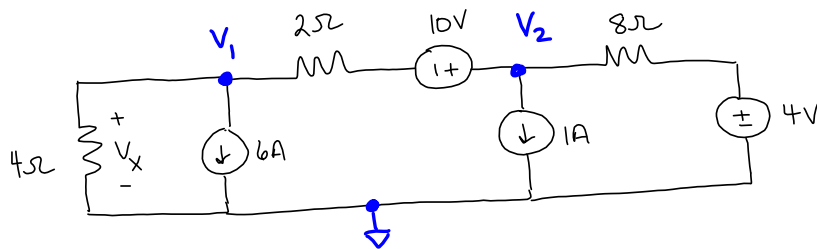EE 213 Honors Exam1 Solutions; Spring 2020

①

$Know$

$V_X = V_1$

N1: $\dfrac{V_1}{4} + 6 + \dfrac{V_1 + 10 - V_2}{2} = 0$

N2: $\dfrac{V_2 - 10 - V_1}{2} + 1 + \dfrac{V_2 - 4}{8} = 0$

simplify

$V_1(.75) + V_2(-.5) = -11$

$V_1(-.5) + V_2(.625) = 4.5$

$$\boxed{\begin{array}{l} V_1 = -21.14\,V \\ V_2 = -9.71\,V \end{array}}$$

$V_X = -21.14\,V$

Power: Sources

6A: $P = -V_1(6) = 126.86\,W,\ Del$

1A: $P = -V_2(1) = 9.71\,W,\ Del$

4V: $P = \left(\dfrac{V_2 - 4}{8}\right)(4) = -6.86\,W,\ Abs$

         or $6.86\,W,\ Del$

10V: $P = (10)\left(\dfrac{V_1 + 10 - V_2}{2}\right) = -7.14\,W,\ Del$

Power: Resistors

2Ω: $P = \dfrac{(V_1 + 10 - V_2)^2}{2} = 1.02\,W,\ Abs$

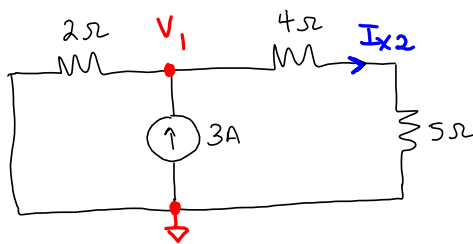4Ω: $P = V_1^2/4 = 111.76\,W,\ Abs$

8Ω: $P = \dfrac{(V_2 - 4)^2}{8} = 23.51\,W,\ Abs$

$\Sigma P_{del} = 136.29\,W \leftarrow \overset{\smile}{\ddot{\cup}} \rightarrow \Sigma P_{abs} = 136.29\,W$

② 4V on

2Ω   4Ω I_{x1}

4V (±)   5Ω

$$\boxed{I_{x1} = \frac{4}{11} = 0.\overline{36}\ A}$$

2Ω V_1 4Ω I_{x2}

(↑) 3A   5Ω

$$\frac{V_1}{2} + \frac{V_1}{9} + (-3) = 0$$

$$V_1(0.6\overline{1}) = 3$$

$$V_1 = 4.91\ V$$

$$I_{x2} = \frac{V_1}{9}$$

$$\boxed{I_{x2} = 0.\overline{54}\ A}$$

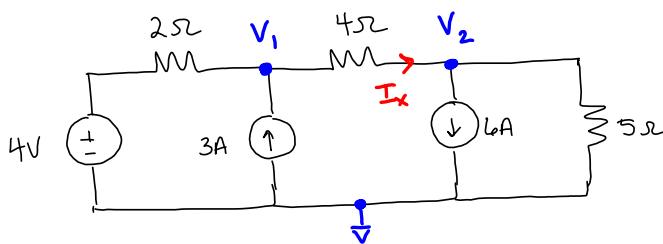2Ω   4Ω I_{x3}

in series   (↓) 6A   5Ω
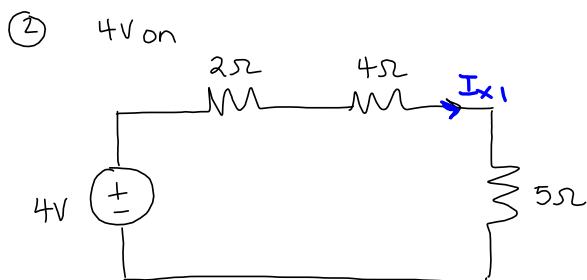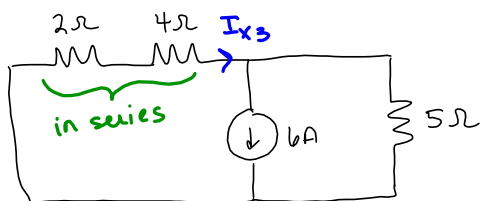
using current division

