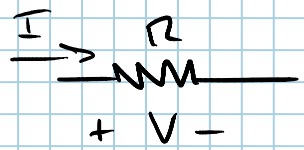
EE 315

Tuesday, May 26, 2015
5:00 PM

REVIEW OF EE 213 CONCEPTS

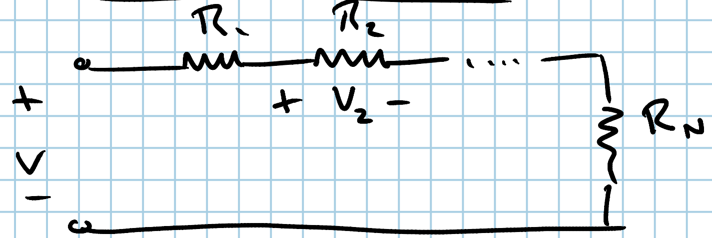


$V = IR$

REMEMBER: KVL, KCL

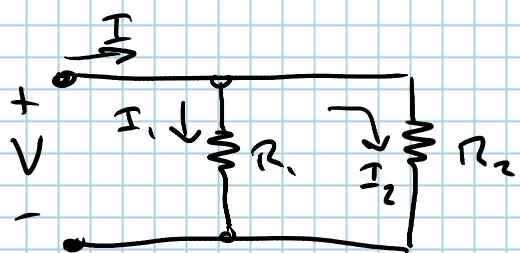
(PASSIVE SIGN CONVENTION)

VOLTAGE DIVISION:



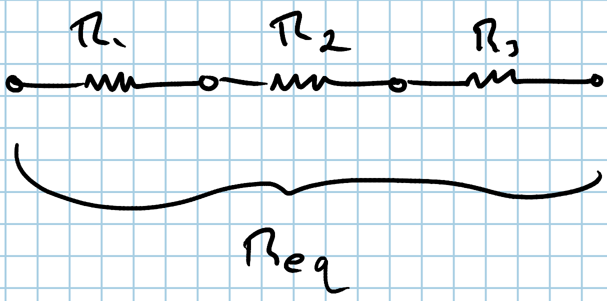
$$V_2 = \left(\frac{R_2}{R_1 + R_2 + \ldots + R_N}\right) V$$

CURRENT DIVISION: (2 RESISTORS IN PARALLEL)

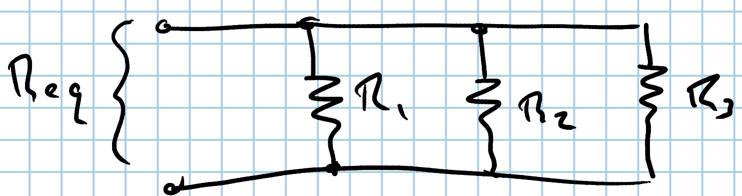


$$I_1 = \left(\frac{R_2}{R_1 + R_2}\right) I$$

$$I_2 = \left(\frac{R_1}{R_1 + R_2}\right) I$$



$$R_{eq} = R_1 + R_2 + R_3$$

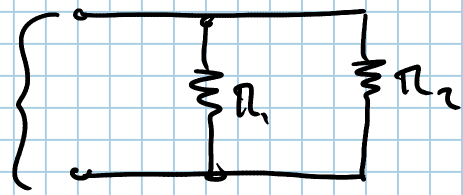


$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \Rightarrow R_{eq} = \frac{1}{1/R_1 + 1/R_2 + 1/R_3}$$

