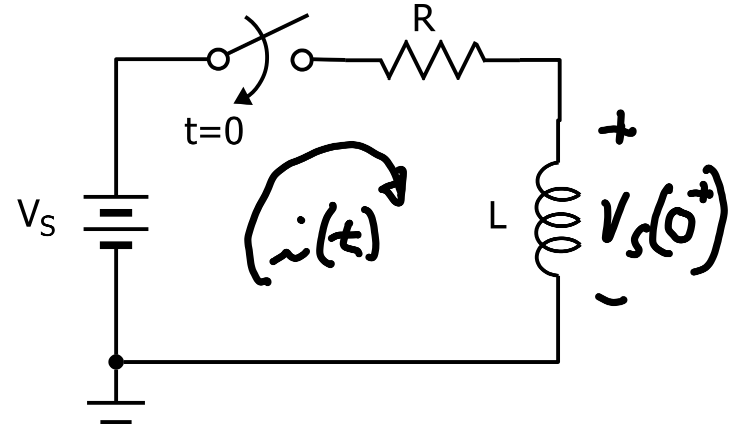
R-L TRANSIENTS

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



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

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

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

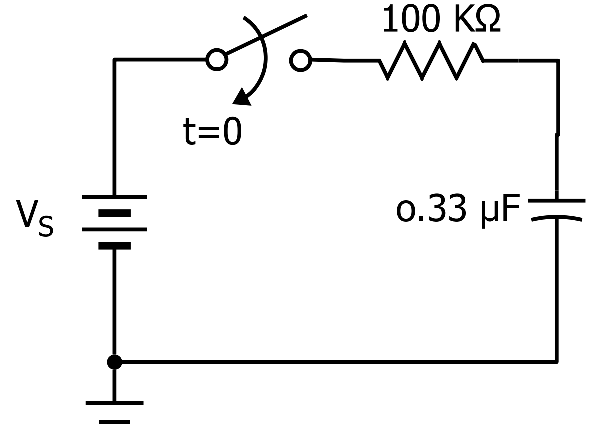
$$i(t) = \frac{V_s}{R}\left(1 - e^{-t/\frac{L}{R}}\right)$$