$$\boxed{I_{x3} = \frac{6\,(6\|5)}{6} = 2.\overline{72}\ A}$$

$$I_x = I_{x1} + I_{x2} + I_{x3}$$

$$\boxed{I_x = 3.64\ A}$$

② Check w/ nodal

Know $I_x = \dfrac{V_1 - V_2}{4}$

N1: $\dfrac{V_1 - 4}{2} + (-3) + \dfrac{V_1 - V_2}{4} = 0$

N2: $\dfrac{V_2 - V_1}{4} + 6 + \dfrac{V_2}{5} = 0$

⎫ simplify

$V_1(.75) + V_2(-.25) = 5$

$V_1(-.25) + V_2(.45) = -6$

$V_1 = 2.73\ V$
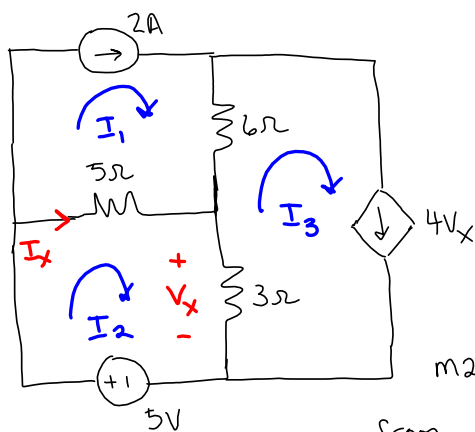
$V_2 = -11.82\ V$

$\boxed{I_x = 3.64\ A}$

Checks w/ Superposition ☺

③

2A

I_1

5Ω

6Ω

I_x

I_3

4V_x

+
V_x
−

3Ω

I_2

(+)

5V

Know: $\quad I_1 = 2A \qquad V_x = 3(I_2 - I_3)$

$\qquad\qquad I_3 = 4V_x \qquad I_x = I_2 \cdot I_1$

m1: Don't need yet

m2: $5 - 5(I_2 - \overset{2}{\cancel{I_1}}) - 3(I_2 \cdot I_3) = 0$

m3: Don't need yet

m2: $\boxed{-8I_2 + 3I_3 = -15}$

from knowns: $\qquad I_3 = 4(3(I_2 - I_3))$

$\boxed{12I_2 - 13I_3 = 0}$

$I_2 = 2.87A \qquad I_3 = 2.65A$

$\boxed{V_x = 0.662V \qquad I_x = 0.868A}$

4

3 cont
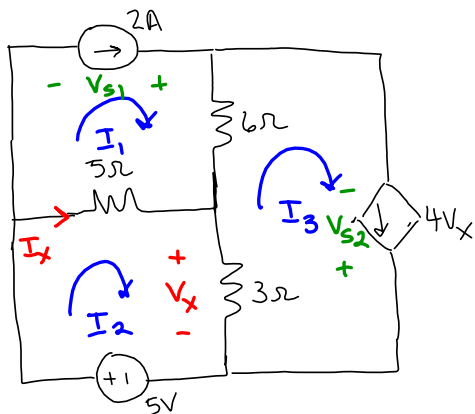
now write m1 & m3 equations

m1: $V_{S_1} - 6(I_1 - I_3) - 5(I_1 - I_2) = 0$

$V_{S_1} = -8.22 \text{ V}$

m3: $-6(I_3 - I_1) + V_{S_2} - 3(I_3 - I_2) = 0$

$V_{S_2} = 3.22 \text{ V}$

Power: Sources

2A: $P = V_{S_1}(2) = -16.44 \text{ W, Del}$

5V: $P = 5(I_2) = 14.34 \text{ W, Del}$

$4V_x$: $P = V_{S_2}(4V_x) = 8.53 \text{ W, Del}$

$\sum P_{del} = 6.43 \text{ W}$

Power: Resistors

3Ω: $P = (I_2 - I_3)^2 (3) = 0.146 \text{ W, Abs}$

5Ω: $P = (I_2 - I_1)^2 (5) = 3.76 \text{ W, Abs}$

6Ω: $P = (I_3 - I_1)^2 (6) = 2.52 \text{ W, Abs}$

$\sum P_{abs} = 6.43 \text{ W}$