EE100 - Lecture 3

(1) <u>Administrivia</u>

(i) Readers – Copy central printed more copies!

(ii) Office hours in 197 Cory

(iii) Homework

- in course notes!
- "p" symbol <u>does not</u> mean you should do the problem in PSPICE
- Scan in HW problems
  - NO!

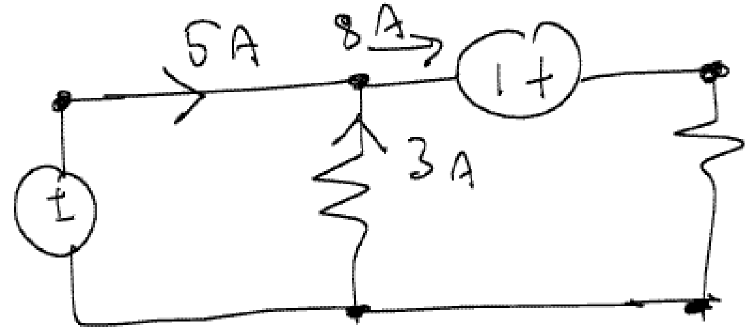
(2) Today:

- Finish chapter 2
- Chapter 3 (just examples, skip 3.5, 3.6)
- PSPICE (??)

TODAY → KCL (Kirchoff's Current law)

Mechanical Analogy:

KCL:



Algebraic sum of currents at a node is zero.

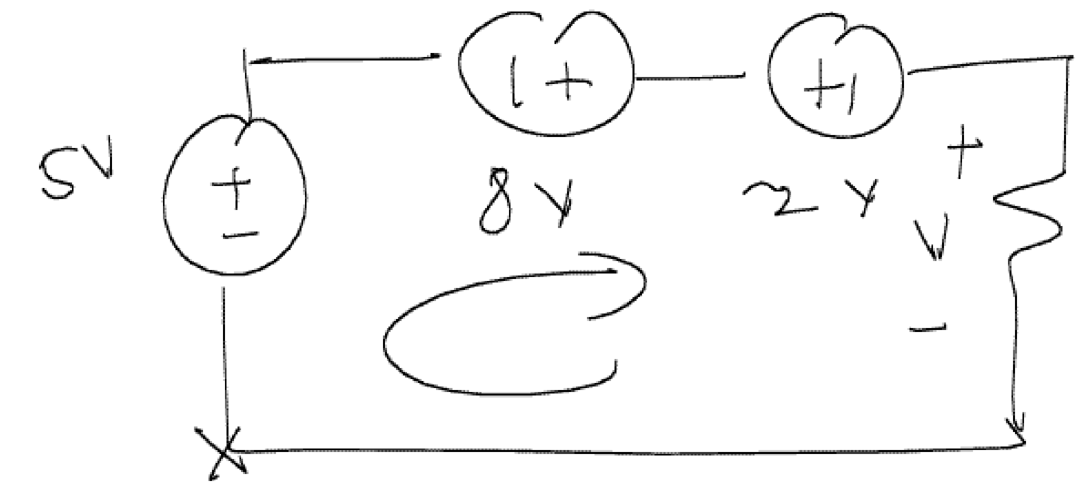
→ i.e.. assign a sign to indicate direction of current

Current entering ≙ positive
Current leaving ≙ negative

$$(+5) + (+3) + (-8) = 0$$

KVL: "Dual of KCL"
[Kirchoff's voltage law]

eg:

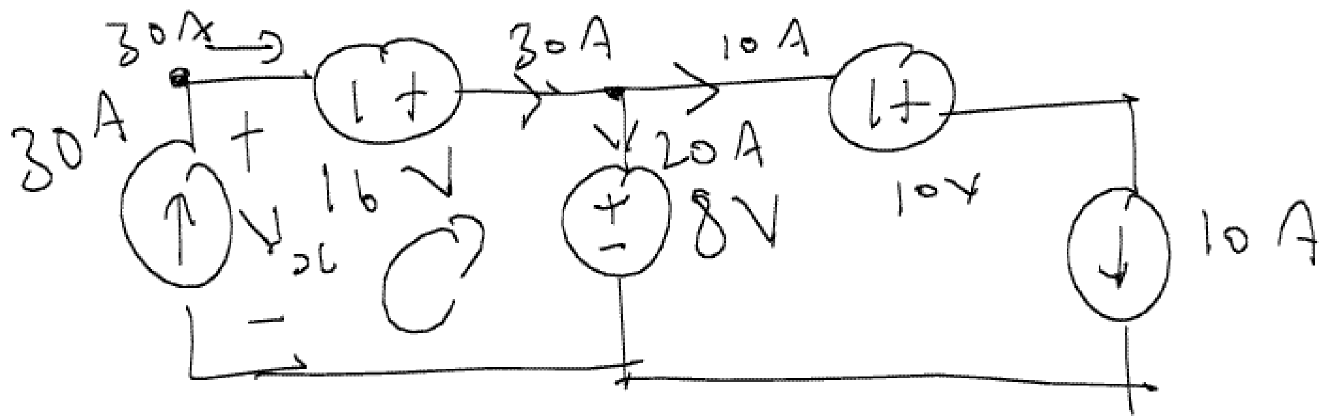


KVL: $(5V) + (8V) + (-2V) + (-v) = 0$

$\Rightarrow$ $\boxed{v = 11\ V}$

EXAMPLES

(2.7) [over →]



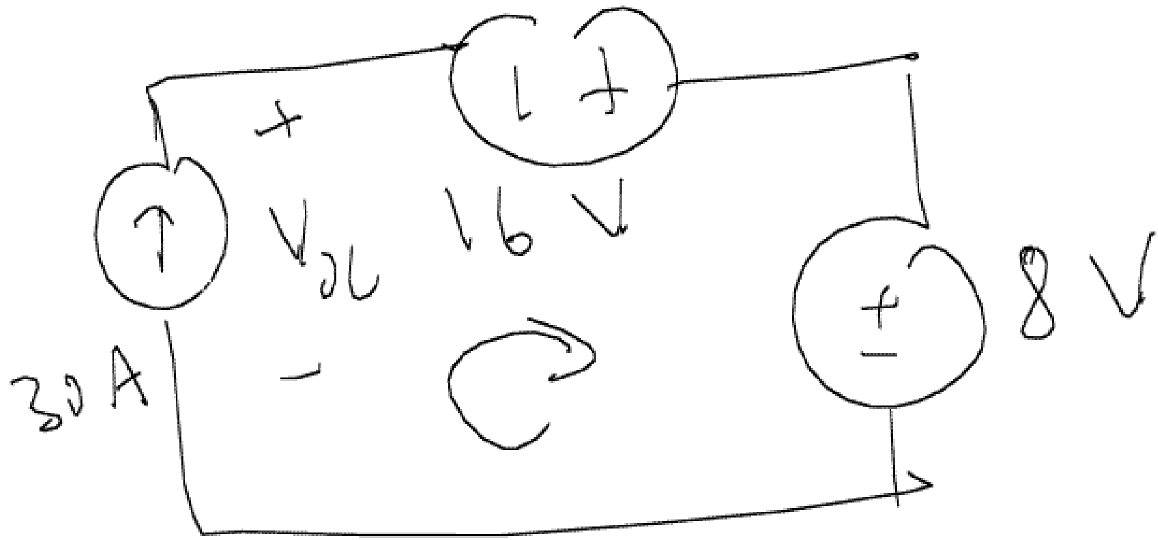
(Q:) Check if the circuit above is valid?

