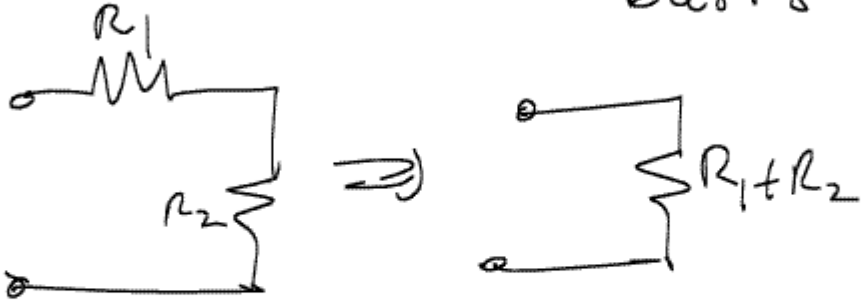
Lecture 7 - Chapter 4 [contd.]

Today
- Administrivia
  - my OH have changed:
    - Th 10-11 197 Cory
    - Th 5pm - 9pm FSM [Cafe]
- Source transforms
- Dependent sources with PSPICE

Section 4-9 - Source Transforms

↳ Bart's favourite method

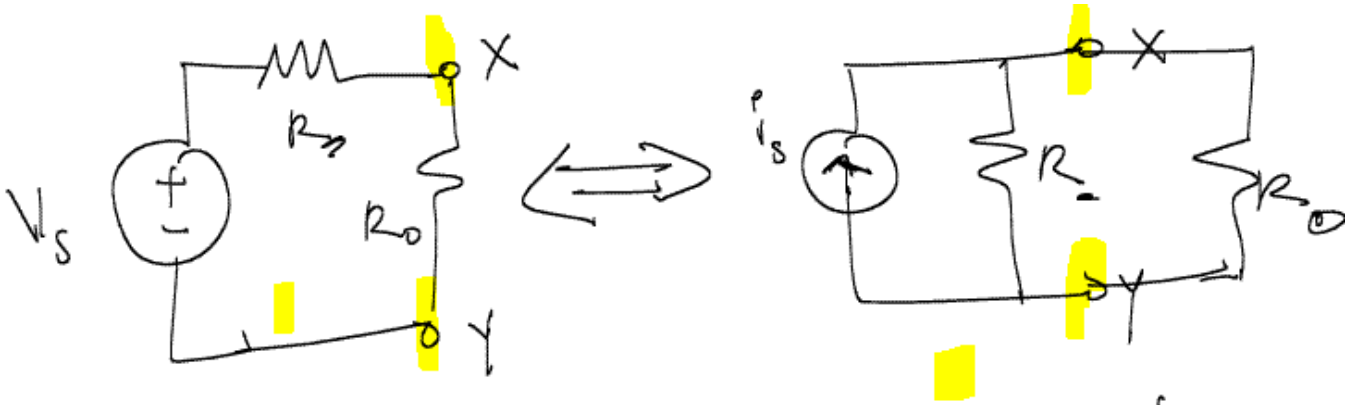
Recall:



] Simplified circuit!

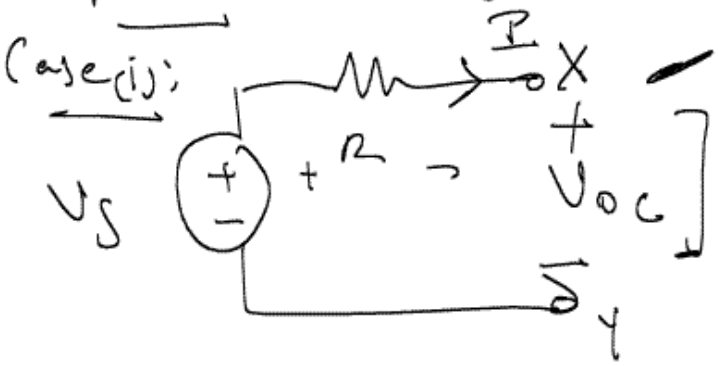
Idea behind Source transforms is the same ⇒ Simplify circuits. But, we are going to include independent sources (voltage and current)

That is,



Goal: Find relationship between V_s & i_s

Case (i):