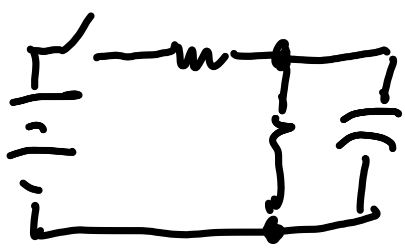
TIME CONSTANTS

$\tau = RC$

$= (100e3)(.33e\text{-}6)$

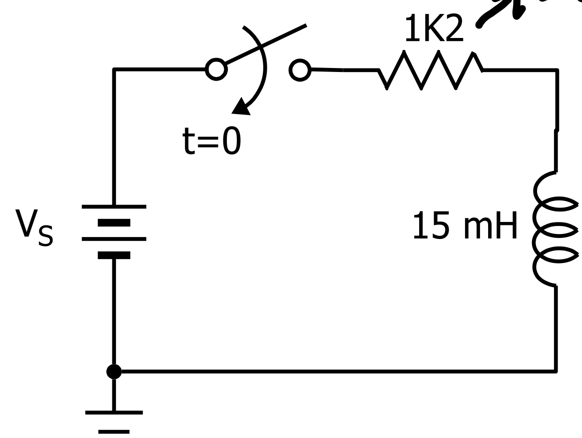
$= 33e\text{-}3 = 33\,ms$





3V3

1.2K Ω



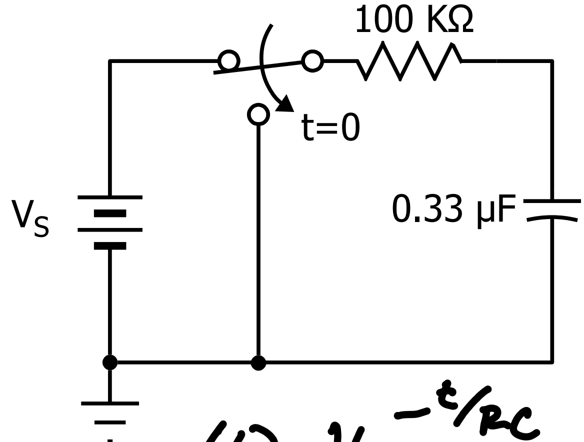
1MΩ

$\tau = L/R$

$= \dfrac{15e\text{-}3}{1.2e3}$

TIME CONSTANT EQUATIONS

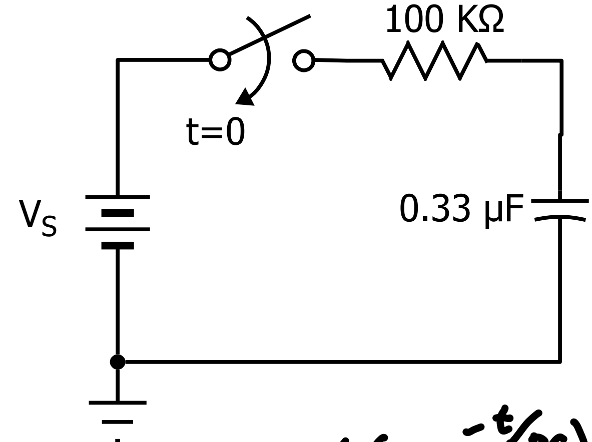
NATURAL RESPONSE



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

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

STEP (FORCED) RESPONSE

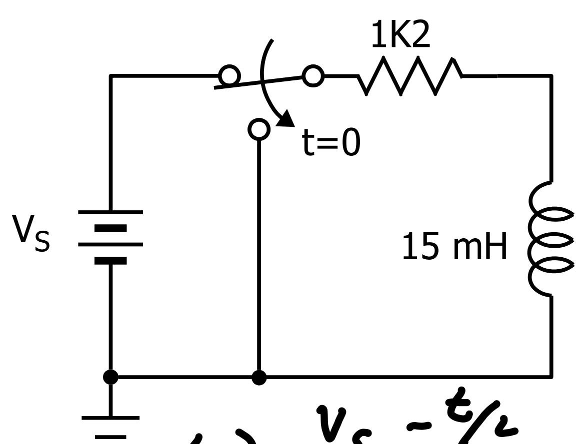


$$v_c(t) = V_s\left(1 - e^{-t/RC}\right)$$

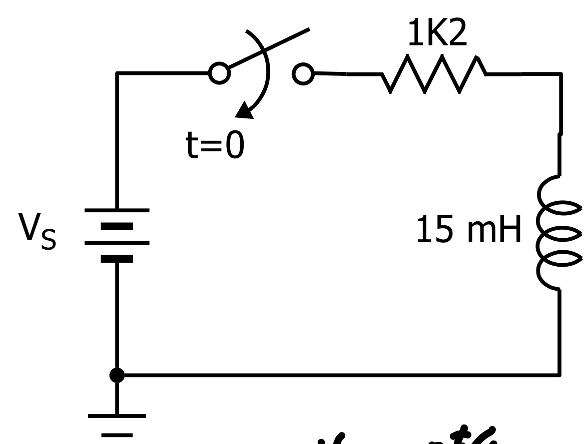
if $v_c(0) = 0$

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

if $v_c(0) \neq 0$



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



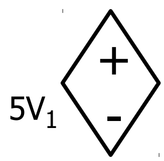
$$i(t) = \frac{V_s}{R}\left(1 - e^{-t/\frac{L}{R}}\right)$$

if $i(0) = 0$

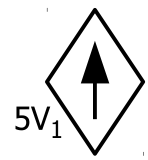
$$i(t) = \frac{V_s}{R} - \left[\frac{V_s}{R} - i(0)\right] e^{-t/\frac{L}{R}}$$