SPECIAL CASE: 2 RESISTORS IN PARALLEL

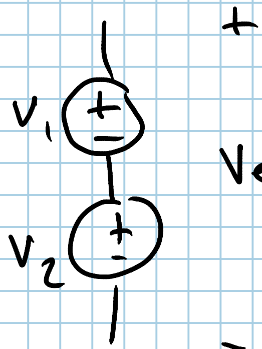
Tuesday, May 26, 2015
5:27 PM

R_{eq}

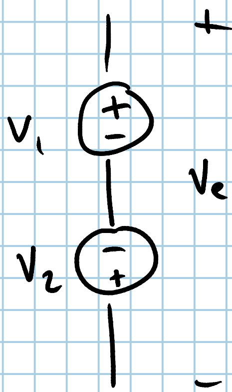


$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$$

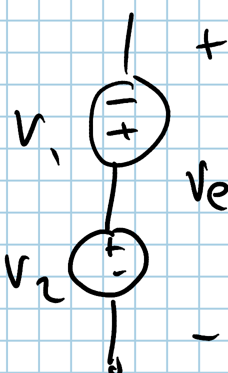
VOLTAGE SOURCES



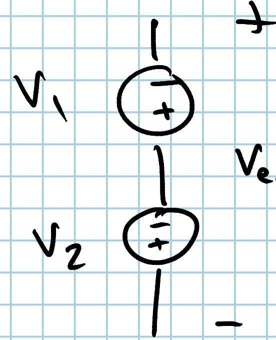
$V_{eq} = V_1 + V_2$,



$V_{eq} = V_1 - V_2$

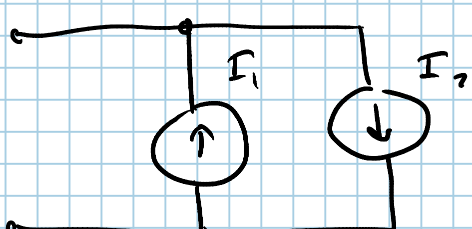


$V_{eq} = -V_1 + V_2$

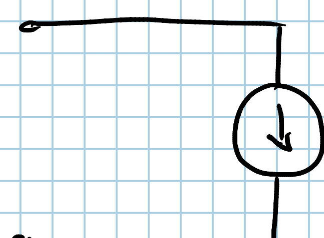


$V_{eq} = -V_1 - V_2 = -(V_1 + V_2)$

CURRENT SOURCES



$\equiv$

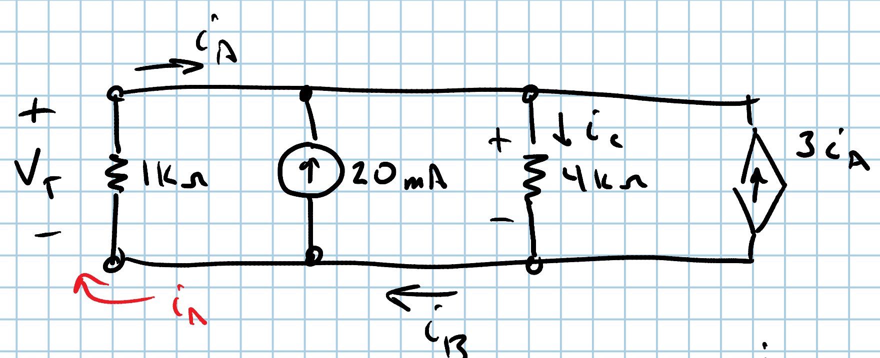


$I_{eq} = I_2 - I_1$

Example

Tuesday, May 26, 2015
5:34 PM

Find: V_T
i_A
i_B
i_C



KCL: $i_A + 20\times10^{-3}A - i_c + 3i_A = 0$

$\longrightarrow 4i_A - i_c + 20\times10^{-3} = 0$

$i_A = -\frac{V_T}{1k\Omega}$

$i_c = \frac{V_T}{4k\Omega}$

$4\left(\frac{-V_T}{1k}\right) - \left(\frac{V_T}{4k}\right) + 20\times10^{-3} = 0$