↓ means

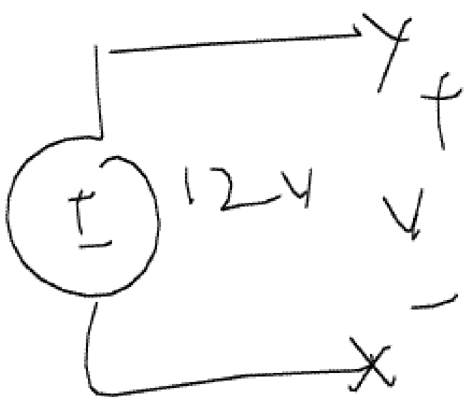
are KCL, KVL, power law satisfied

↓

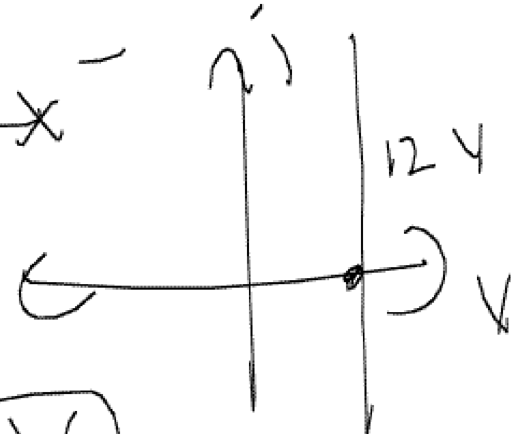
is power delivered = power absorbed



Note:



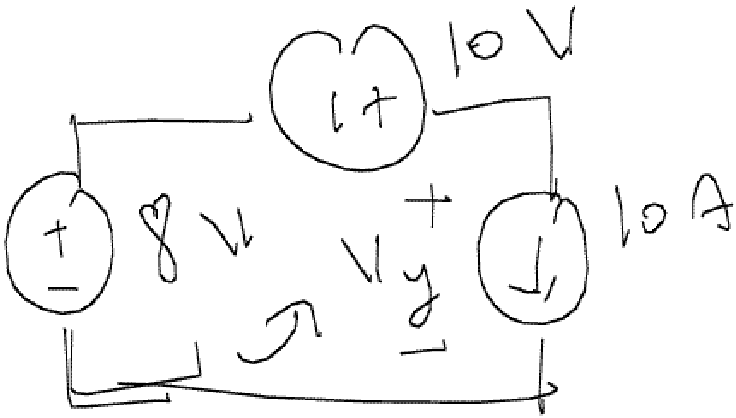
$V = 12$



KVL:

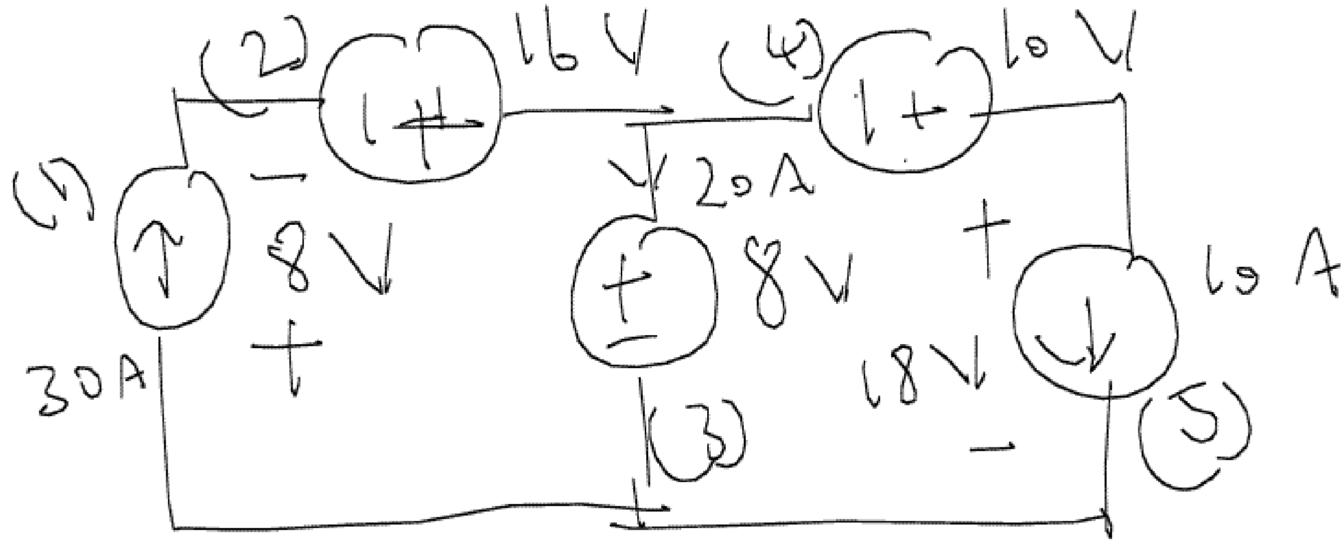
$$V_{oc} + 16 - 8 = 0$$

$$\Rightarrow \boxed{V_{oc} = -8\,V}$$

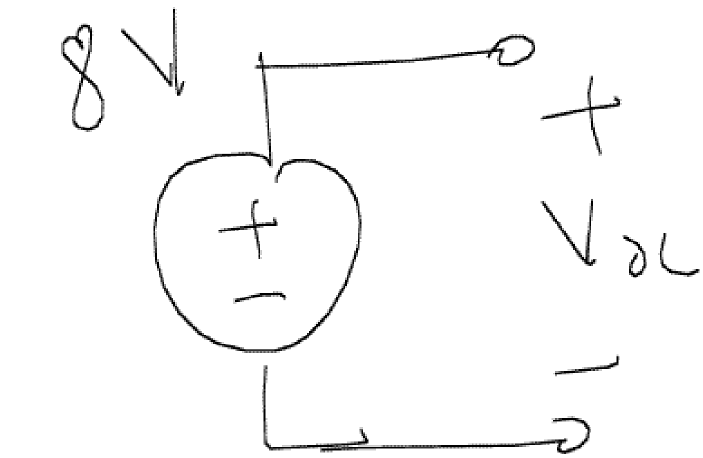


KVL: $V_y - 10 - 8 = 0$

$\Rightarrow \boxed{V_y = 18\ V}$



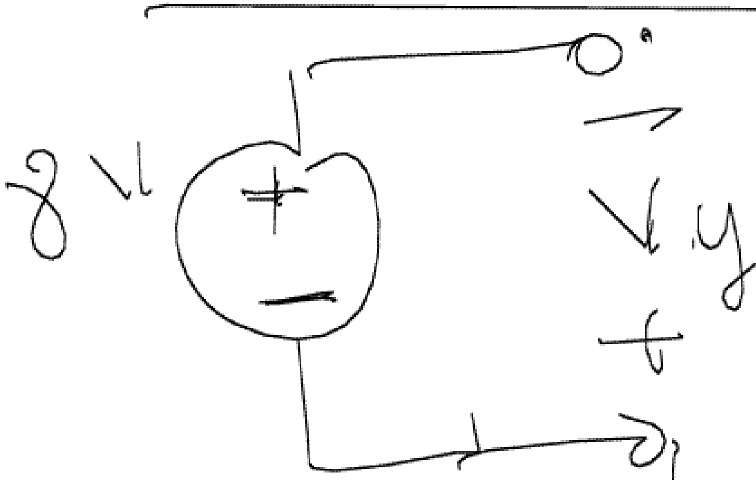
Delivered	Absorbed
(2): (16 V)(30 A) = 480 W	(1): (30 A)(8 V) = 240 W
	(3): (20 A)(8 V) = 160 W
(4): (10 A)(10 V) = 100 W	(5): (10 A)(18 V) = 180 W
580 W	= 580 W



KVL:

$$V_{oc} - 8 = 0$$

$$\Rightarrow \boxed{V_{oc} = 8\,V}$$



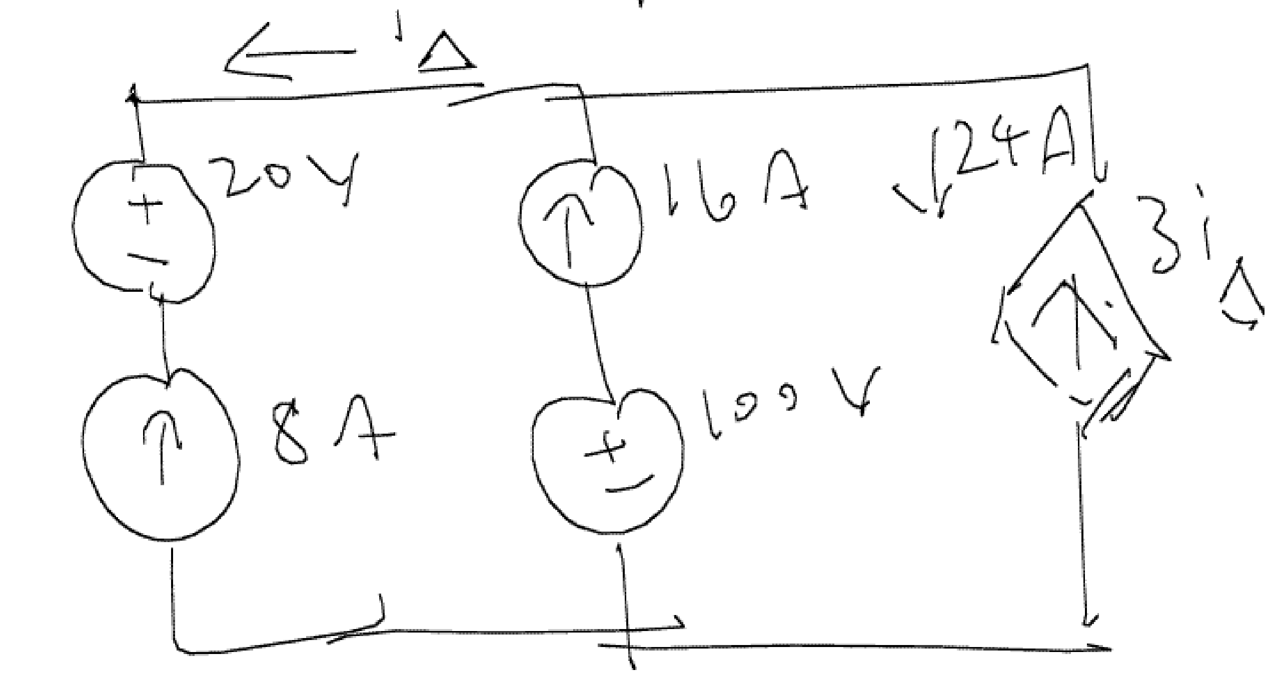
KVL:

$$-V_y - 8 = 0$$

$$\Rightarrow \boxed{V_y = -8}$$

$$\boxed{V_{oc} = -V_y}$$

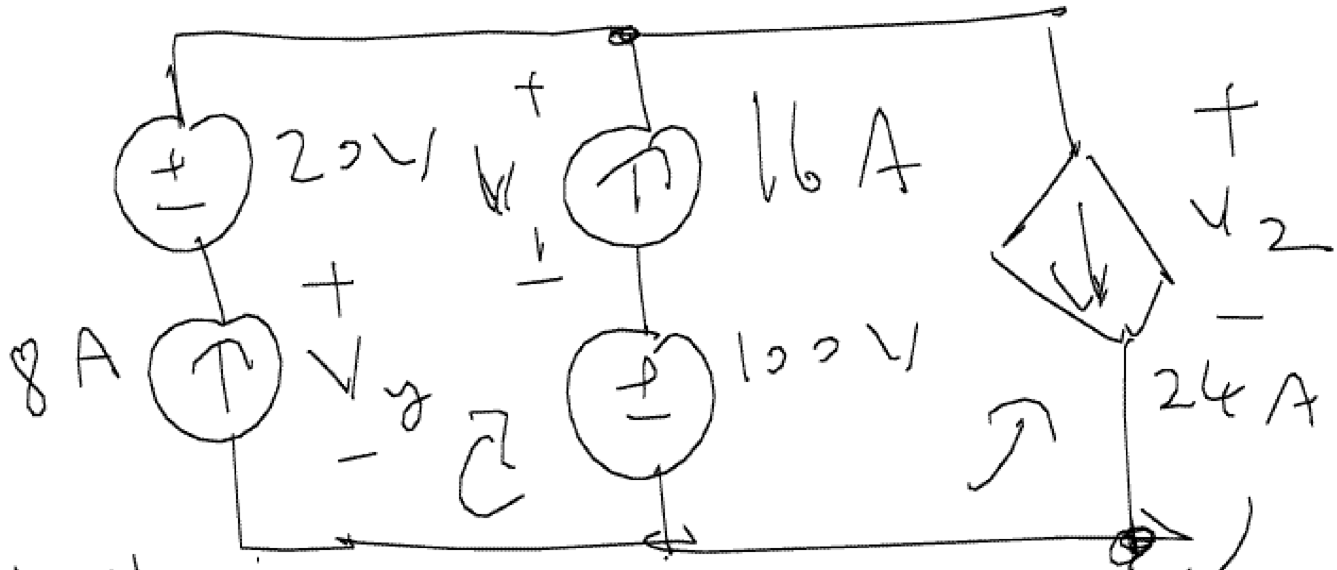
Example: p. 2-12



(Q:) Is circuit valid?

