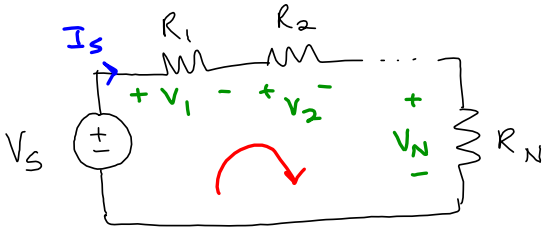
Quiz Wednesday, January 22nd

* Brute Force, Power *

20 min (Beginning of Class)

Resistors in Series:



by KVL:

$$V_S - V_1 - V_2 - \dots - V_N = 0$$

by Ohm's law:

$$V_1 = R_1 I_S$$
$$V_2 = R_2 I_S$$
$$\vdots$$
$$V_N = R_N I_S$$

$$V_S - I_S R_1 - I_S R_2 - \dots - I_S R_N = 0$$

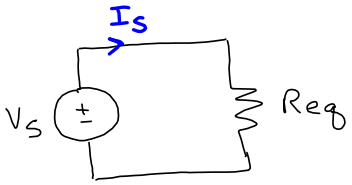
$$V_S - I_S (R_1 + R_2 + \dots + R_N) = 0$$

$$V_S = I_S (R_1 + R_2 + \dots + R_N)$$

let $R_{eq} = R_1 + R_2 + \dots + R_N$

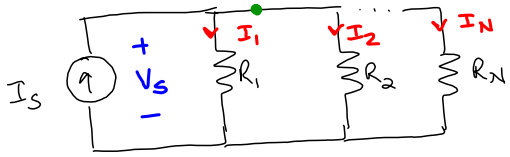
$$\boxed{V_S = I_S R_{eq}}$$

Equivalent ckt



* that resistors in series combine via addition.

Resistors in Parallel



by KCL

$$I_S = I_1 + I_2 + \dots + I_N$$

by Ohm's law

$$I_1 = \frac{V_S}{R_1} \qquad I_2 = \frac{V_S}{R_2} \qquad \dots \qquad I_N = \frac{V_S}{R_N}$$

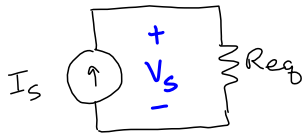
$$I_S = \frac{V_S}{R_1} + \frac{V_S}{R_2} + \dots + \frac{V_S}{R_N}$$

$$I_S = V_S\left(\frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_N}\right)$$

$$V_S = I_S \cdot \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_N}}$$

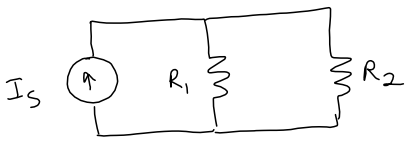
let $R_{eq} = \dfrac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_N}}$

Eq ckt

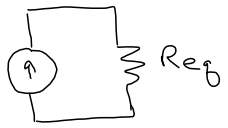


$$V_S = I_S R_{eq}$$

* resistors in parallel combine as the inverse of the sum of the inverses.



$\Rightarrow$



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

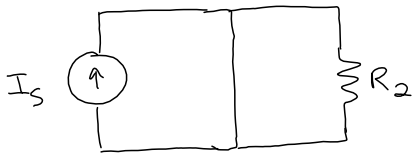
$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$$