if $i(0) \neq 0$

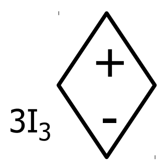
DEPENDENT SOURCES



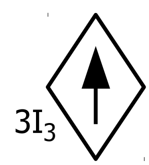
VOLTAGE-CONTROLLED
VOLTAGE SOURCE



VOLTAGE-CONTROLLED
CURRENT SOURCE



CURRENT-CONTROLLED
VOLTAGE SOURCE



CURRENT-CONTROLLED
CURRENT SOURCE

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

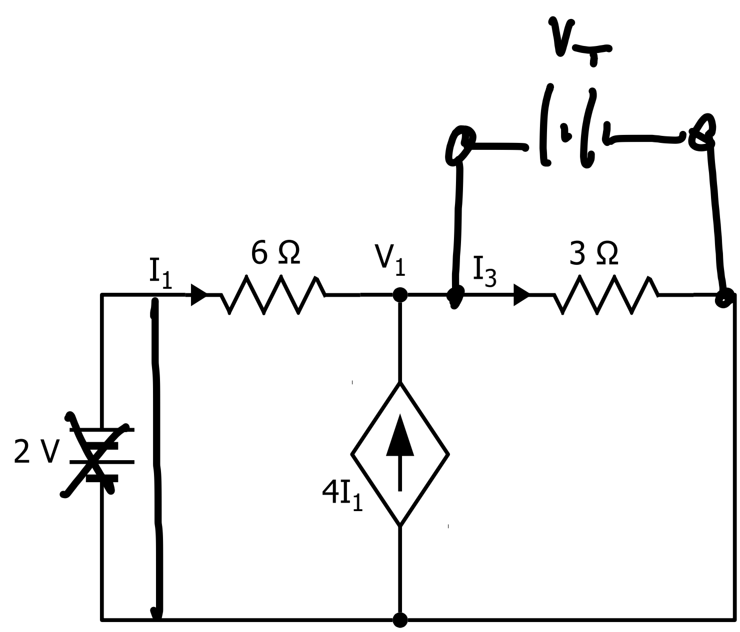
$$I_1 = \frac{2-V_1}{6}$$

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

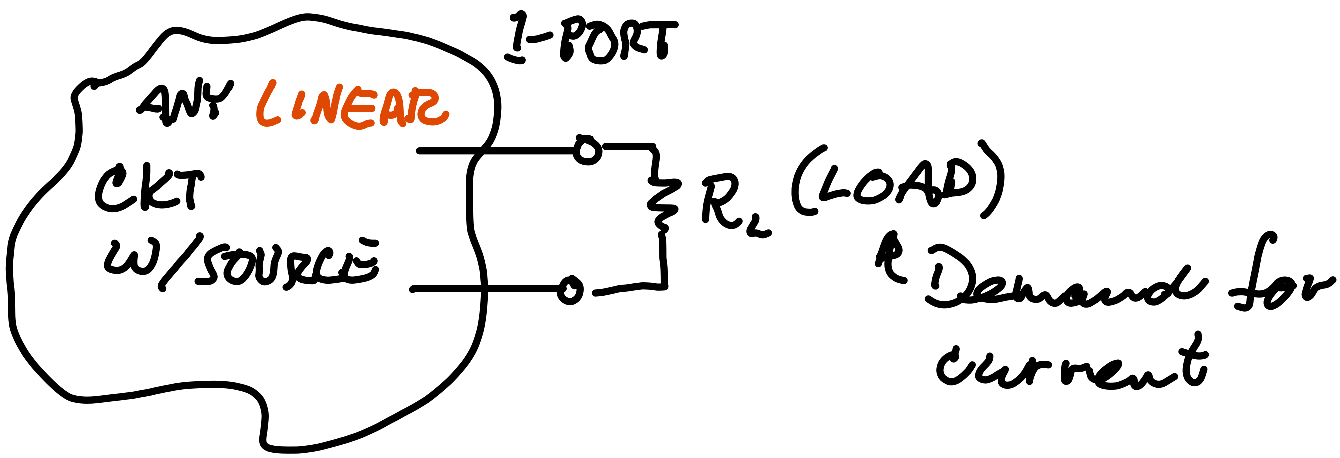
$$V_1 = 1.43$$

$$I_1 = 95.2\,mA$$

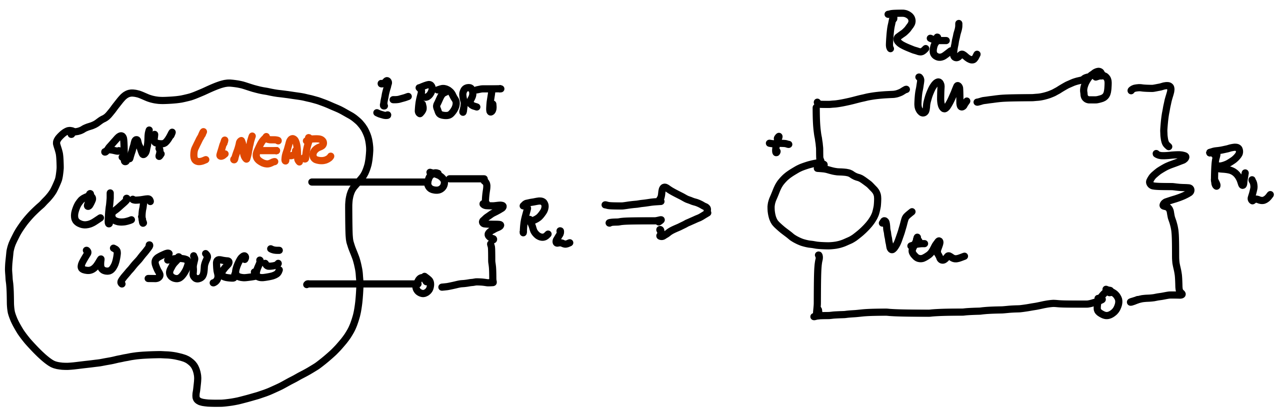
$$I_3 = 476\,mA$$



