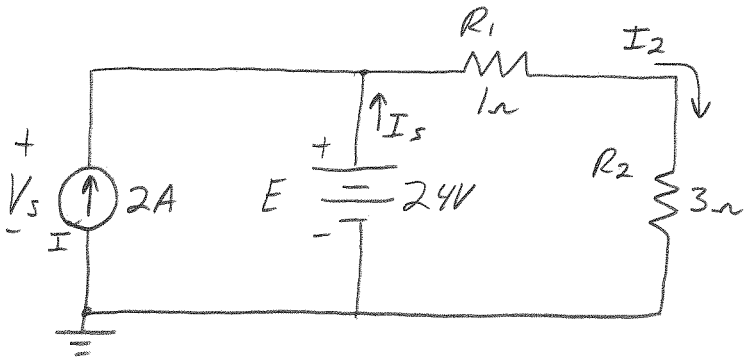
8-4)



a) FIND V_s

$\boxed{V_s = E = 24V}$, I & E ARE IN PARALLEL

b) CALCULATE I_2

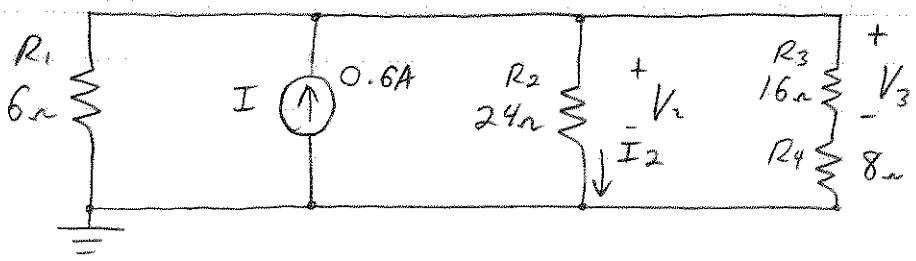
$$I_2 = \frac{E}{R_1 + R_2} = \frac{24V}{4\Omega} = \boxed{6A}$$

c) FIND I_s

KCL: $I + I_s + (-I_2) = 0$

$$I_s = I_2 - I$$
$$= 6A - 2A$$
$$\boxed{I_s = 4A}$$

(8-5) FIND V_3 & I_2



$I_2 = I_T \left(\frac{R_T}{R_2} \right)$, $I_T = 0.6A$

$R_T = R_1 // R_2 // (R_3 + R_4)$

$= 4\Omega$

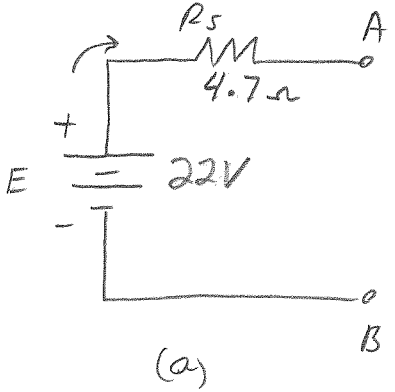
$= 0.6A \left(\frac{4\Omega}{24\Omega} \right) = \boxed{100\,mA}$

$V_2 = (I_2)(R_2) = \underline{2.4V}$

$V_3 = V_2 \left(\frac{R_3}{R_3 + R_4} \right) = 2.4V \left(\frac{16\Omega}{24\Omega} \right)$