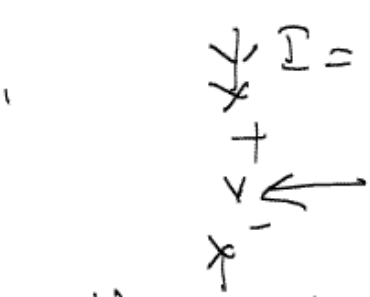


open circuit voltage

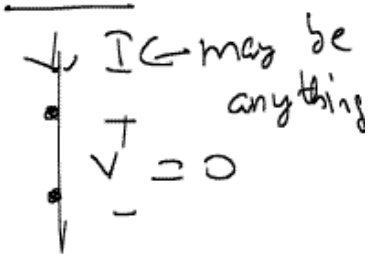
$V_{oc} = V_s$ [KVL]

Note: Be careful with open circuits

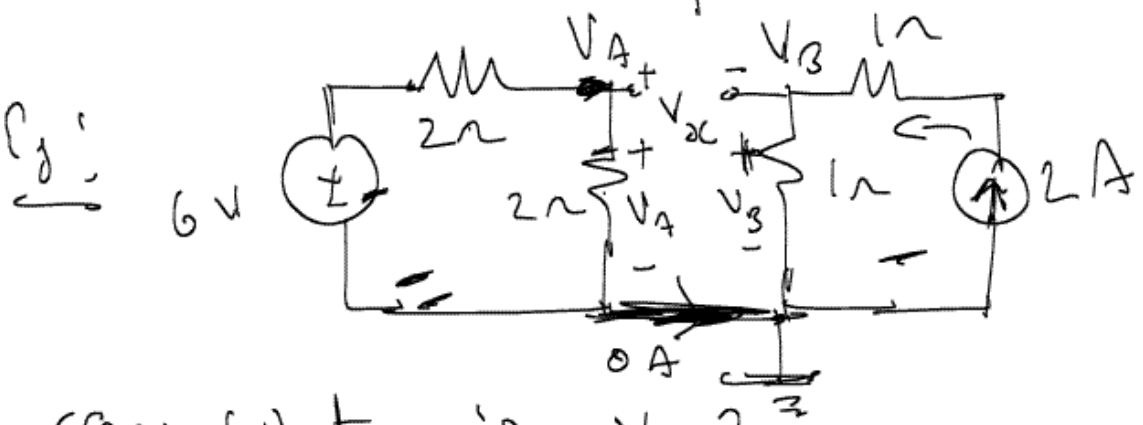
Open Circuit: $I = 0$



Dual:



Eg:



(Qi:) what is V_x?

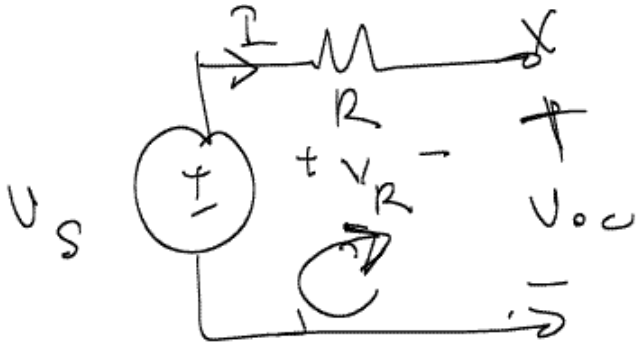
$V_x = V_A - V_B$

$V_A = \left[\frac{2}{(2+2)}\right] 6$ (voltage divider) $= 3$ V

$V_B = (2\text{ A})(1\ \Omega) = 2$ V

$\boxed{V_x = 1 \text{ V}}$

Going back:



$I = 0$ (open circuit)