(KCL) $i_B + 3i_A = i_c$

$\underline{i_B = i_c - 3i_A}$

$4\left(\frac{V_T}{1}\right) - \frac{V_T}{4} + 20 = 0$

$V_T\left(\frac{4}{1} + \frac{1}{4}\right) = 20 \Rightarrow \boxed{V_T = 4.71V}$

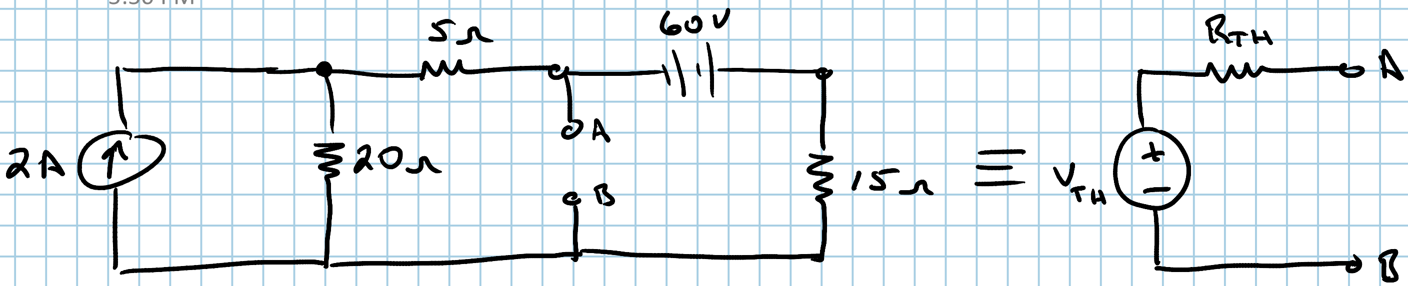
$i_A = \frac{-V_T}{1k\Omega} = \frac{-4.71V}{1k\Omega} = \boxed{-4.71mA}$

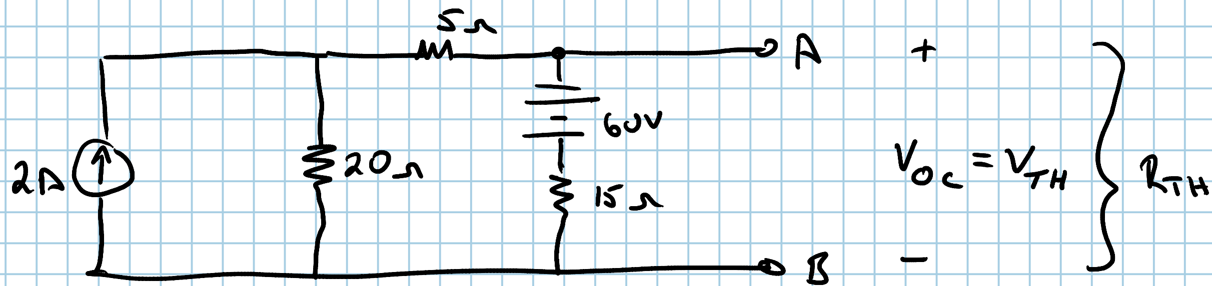
$i_C = \frac{V_T}{4k\Omega} = \frac{4.71V}{4k\Omega} = \boxed{1.18mA}$

$i_B = i_c - 3i_A = 1.18 - 3(-4.71) = \boxed{15.31mA}$

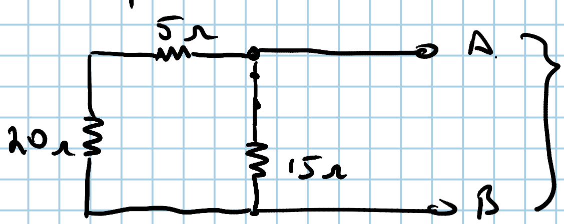
Thevenin's Theorem

Tuesday, May 26, 2015
5:50 PM





• "Kill" sources, find R_{TH}

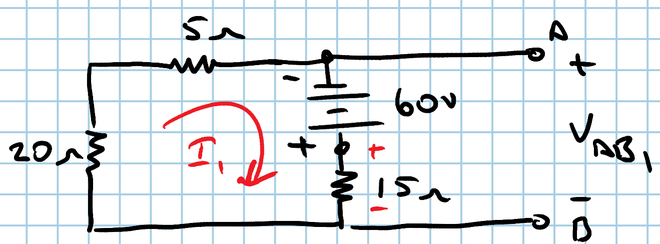


$$R_{AB} = R_{TH} = (20+5) \parallel 15 = \frac{1}{\frac{1}{25} + \frac{1}{15}}$$

