Th 4th week

~~This is 2nd week~~

KCL $\sum_{n=1}^{N} i_n = 0$ node

KVL $\sum_{m=1}^{M} V_m = 0$ loop

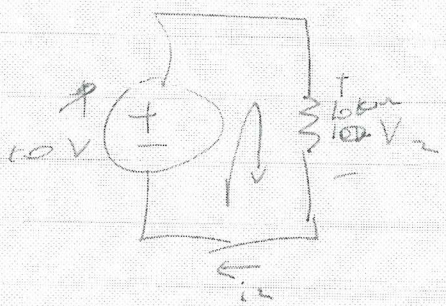
V_m = voltage drop

~~As you go around loop~~ if

Apply these + Ohm's law to circuits ⇒ Find I, V everywhere.

Note: Ch 2 ex. probs easy. Need method to do this (Ch 3).

e.g.



2 nodes ~~V_1 V_2~~

KVL $-10V + V_2 = 0 \Rightarrow$

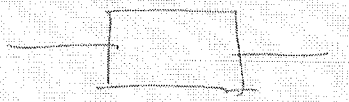
$\Rightarrow V_2 = 10V$

KCL $\Rightarrow i_1 = i_2$

Ohm's law = $V_2 = i_2 R \Rightarrow i_2 = \frac{10V}{10k\Omega} = 1mA$

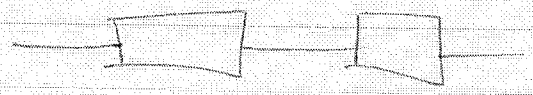
Done. Know I, V everywhere.

Absolute V vs relative?



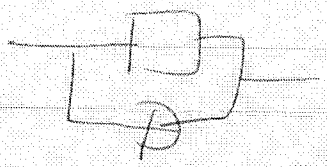
Stands for any circuit element (Resistor, source)

2 circuit elements connected like this



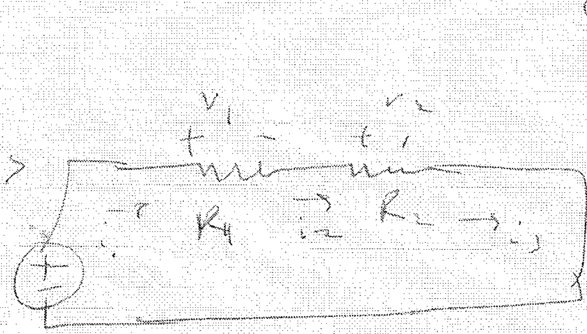
are said to be in series.

2 circuit elements connected like this



are said to be in parallel.

Series resistors



$i_1 = i_2 = i_3$ call i

$v_1 = iR_1$

$v_2 = iR_2$

$-v + v_1 + v_2 = 0$ KVL

R_1 R_2 v knowns
i v_1 v_2 not known

3 eqns, 3 unknown. general theorem
linear algebra

$i = \frac{v}{R_1 + R_2}$

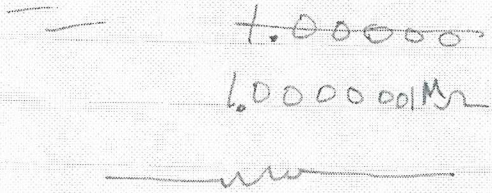
$R_{eq} = R_1 + R_2$

$\Rightarrow$

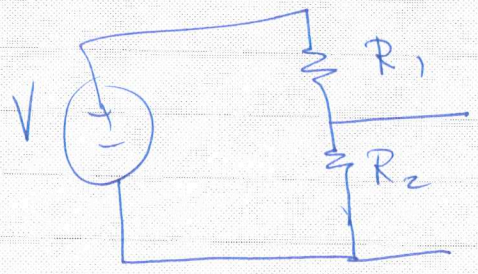
N resistors in series $R_{eq} = \sum_n R_n$