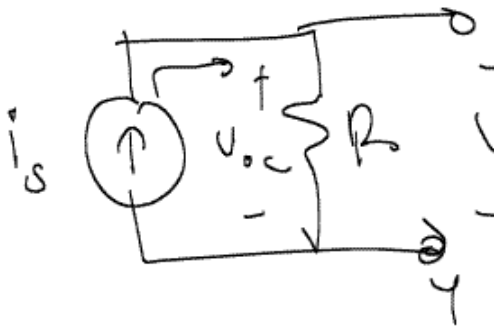
$V_R = (I)(R)$

$= 0\ V$

KVL: $V_s - V_R - V_{oc} = 0$

$\Rightarrow \boxed{V_{oc} = V_s}$

Now,

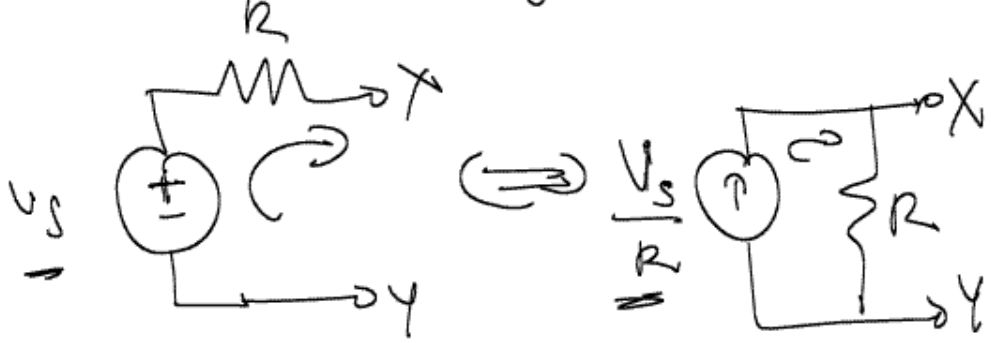


$V_{oc} = V_s$ ← if this circuit is equivalent to the circuit above — ①

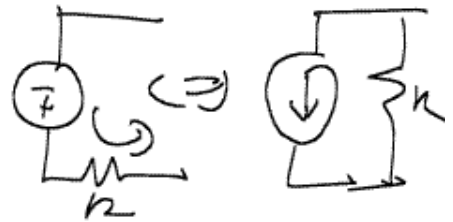
But, $V_{oc} = i_s R$ — ②

$\therefore$ Equating ① & ②

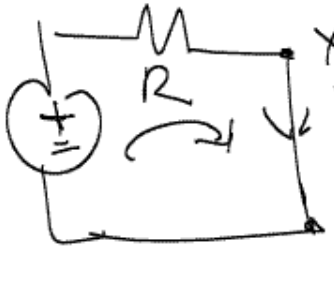
$$i_S R = V_S \Rightarrow \boxed{i_S = \frac{V_S}{R}}$$

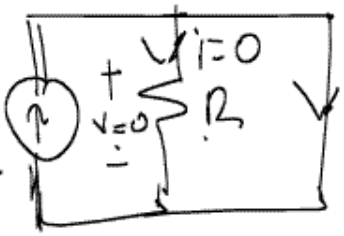


Note:



Note: We could have used I_{SC} [Short-circuit current]

i.e.. 