$$\boxed{R_{TH} = 9.375\,\Omega}$$

• Use superposition to find $V_{AB_{OC}} = V_{TH}$

• Turn-off current source

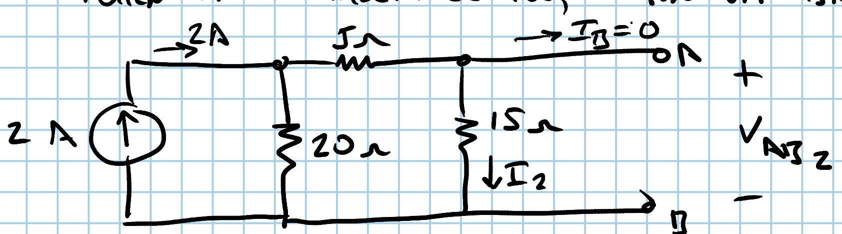


$$I_1 = \frac{60V}{40\Omega} = 1.5A$$

$$V_{AB_1} = -60V + (1.5A)(15\Omega)$$

$$V_{AB_1} = -37.5\,V$$

• Turn-on current source, turn-off battery



$$I_2 = \left(\frac{20}{20 + (15+5)}\right)(2A)$$

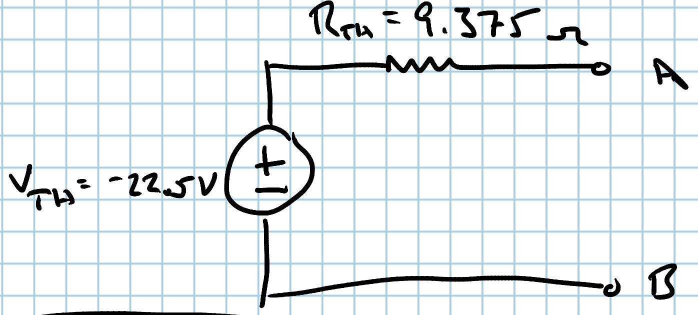
$I_2 = 1A \Rightarrow V_{AB_2} = (1A)(15\Omega)$