$i_\Delta = -8A$

$\therefore 3i_A = -24A$



KVL

$V_2 - v_1 - 100 = 0$

$\Rightarrow \boxed{V_2 = V_1 + 100}$

$V_y + 20 - V_1 - 100 = 0$

$\Rightarrow \boxed{V_y - V_1 = 80}$ — (2)

"outside loop":

$V_y + 20 - V_2 = 0$

$\Rightarrow \boxed{V_y - V_2 = -20}$ ← ③

But, ② − ①

$\Rightarrow V_y - \cancel{V_1} - V_2$

$= 80 - \cancel{V_1} - 100$

⇒ eq. ③

So, is system valid? Now, we have a linear circuit. Going back to linear algebra, this system ~~has~~ may have ∞ly many solutions.

Eg: $V_1 = 20V$

$V_2 = 120V$ [eq. (1)]

$V_y = 100V$ [eq. (2)]

But Power absorbed

$= P_{delivered}$

We still have to do this!

Delivered	Absorbed
(1) $(8A)(V_y)$	$(V_2)(24A)$
(2) $(8A)(20V)$ $= 160W$	
(3) $(16A)(V_1)$	
(4) $(16A)(100A)$	

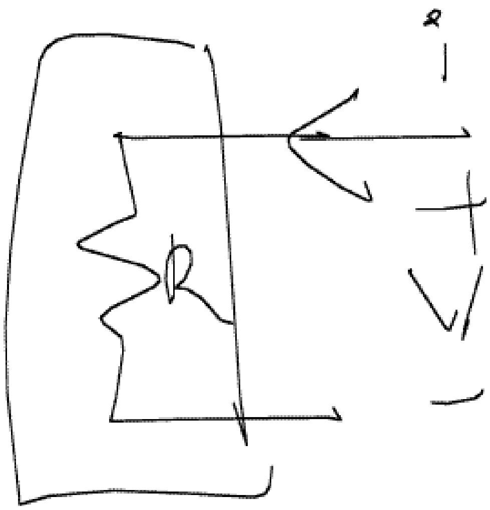
$\therefore 8V_y + 160 + 16V_1 + 1600 = 24V_2$