$\boxed{V_3 = 1.6V}$

(8-7) CONVERT THE VOLTAGE SOURCES TO CURRENT SOURCES



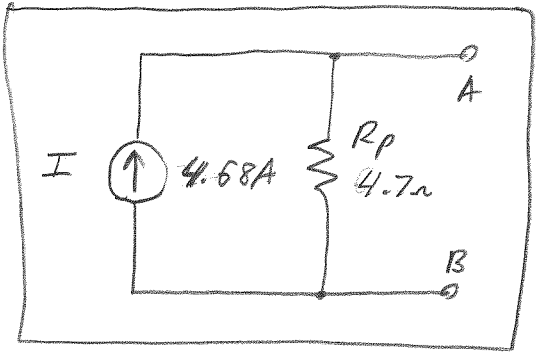
(a)

$$I = E/R_S = 22V/4.7\Omega = 4.68A$$

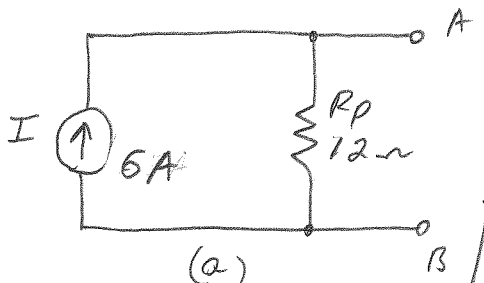
DIR: UP FROM E

$$\Rightarrow$$

$$R_P = R_S = 4.7\Omega$$



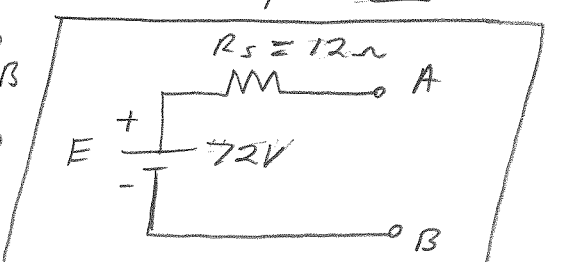
(8-8) CONVERT THE CURRENT SOURCES TO VOLTAGE SOURCES



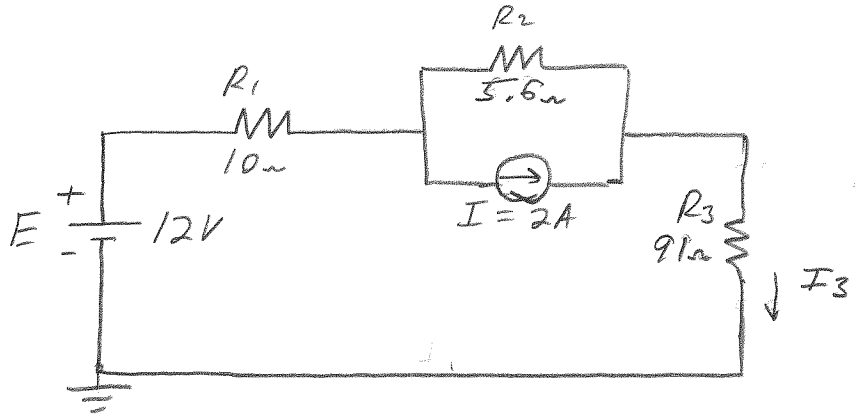
$E = (I)(R_p) = (6A)(12\Omega) = \underline{72V}$

"+" AT A

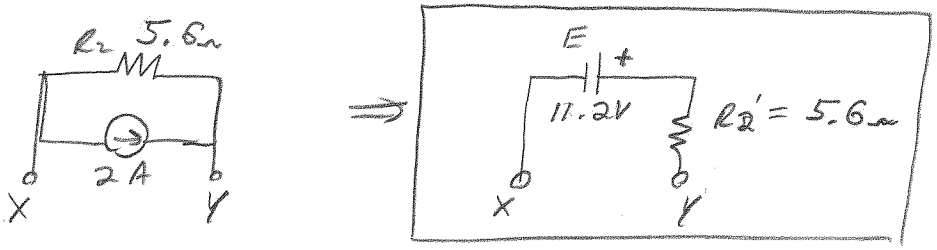
$R_s = R_p = \underline{12\Omega}$



(8-19)