$V_{AB_2} = 15V$

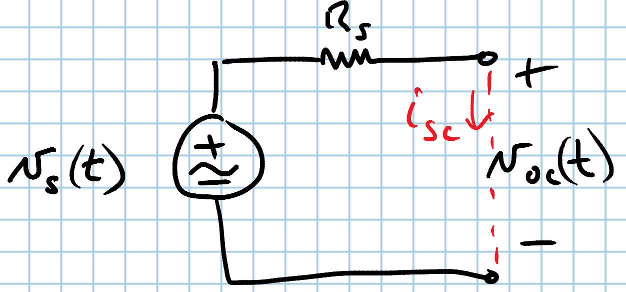
Tuesday, May 26, 2015
6:21 PM

$$V_{AB} = V_{oc} = V_{TH} = V_{AB_1} + V_{AB_2}$$

$$V_{TH} = -37.5 + 15\ V = \underline{\underline{-22.5V}}$$

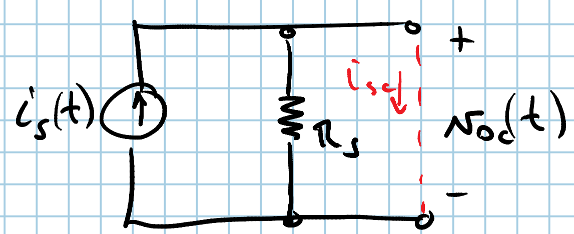


Signal Sources



$$v_{oc}(t) = v_s(t)$$

$$i_{sc} = \frac{v_s}{R_s}$$



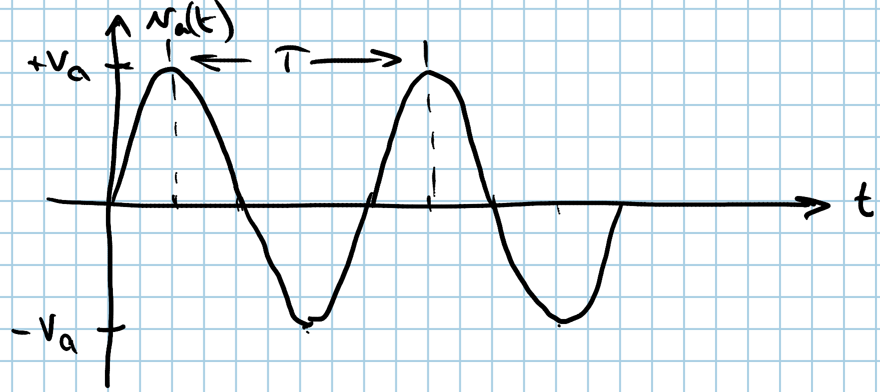
$$v_{oc}(t) = i_s(t)\, R_s$$

$$i_{sc}(t) = i_s(t)$$

Frequency Spectrum of Signals

Tuesday, May 26, 2015
6:30 PM

- Graph $v_a(t) = V_a \sin(\omega t)$



$T \equiv$ Period

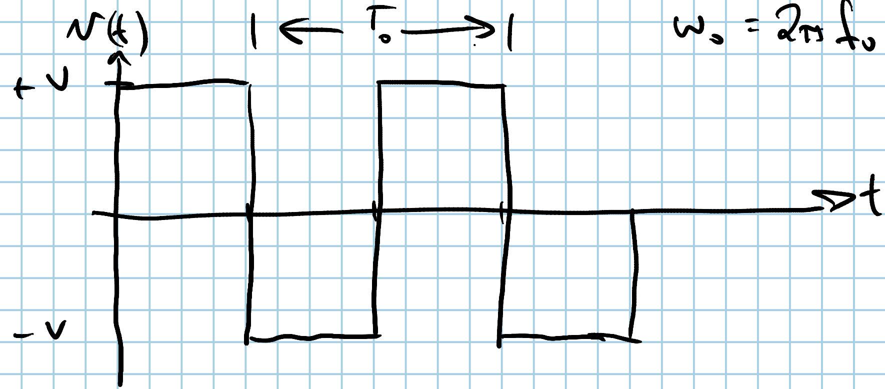
$f = 1/T \equiv$ Frequency (Hz)

$\omega = 2\pi f \equiv$ "angular" rad/sec

$V_a \equiv$ Amplitude

$V_{a\,rms} = \dfrac{V_a}{\sqrt{2}}$

$\omega_0 = 2\pi f_0 , \quad f_0 = 1/T_0$



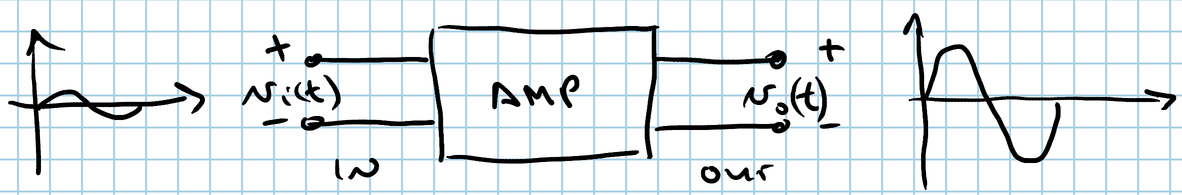
$$v(t) = \frac{4V}{\pi}\left[\sin(\omega_0 t) + \frac{1}{3}\sin(3\omega_0 t) + \frac{1}{5}\sin(5\omega_0 t) + \cdots\right]$$