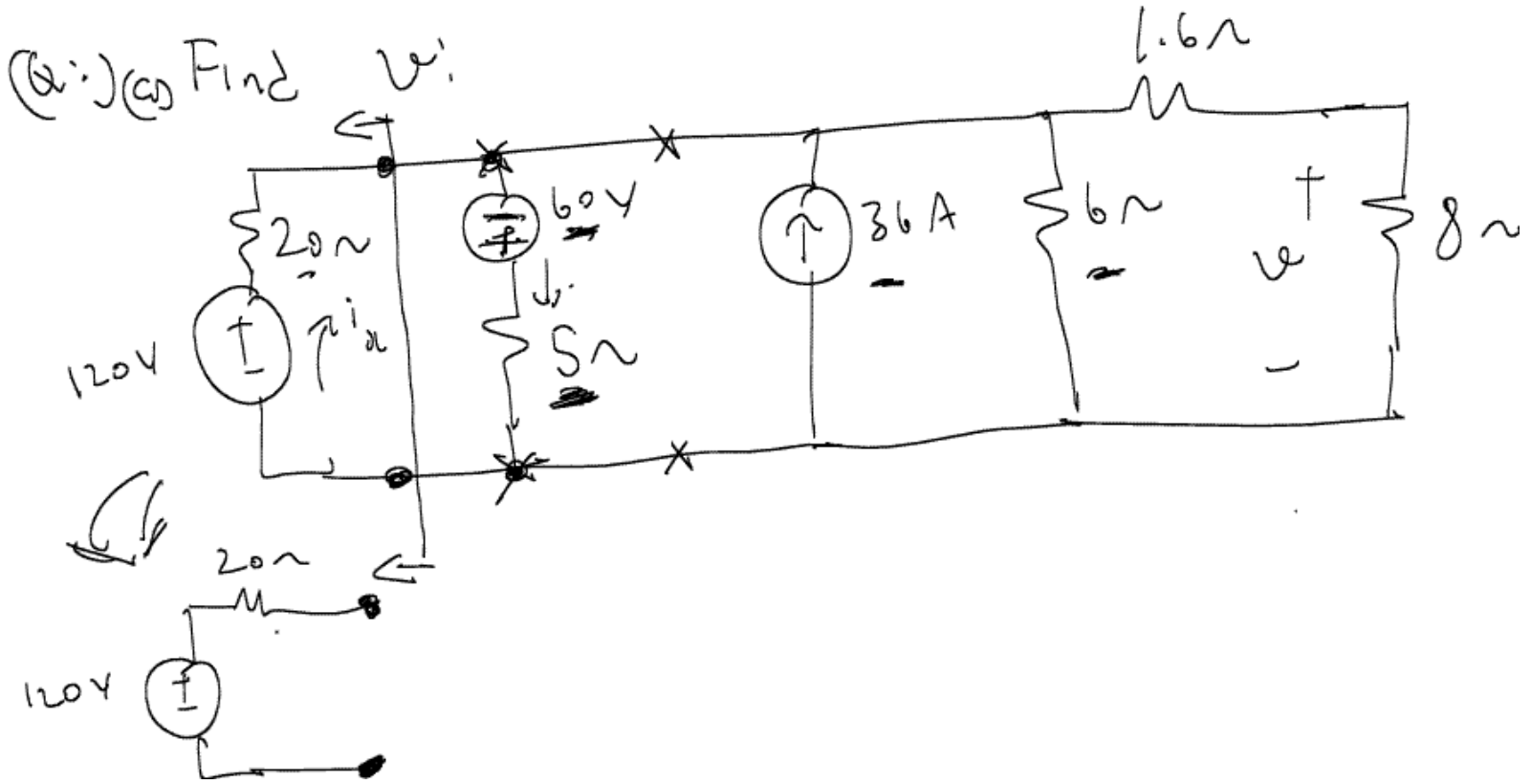
$I_{SC} = \frac{V_S}{R}$ ||| 

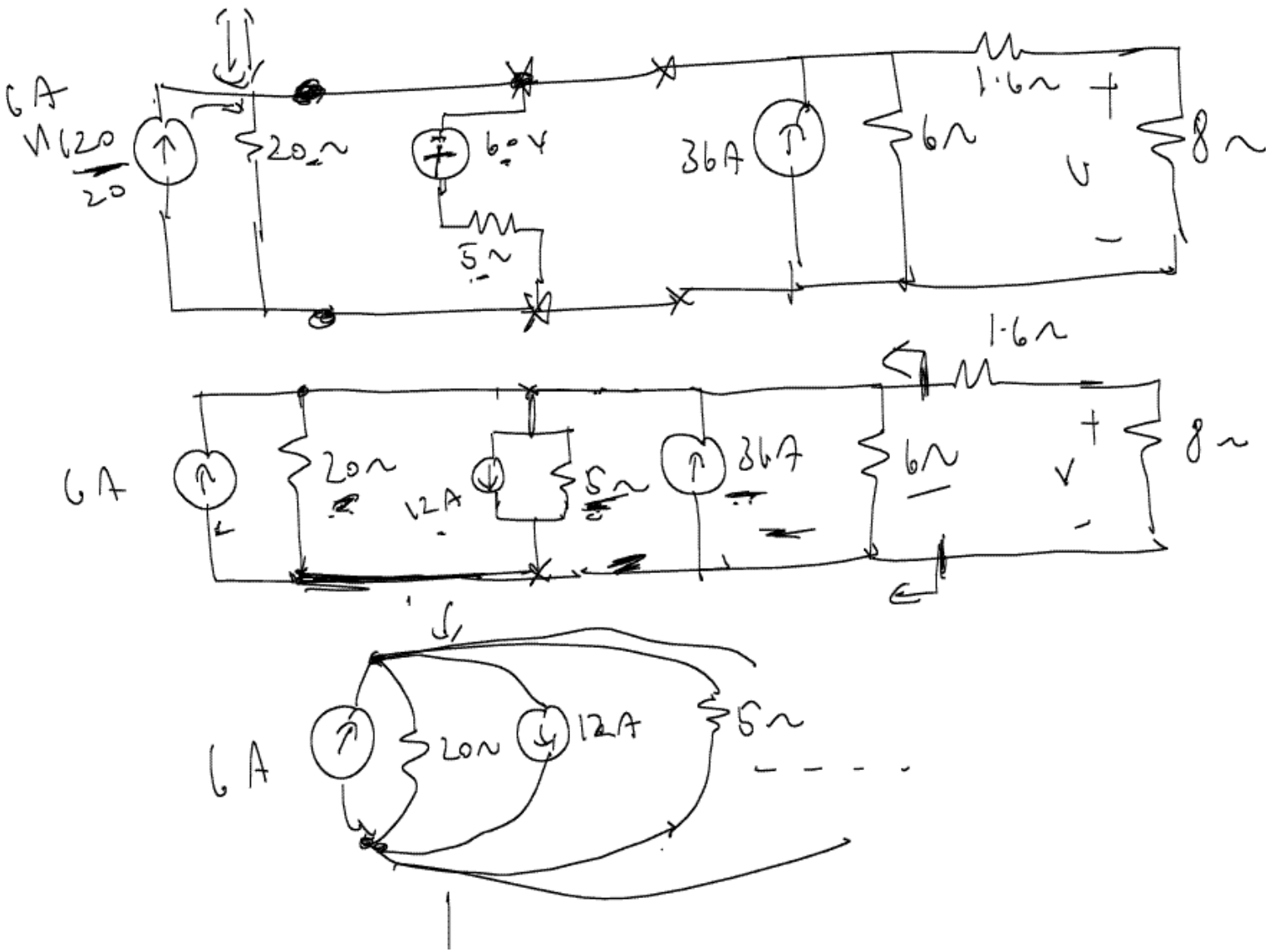
$I_{SC} = \frac{V_S}{R}$

Why is this useful?

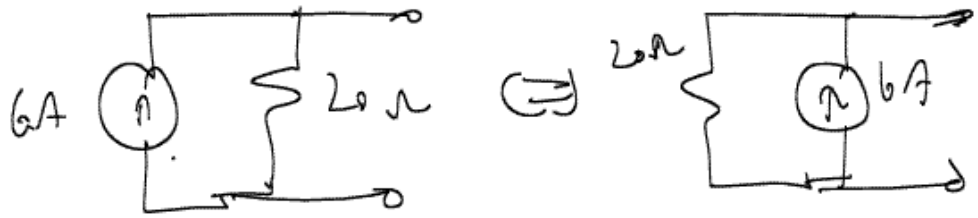
Example: D 4.15, p. 139

(a) Find v.