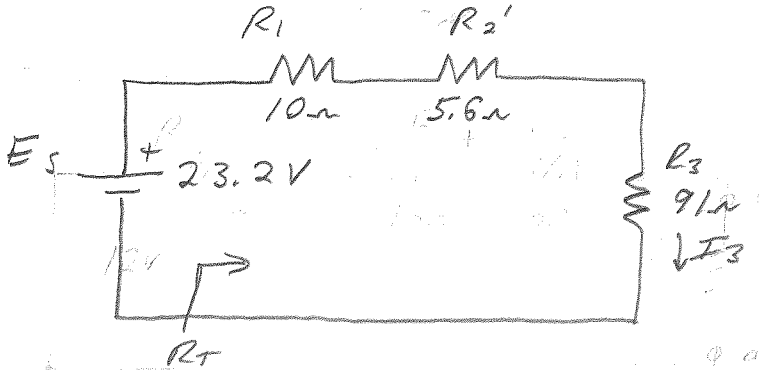
a) CONVERT R_2 & I INTO A VOLTAGE SOURCE



$E = (2A)(5.6\Omega)$

$= \underline{11.2V}$

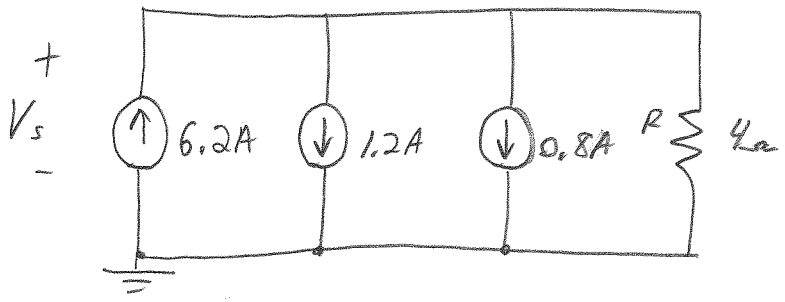
b) COMBINE THE SERIES SOURCES



c) FIND I_3

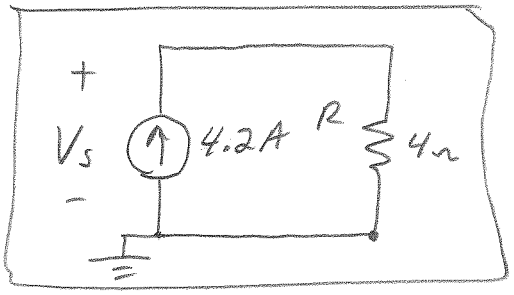
$$I_3 = \frac{E_S}{R_T} = \frac{23.2V}{10\Omega + 5.6\Omega + 91\Omega} = \boxed{217.6\ mA}$$

(8-11)



a) REPLACE THE CURRENT SOURCES BY A SINGLE EQUIVALENT SOURCE

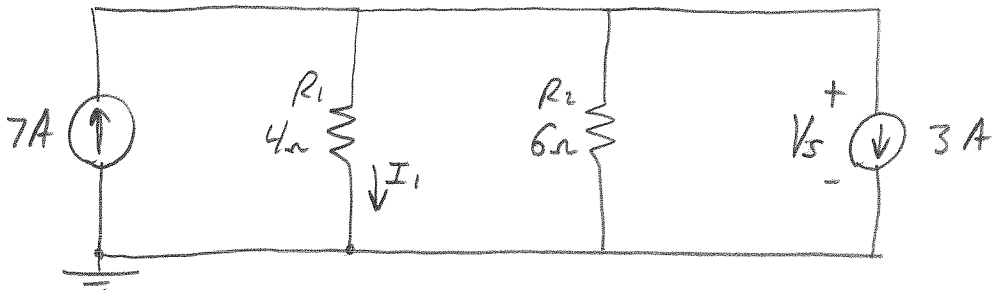
$I_{EQUIV} = 6.2 + (-1.2) + (-0.8) =$ **4.2A, up**