$$\Rightarrow 8V_g + 16V_1 + 1760 = 24V_2$$

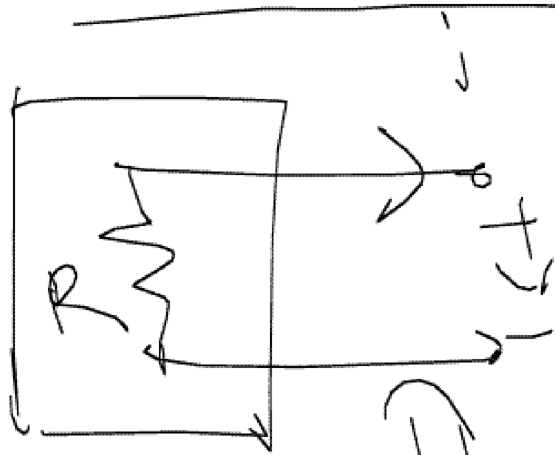
$$\Rightarrow V_g + 2V_1 + 220 = 3V_2$$

$$\Rightarrow \boxed{V_g + 2V_1 - 3V_2 = 220}$$

Chapter 3 - Simple Resistive Circuits



$\Rightarrow v = iR$

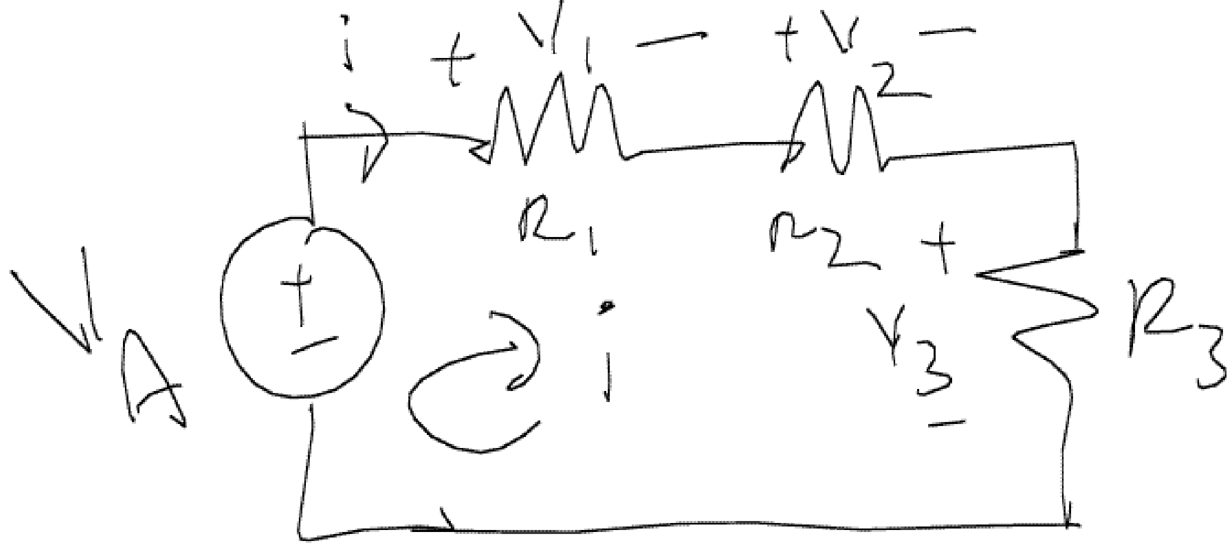


✓ Resistors don't do this!

$\Downarrow$

$v = -iR$

Resistors in series



Series: same current flows ~~through~~ the element(s)