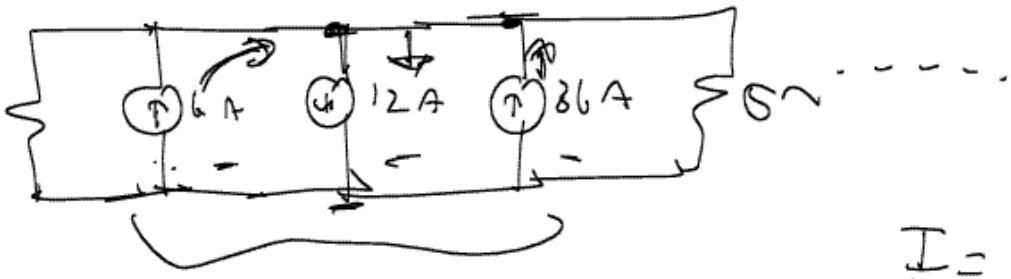



6A
V/20
20
20Ω
6.0V
5Ω
36A
6Ω
1.6Ω
+
V
-
8Ω
6A
20Ω
12A
5Ω
36A
6Ω
1.6Ω
+
V
-
8Ω
6A
20Ω
12A
5Ω

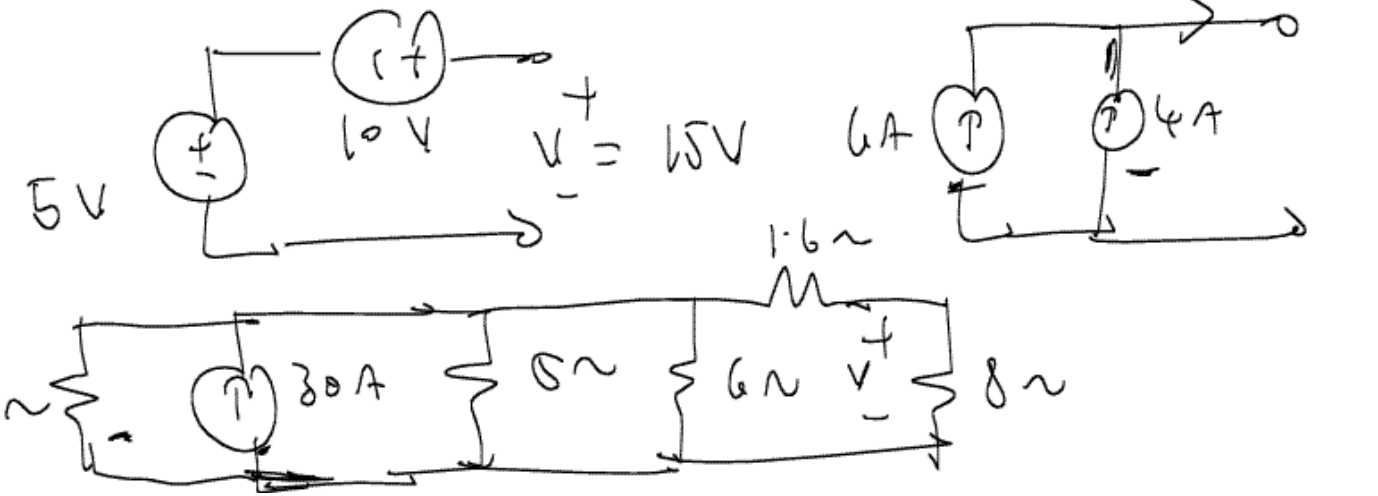
Note:

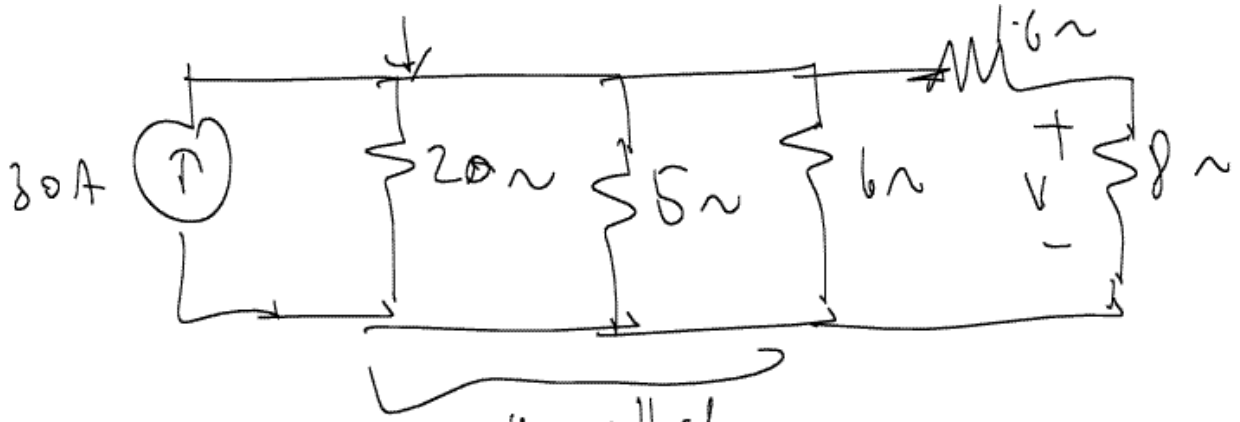


Going back:

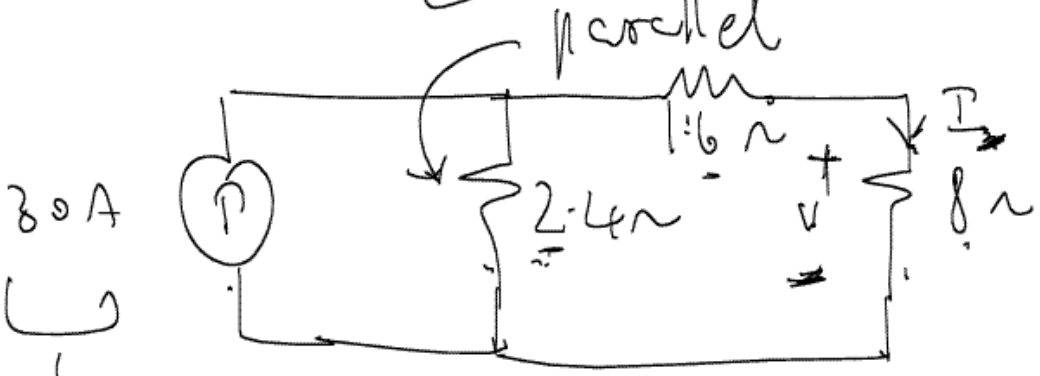


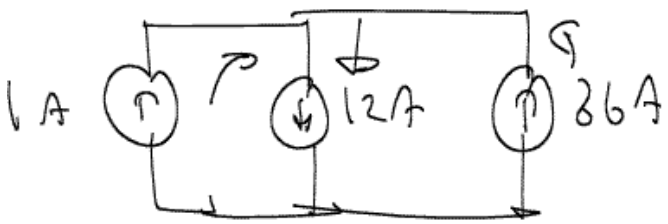
Dual:





parallel

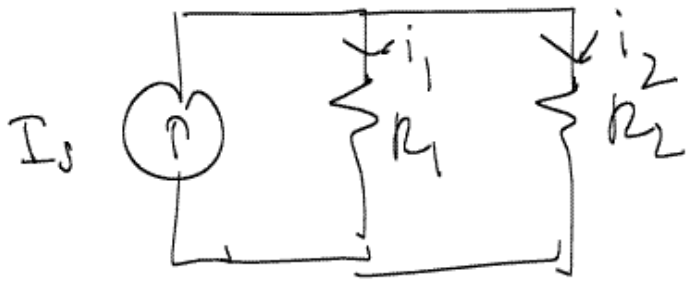




$$V = (I)(8\,\Omega)$$

$$= \left[\left(\frac{2.4}{2.4+9.6}\right)30A\right][8\,\Omega]$$

Note:

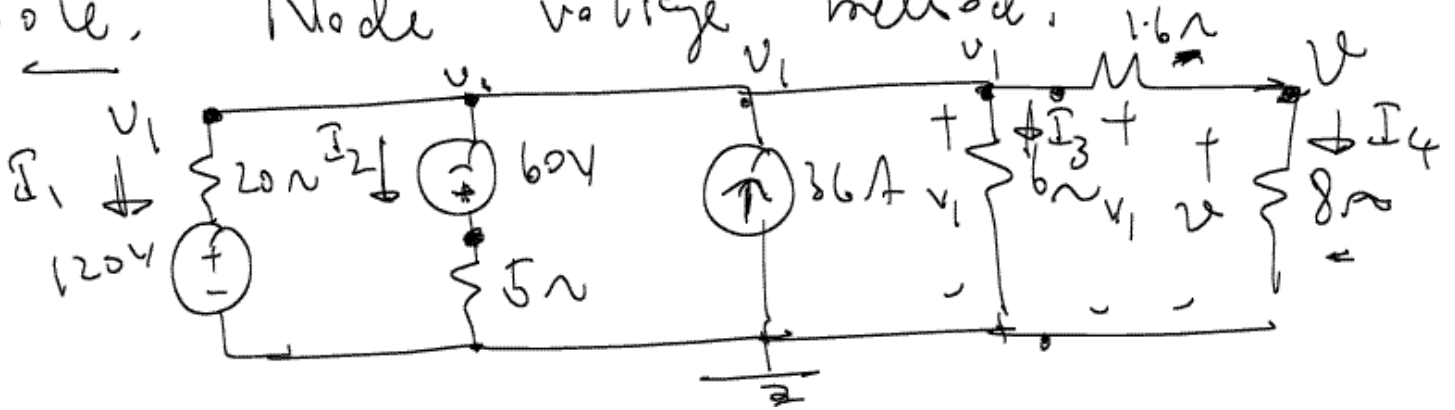


$$i_2 = \left(\frac{R_1}{R_1 + R_2}\right) I_s$$

[Current divider]

$$\therefore v = \frac{2.4}{12} \cdot 240 \Rightarrow \boxed{v = 48\ V}$$

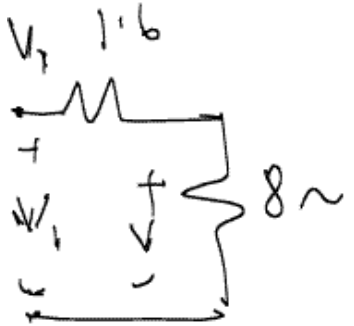
Note: Node voltage method:



Note:

$$86 = I_1 + I_2 + I_8 + I_4 \quad \text{(KCL)}$$

$$\Rightarrow 86 = \frac{v_1 - 120}{20} + \frac{V_1 + 60}{5} + \frac{V_1}{6} + \frac{V_1}{(1.6+8)}$$



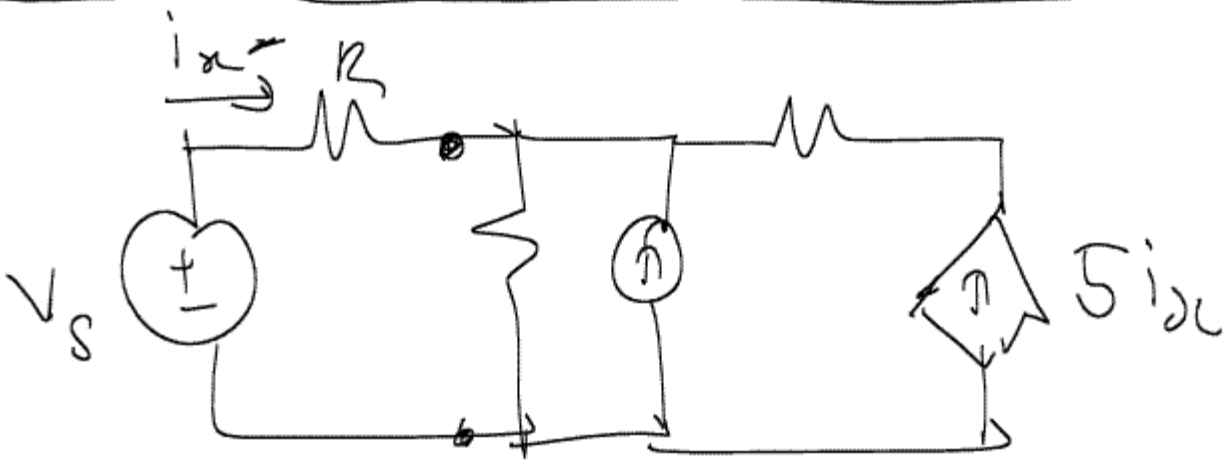
$$\Rightarrow 86 = \frac{v_1 - 120}{20} + \frac{V_1 + 60}{5} + \frac{V_1}{6} + \frac{V_1}{9.6}$$

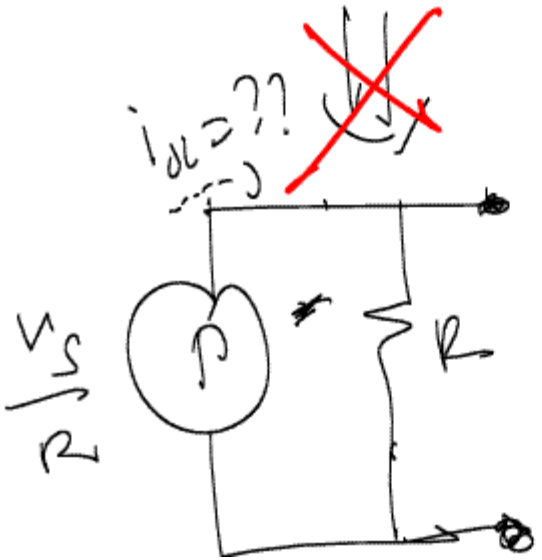
$$\Rightarrow \boxed{v_1 = 57.6 \text{ V}}$$

$$v = \left(\frac{8}{9.6}\right) v_1 \quad \text{[Voltage divider]}$$

$$= 48 \text{ V} \checkmark \quad \text{Check!}$$

When is source transform a bad idea?





Moral: Be careful with dependent sources.

Sorry, no time for dependent sources. ⇒ OFFICE hours

Next time: → Thevenin / Norton equivalents

Note: I will try using the highlighter from now on, but watch out when printing the lectures.