$$v(t) = \frac{4V}{\pi}\sum \frac{1}{(2n+1)}\sin\{(2n+1)\omega_0 t\}$$

AMPLIFIERS

Tuesday, May 26, 2015
6:41 PM

AMPLIFICATION: THE PROCESS OF INCREASING THE AMPLITUDE OF A SIGNAL.



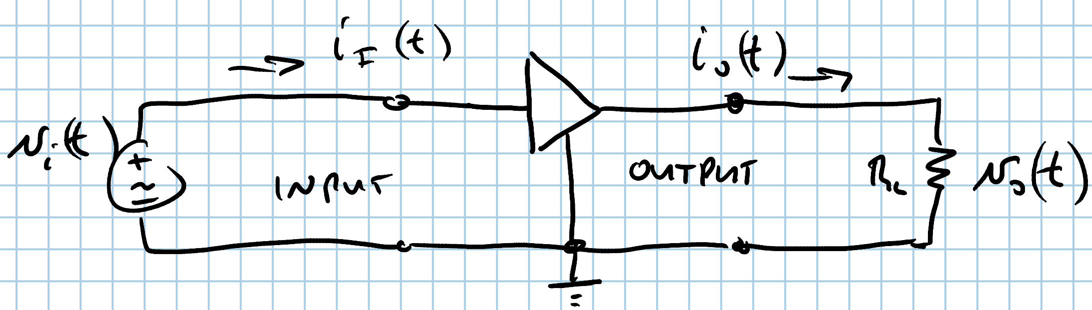
$$v_o(t) = A\, v_i(t)$$

$$A = \frac{v_o(t)}{v_i(t)}$$

$v_i \equiv$ INPUT VOLTAGE

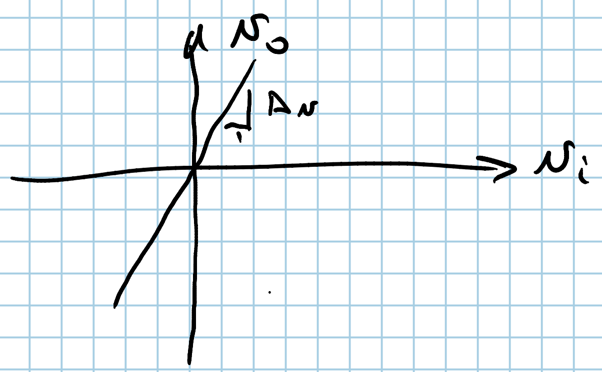
$v_o \equiv$ OUTPUT VOLTAGE

$A \equiv$ AMPLIFIER "GAIN"



CURRENT GAIN: $A_i = \dfrac{i_o}{i_t}$

VOLTAGE TRANSFER CHARACTERISTIC



Power Gain

Tuesday, May 26, 2015
6:50 PM

$$A_p = \frac{\text{LOAD POWER}(P_L)}{\text{INPUT POWER}(P_I)} = \frac{v_O\, i_O}{v_I\, i_I} \quad , \left(i_O = \frac{v_O}{R_L}\right)$$

$$\therefore \quad A_p = A_v A_i$$

Units of Gain

$$A_v = \frac{v_O\,(V)}{v_I\,(V)} \Rightarrow V/V \quad \therefore$$ VOLTAGE GAIN IS UNITLESS

$$A_i = \frac{i_O}{i_I} \Rightarrow \frac{A}{A} \Rightarrow$$ UNITLESS

$$A_p \equiv \frac{W}{W} \Rightarrow$$ UNITLESS

$$A_p = \frac{P_L}{P_I} \Rightarrow P_I << P_L \quad (???)$$