Goal: Find V_1, V_2 & V_3

Ohm's law: $v_1 = i R_1$

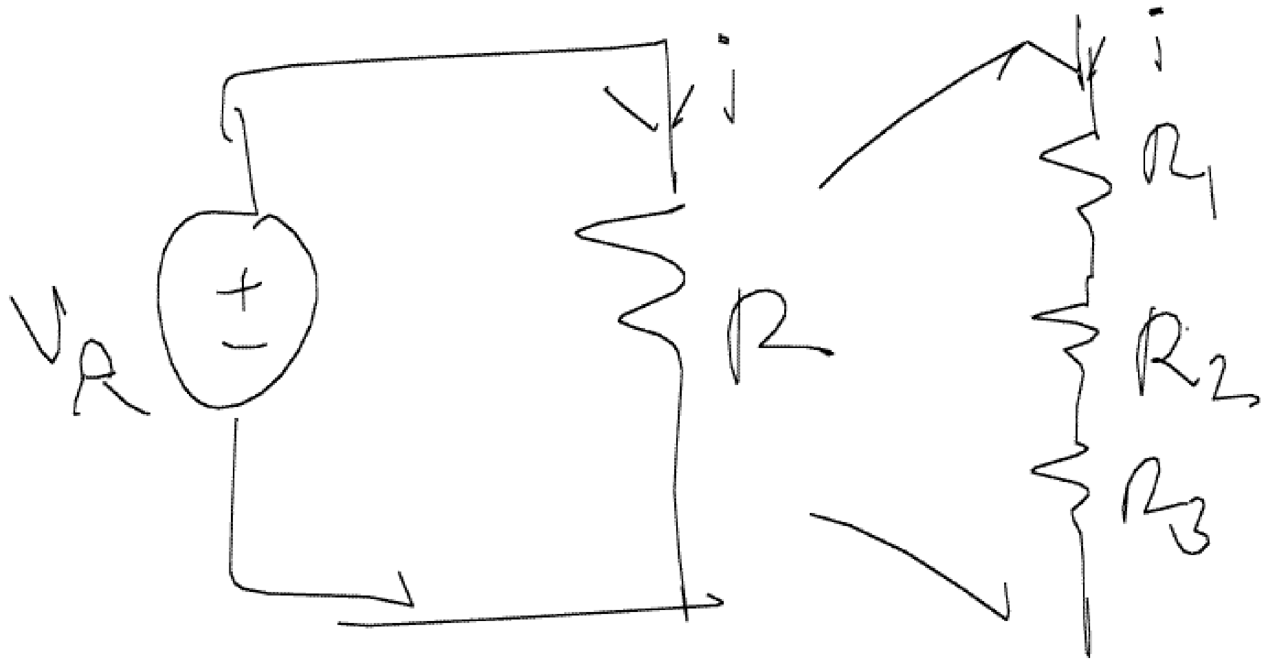
$v_3 = i R_3 \quad v_2 = i R_2$

KVL: $v_A - v_1 - v_2 - v_3 = 0$

$\Rightarrow v_A = v_1 + v_2 + v_3$

$\Rightarrow v_A = i R_1 + i R_2 + i R_3$

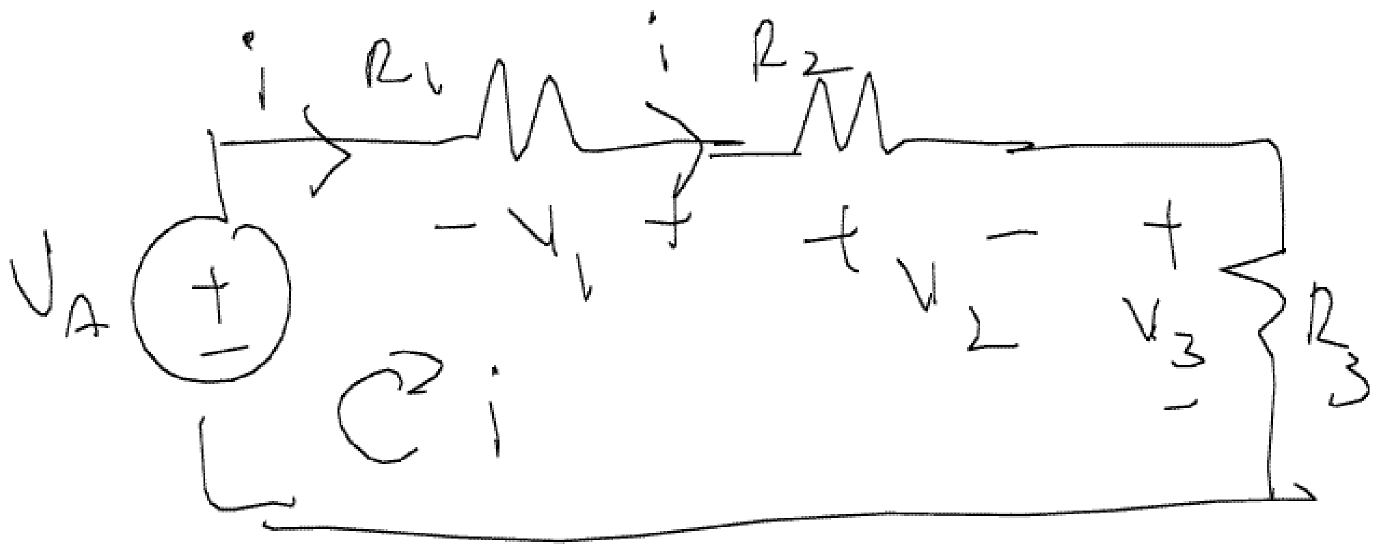
$$v_A = i \underbrace{(R_1 + R_2 + R_3)}_{R}$$



"Series combination of resistors"

Sign Convention:

Note:



KVL: $V_A + v_1 - v_2 - v_3 = 0$

$\Rightarrow V_A = -v_1 + v_2 + v_3$

Ohm's law: $v_1 = -iR_1$

$\therefore V_A = iR_1 + iR_2 + iR_3$

<u>Bottomline:</u> You can pick the direction of unknown voltages and currents in a circuit arbitrarily, you just have to apply the correct sign convention.

Next time →
- Finish chapter 3
  - Voltage divider
  - Parallel Circuits
  - Δ-Y transforms
  - Ex. 2-28
- PSPICE example
- Chapter 4