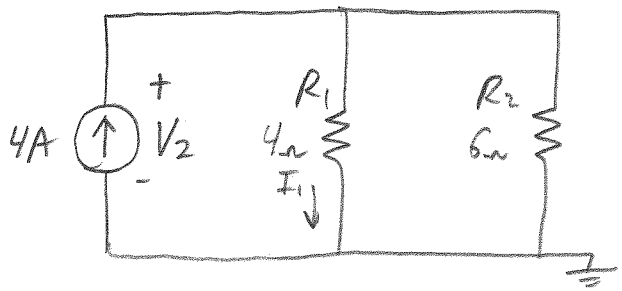
b) FIND V_s

$V_s = (4.2A)(4\Omega) =$ **16.8V**

(12) FIND V_S & I_1



- COMBINE THE SOURCES, USE CURRENT DIVIDER



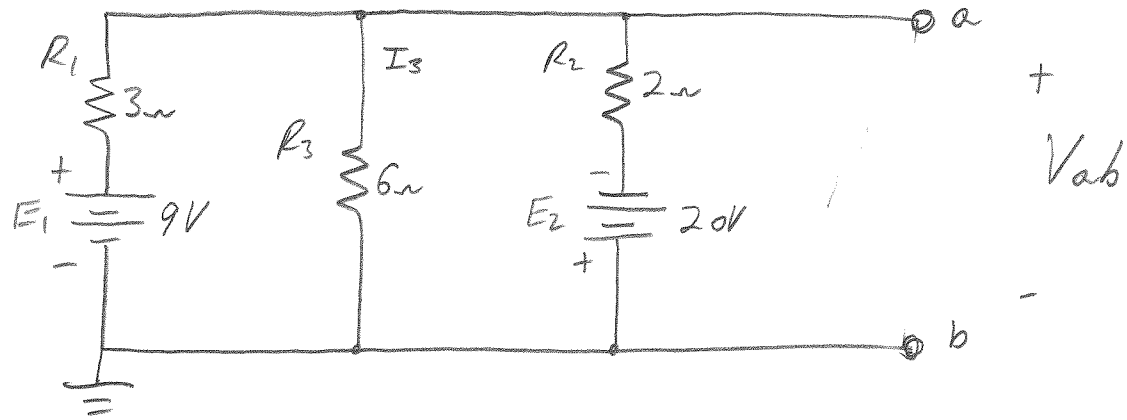
$$I_1 = 4A\left(\frac{4\Omega \,//\, 6\Omega}{4\Omega}\right)$$