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.

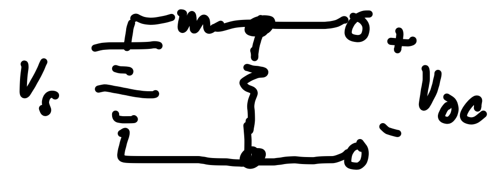
THÉVENIN EQUIVALENT CIRCUITS

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)

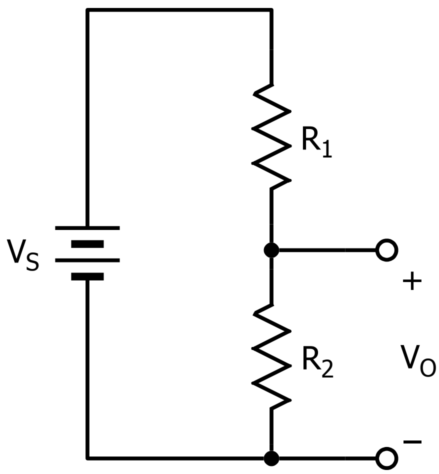
   a. V_{oc} - I_{sc} (SHORT CKT)

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

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

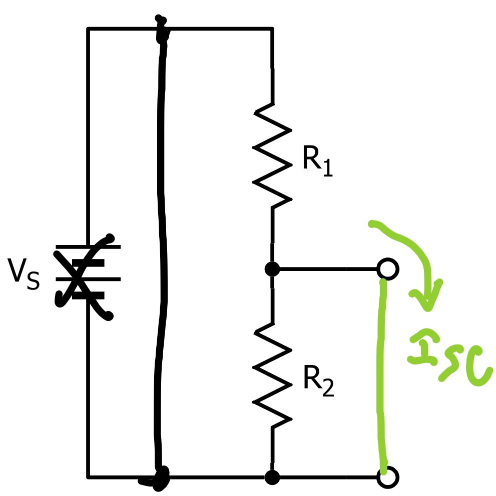
* Does not work in ckts with dependent sources!

FINDING THE THÉVENIN EQUIVALENT



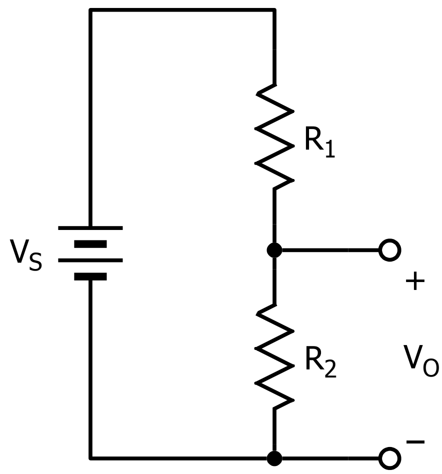
$$V_{th} = V_{oc} = V_s \frac{R_2}{R_1+R_2}$$

