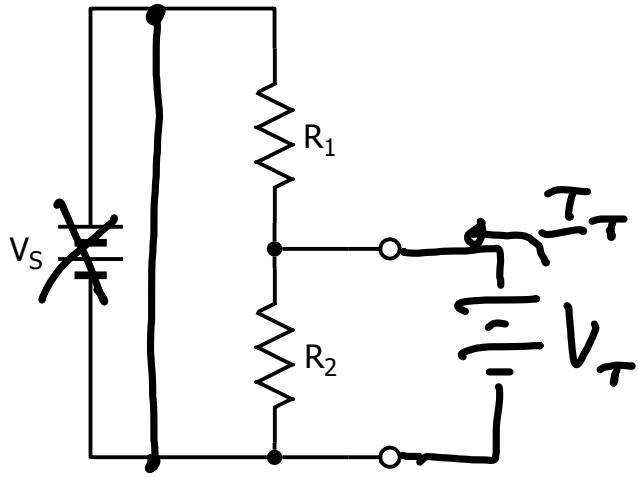
$$R_{th} = \frac{V_{OC}}{I_{SC}} = \frac{V_S \frac{R_2}{R_1 + R}}{V_S / R_1} = \frac{R_1 R_2}{R_1 + R_2} = R_1 \| R_2$$

FINDING THE THÉVENIN EQUIVALENT



$$V_{th} = V_S \frac{R_2}{R_1 + R_2}$$

Method B

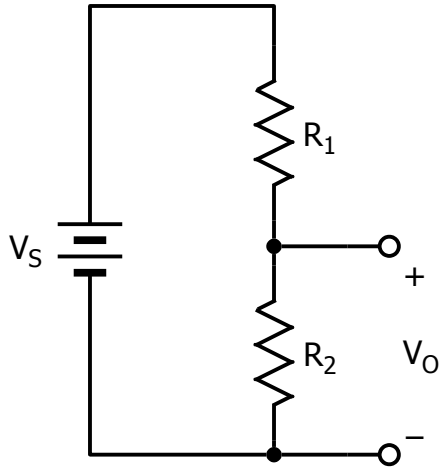


$$R_{th} = \frac{V_T}{I_T}$$

$$I_T = \frac{V_T}{\frac{R_1 R_2}{R_1 + R_2}}$$

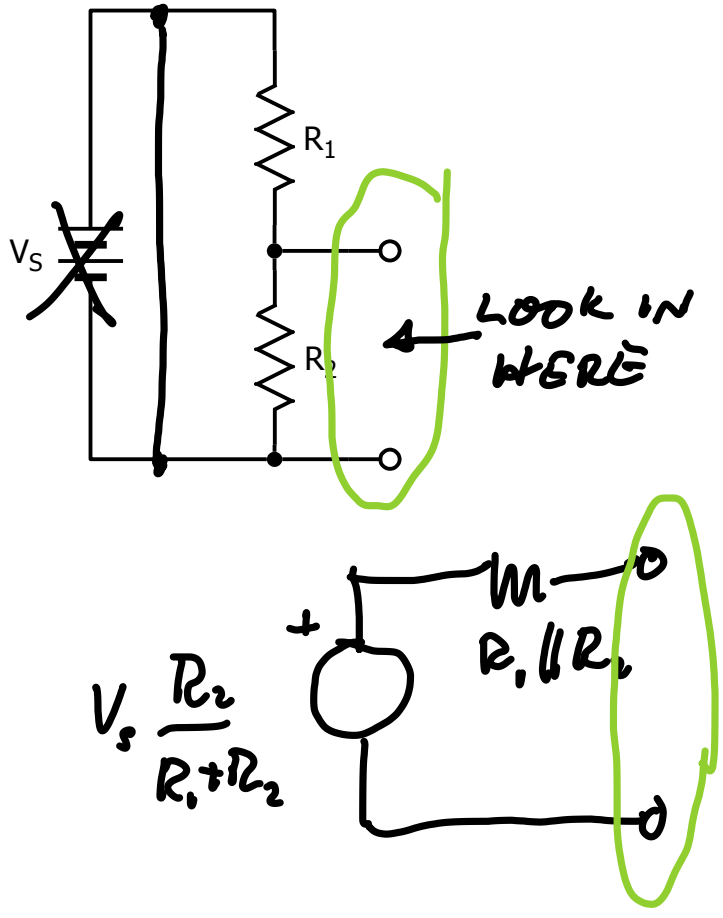
$$R_{th} = \frac{V_T}{\frac{V_T}{\frac{R_1 R_2}{R_1 + R_2}}} = \frac{R_1 R_2}{R_1 + R_2} = R_1 \| R_2$$

FINDING THE THÉVENIN EQUIVALENT



$$V_{th} = V_s \frac{R_2}{R_1 + R_2}$$

Method C



MAXIMUM POWER TRANSFER

THÉVENIN EQUIVALENT CIRCUIT