Analog voltage divider.
Elaborate

Very important example



Be reasonable. Ignore 0.1Ω



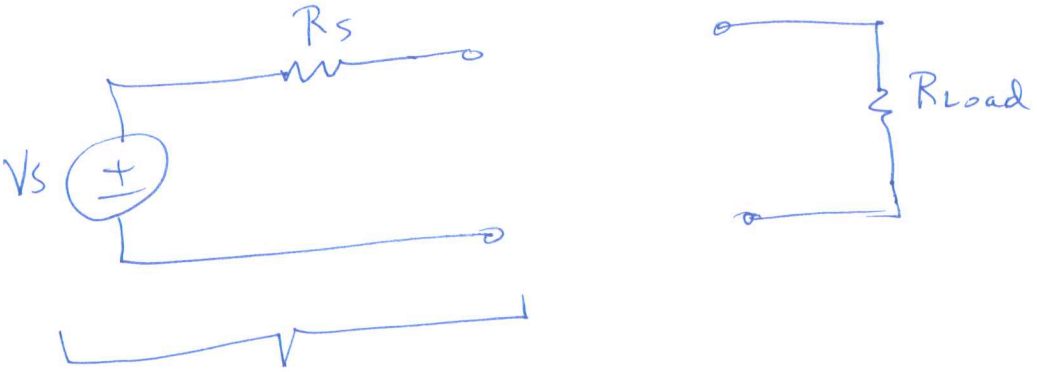
$$V_2 = \frac{R_2}{R_1+R_2} V$$

"Voltage divider"

Voltage divider:

Why important?

Want to connect 2 complex circuits: "Source" and "load"



Thevenin Thm:

Any circuit can be represented by this eg. circuit.

S = "Source"

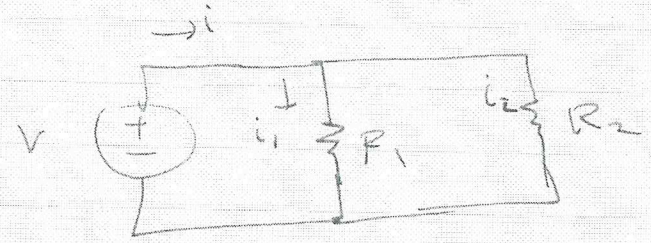
What is V_{Load}? $= \frac{R_{Load}}{R_{Load} + R_S} V_S$

If $R_{load} \gg R_S \Rightarrow V_{Load} = V_S$

If $R_{load} \ll R_1 \Rightarrow V_{Load} \to 0$

We say R_{load} "loads down" ~~power~~ supply source.

Parallel resistors



$V = i_1 R_1 = i_2 R_2$

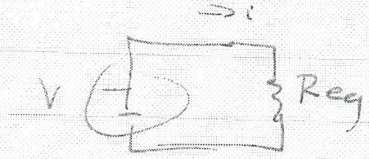
$i_1 = V/R_1$ $\quad$ $i_2 = V/R_2$

KCL $\Rightarrow$ $i = i_1 + i_2$

$$i = \frac{V}{R_1} + \frac{V}{R_2} = V\left(\frac{1}{R_1} + \frac{1}{R_2}\right) = \frac{V}{R_{eq}}$$

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

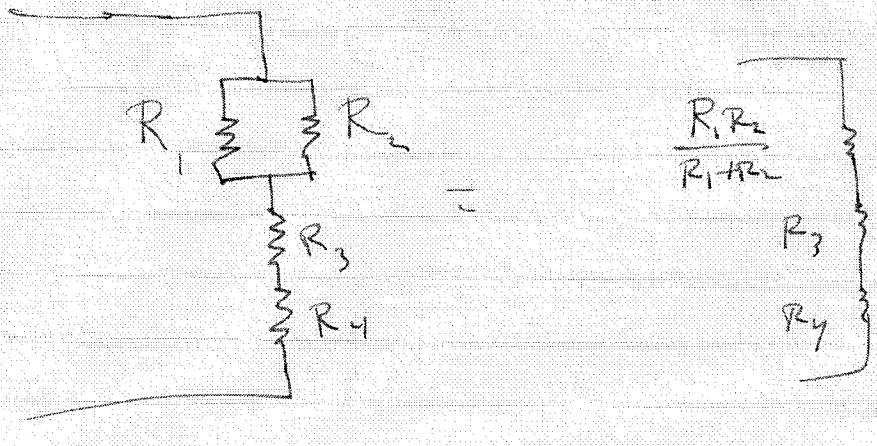
N in parallel $\quad \frac{1}{R_{eq}} = \sum_n \frac{1}{R_n}$