Case 1: $R_1 = 0$, R_2

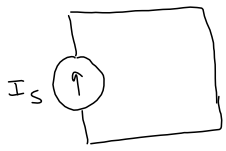
$R_{eq} = 0$

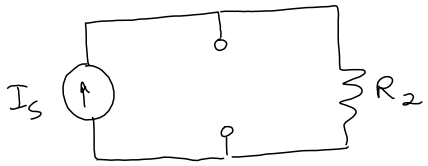
Case 2: $R_1 \to \infty$, R_2

$R_{eq} \to R_2$

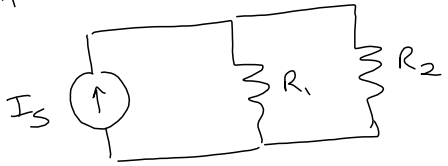


$\Rightarrow$

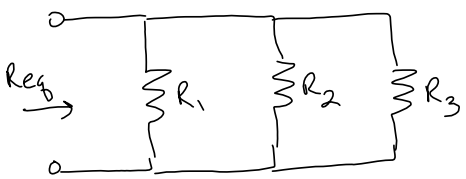


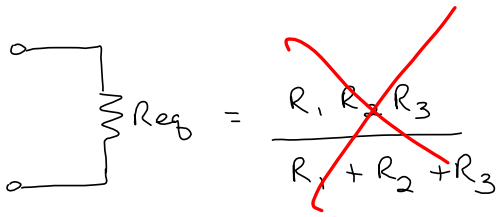


$R_1 = R_2$



more than two resistors in parallel

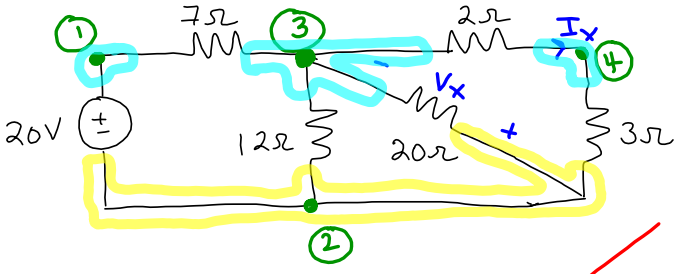




$$= \frac{R_1 R_2 R_3}{R_1 R_2 + R_2 R_3 + R_1 R_3}$$

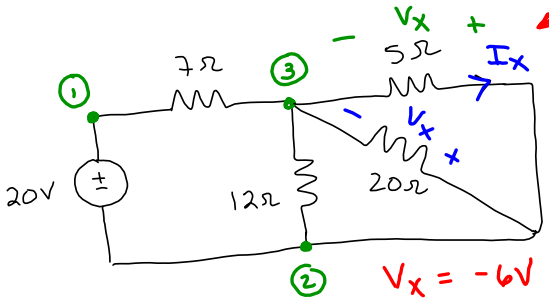
$R_1 + R_2 + R_3 + \ldots$ Series

$R_1 \| R_2 \| R_3 \| \ldots$ Parallel



(A) at (4) $2 + 3 = 5\Omega$

$I_x = -\frac{V_x}{5} = 1.2\ A$



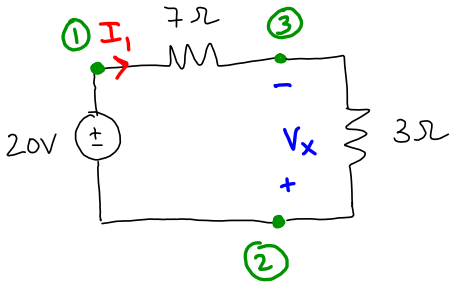
(B) between (2) & (3)

$5 \| 20 \| 12$ *

$5 \| 20 = \frac{100}{25} = 4$ $\quad 4 \| 12$

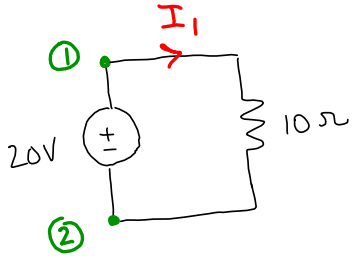
$4 \| 12 = \frac{48}{16} = 3\Omega$

$V_x = -6V$

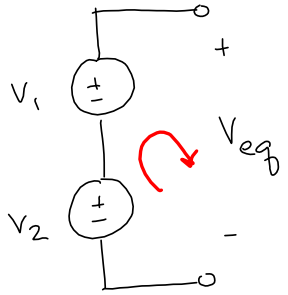


(C) at (3) $7 + 3 = 10\Omega$

$V_x = 3(-I_1) = -6V$



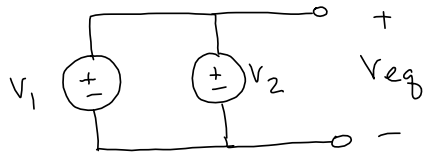
$I_1 = \frac{20}{10} = 2A$

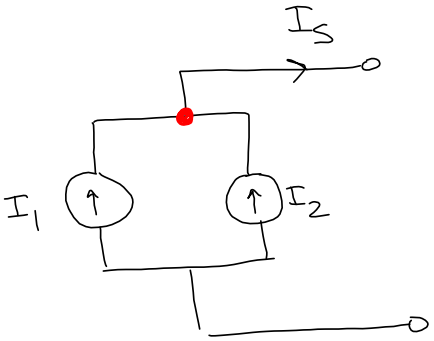


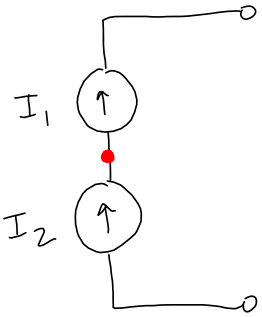
by KVL

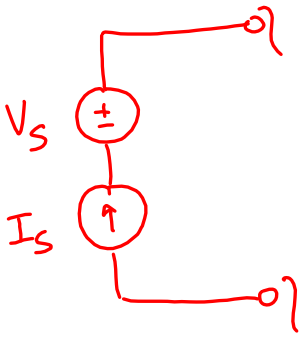
$$V_2 + V_1 - V_{eq} = 0$$

$$V_{eq} = V_1 + V_2$$



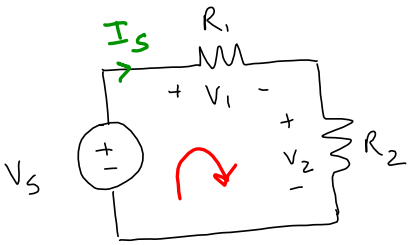






Voltage & Current Division

Voltage division | divider



by KVL

$$V_S - V_1 - V_2 = 0 \qquad V_1 = I_S R_1$$

$$V_S = V_1 + V_2 \qquad V_2 = I_S R_2$$

$$V_S = I_S R_1 + I_S R_2$$