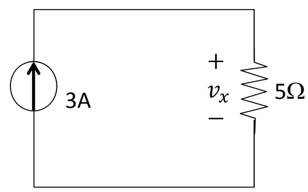
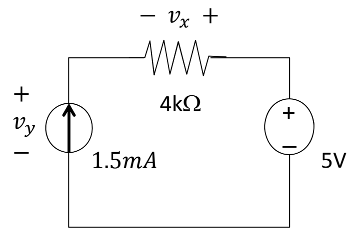
Practice problem 1: Find v_x, v_y in the following circuits



(a)



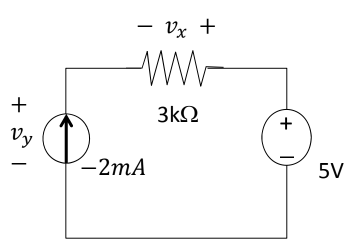
(b)

Solution:

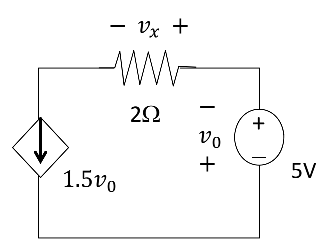
$(a) \quad v_x = 3 \times 5V = 15V$

$(b) \quad v_x = -1.5 \times 4V = -6V$

$v_y = 5 + 6V = 11V$



(c)



(d)

Solution:

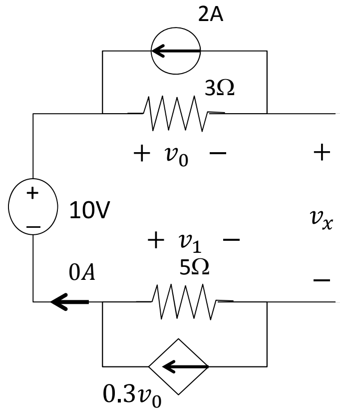
$(c) \quad v_x = -(-2) \times 3V = 6V$

$v_y = 5 - 6V = -1V$

$(d) \quad v_0 = -5V$

$v_x = 2 \times (1.5 \times (-5))V = -15V$

Practice 2: Find v_x



Solution:

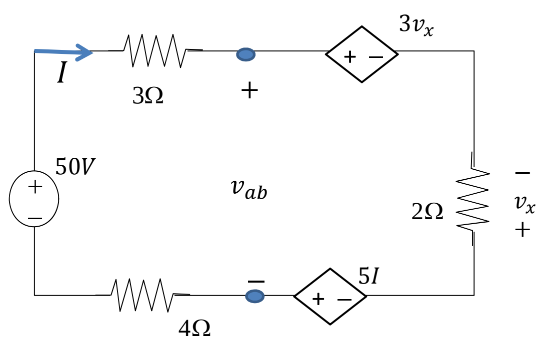
$v_0 = 2 \times 3V = 6V$

$v_1 = 0.3 \times 6 \times 5V = 9V$

$v_x = v_1 + 10 - v_0 = 9 + 10 - 6V = 13V$

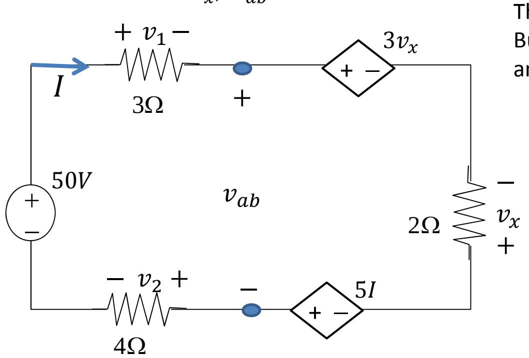
R4

Practice 3: Find $v_x,\ v_{ab}$



R4

Practice 3: Find v_x, v_{ab}



To find v_{ab}, apply KVL on right-side loop

$$3v_x - v_x - 5I - v_{ab} = 0$$

$$v_{ab} = 3v_x - v_x - 5I$$
$$= 150 - 50 + 125$$
$$= 225V$$

Solution:

The loop current is not asked.
But you still need to use it as a key variable and make an equation for it using KVL.

Assign loop current I,

Assign resistor voltages v_1, v_2

Express v_1, v_2, v_x in terms of I:

$v_1 = 3I, v_2 = 4I, v_x = -2\text{I}$ (E1)

Use KVL to make equation for the voltages:

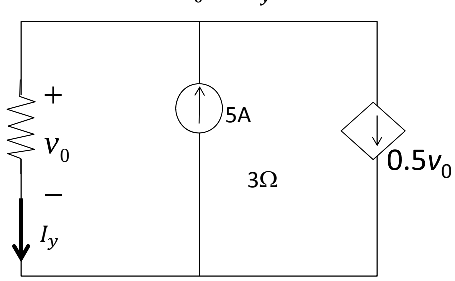
$-50 + v_1 + 3v_x - v_x - 5I + v_2 = 0$ (E2)

Plug (E1) into (E2) to obtain an equation for I:

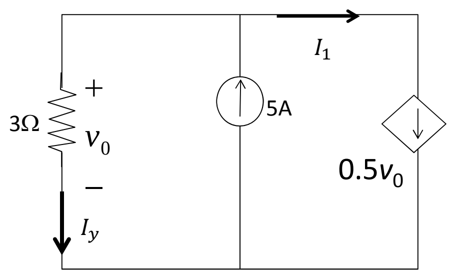
$$-50 + 3I + 3(-2I) - (-2I) - 5I + 4I = 0$$
$$-50 + 3I - 6I + 2I - 5I + 4I = 0$$
$$-2I = 50,$$
$I = -25A$, by (E1)
$$v_x = -2I = 50V$$

R4

Practice 4: Find v_0 and I_y



Practice 4: Find v_0 and I_y



Approach 2: make an equation for I_y

Need to express I_1 in terms of I_y

Since $I_1 = 0.5\,v_0$, $v_0 = 3I_y$

Have $I_1 = 0.5(3I_y) = 1.5I_y$

Plug into (E1),

$1.5I_y + I_y = 5$, ➡ $I_y = 2A$

$v_0 = 3I_y = 6V$

Solution:

Main idea: use KCL to make equation for v_0 *or* I_y

Assign I_1.

By KCL, $I_1 + I_y = 5$ (E1)

By the dependent current source,
$I_1 = 0.5v_0$ (E2)

By Ohm's Law:
$I_y = \frac{v_0}{3}$ (E3)

Plug (E2) and (E3) into (E1),

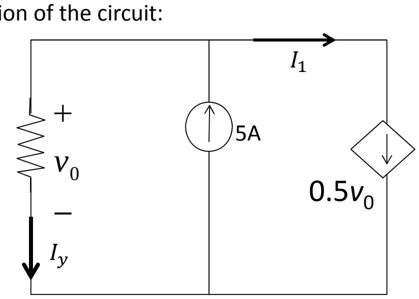
$0.5v_0 + \frac{v_0}{3} = 5$

➡ $v_0 = 6V$

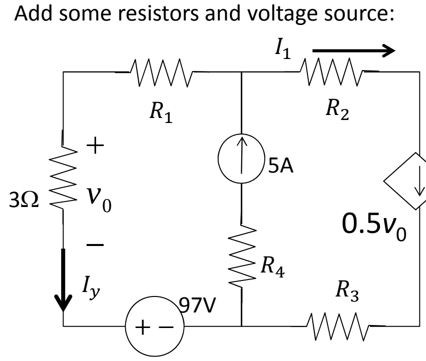
$$I_y = \frac{v_0}{3} = \frac{6}{3} = 2A$$

R4

Variation of the circuit:



Add some resistors and voltage source:



For both circuits:

By KCL, $I_1 + I_y = 5$ (E1)

By the dependent current source,
$I_1 = 0.5v_0$ (E2)

By Ohm's Law:
$I_y = \frac{v_0}{3}$ (E3)

Plug (E2) and (E3) into (E1),

$0.5v_0 + \frac{v_0}{3} = 5$

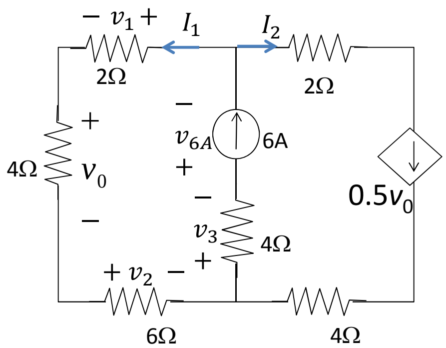
➡ $v_0 = 6V$

$$I_y = \frac{v_0}{3} = \frac{6}{3} = 2A$$

You have the same relationship among $I_1, I_y, and\ v_0$.
Thus the answers are not changed.

But the power supplied by the sources will be different.

Practice 5: Find v_0 and the power supplied by the 6A current source



Assign I_1, I_2 . By KCL,

$I_1 + I_2 = 6$ (1)

By Ohm's Law,

$I_1 = \frac{v_0}{4}$ (2)

By the dependent current source

$I_2 = 0.5v_0$ (3)

plug (2), (3) into (1)

$\frac{v_0}{4} + 0.5v_0 = 6$ ➔ $v_0 = 8V$

To find the power supplied by the 6A current source, Assign voltage v_{6A}

v_{6A} can be found by applying KVL along the left side loop since the current in the resistors are given. We don't apply KVL along the right side loop since the voltage across the dependent current source $0.5v_0$ cannot be computed directly.

Assign resistor voltages v_1, v_2, v_3

Note that $I_1 = \frac{v_0}{4} = 2A$

$v_1 = 2I_1 = 4V; v_2 = 6I_1 = 12V$

$v_3 = 4 \times 6 = 24V$

KVL along left loop:

$-v_{6A} - v_3 - v_2 - v_0 - v_1 = 0$

$v_{6A} = -24 - 12 - 8 - 4 = -48V$

$p_{6A} = vi = -48 \times 6 = -288W$