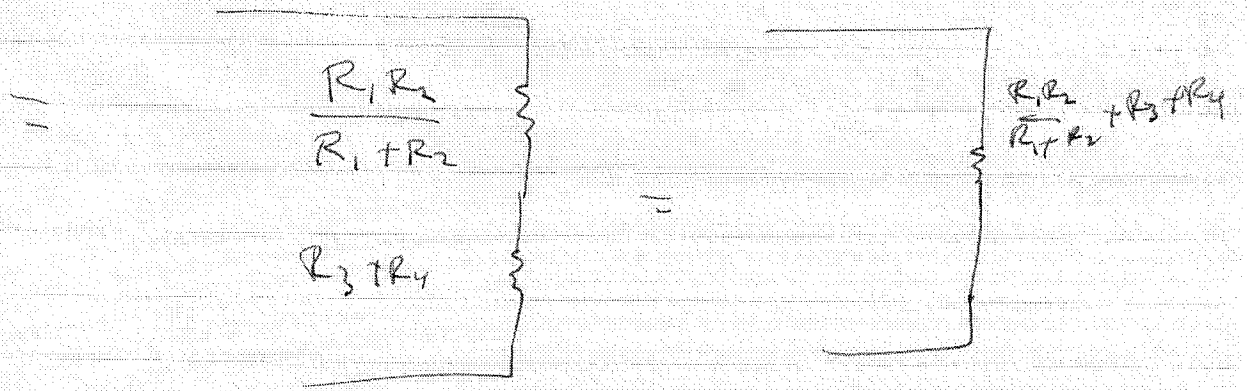
$R_1 \| R_2$ means R_1 in parallel with R_2

Current divider

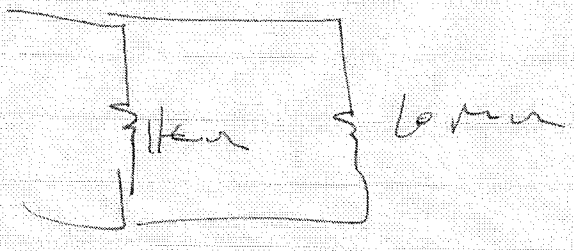
e.g.

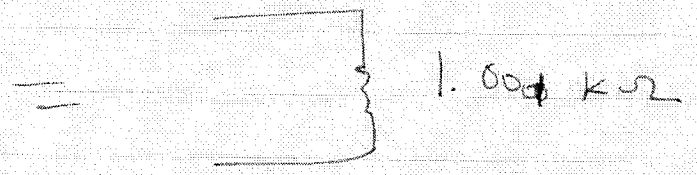


What is R_{eq}?



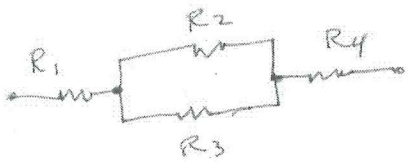
Important Example



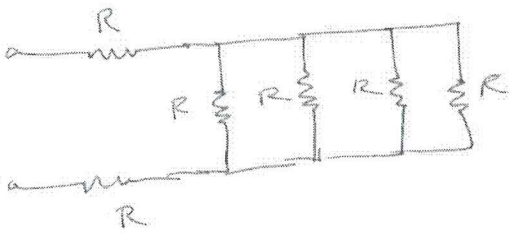


be reasonable. Ignore 10mA.

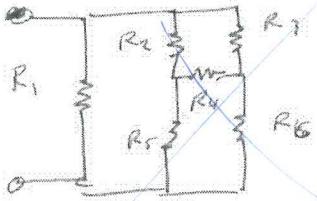
Eg.



$R_{eq} = ?$



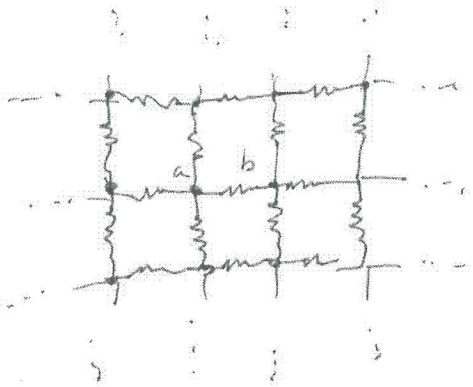
$R_{eq} = ?$



$R_{eq} = ?$

Teach:

$R_{ab} = ?$



Dover