Method A



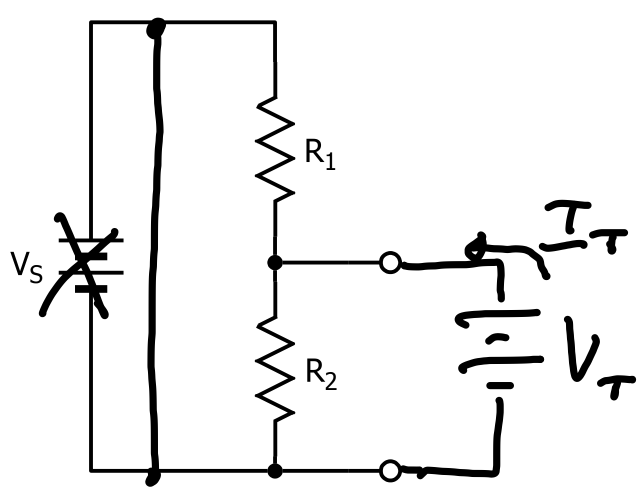
$$R_{th} = \frac{V_{OC}}{I_{SC}} = \frac{V_s \frac{R_2}{R_1+R}}{V_s/R_1} = \frac{R_1R_2}{R_1+R_2} = R_1 \| R_2$$

FINDING THE THÉVENIN EQUIVALENT



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

Method B

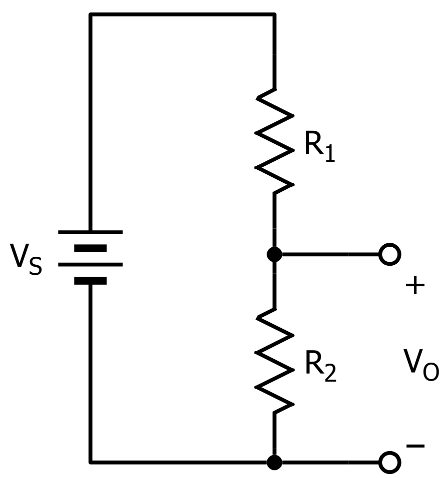


$$R_{th} = \frac{V_T}{I_T}$$

$$I_T = \frac{V_T}{\frac{R_1R_2}{R_1+R_2}}$$

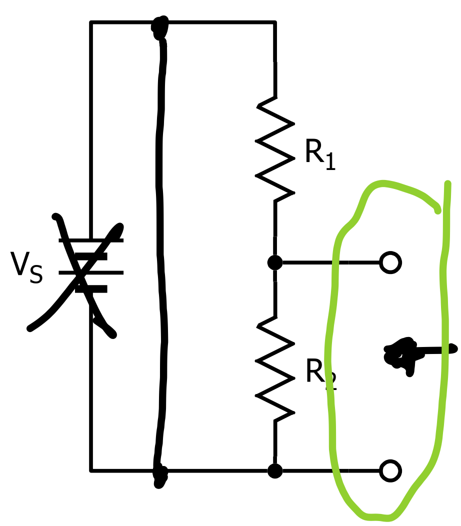
$$R_{th} = \frac{V_T}{\frac{V_T}{\frac{R_1R_2}{R_1+R_2}}} = \frac{R_1R_2}{R_1+R_2} = R_1 \| R_2$$

FINDING THE THÉVENIN EQUIVALENT



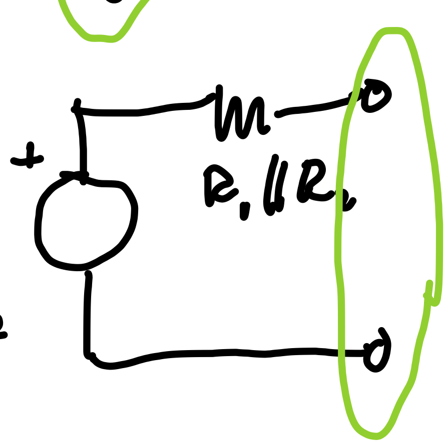
$$V_{th} = V_s \frac{R_2}{R_1 + R_2}$$

Method C



LOOK IN HERE $\Rightarrow R_1 \parallel R_2$

$$V_s \frac{R_2}{R_1 + R_2}$$



MAXIMUM POWER TRANSFER

THÉVENIN EQUIVALENT CIRCUIT