$$= 4A\left(\frac{2.4\Omega}{4\Omega}\right)$$

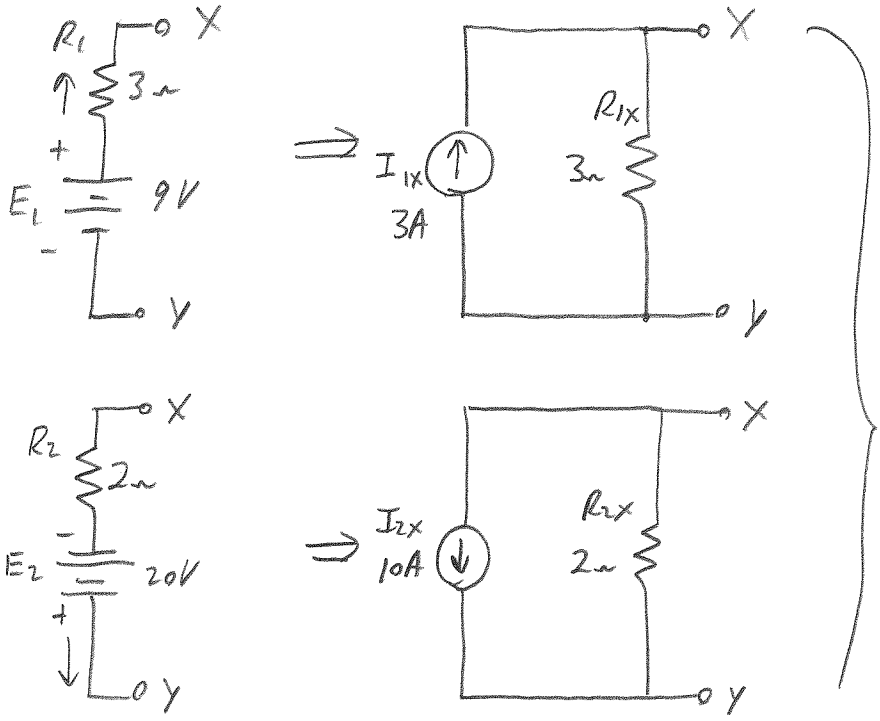
$$\boxed{I_1 = 2.4A}$$

$$V_S = (I_1)(R_1) = \boxed{9.6V}$$

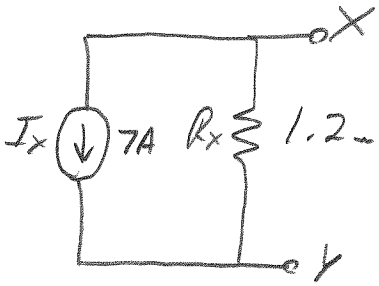
(13) CONVERT THE VOLTAGE SOURCES TO CURRENT SOURCES



(13) CONTINUED

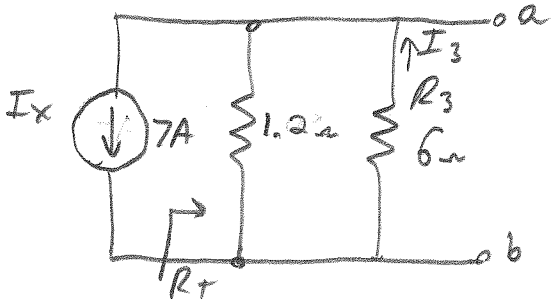


COMBINED, WE HAVE:



(a)

REDRAWING YIELDS:



~~a)~~ FIND V_{ab}

(b) $R_T = 1.2\Omega \,//\, 6\Omega = \underline{1.0\Omega}$

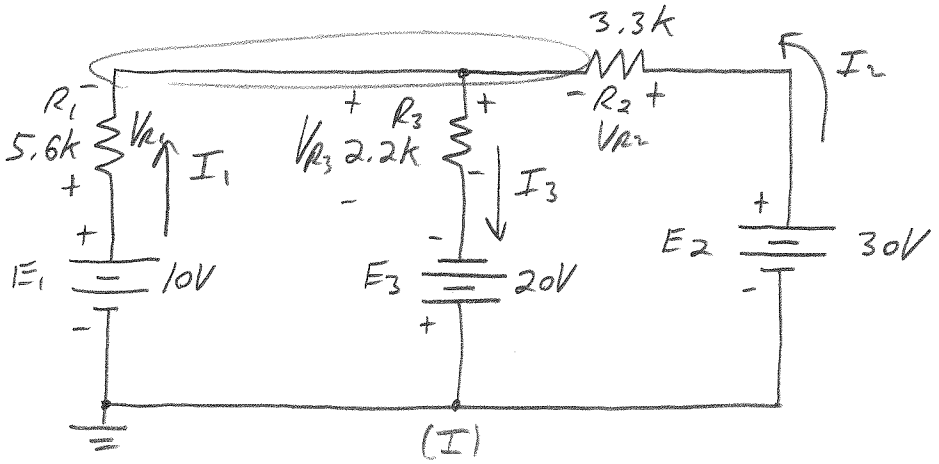
$V_{ab} = (-I_X)(R_T) = \boxed{-7.0\,V}$ $\therefore V_a < V_b$

~~b)~~ FIND I_3

(c) $I_3 = I_X \left(\frac{1.0\,\Omega}{R_3} \right) = 7A\,(0.166) = \boxed{1.17A,\ \text{UPWARD}}$

(R_T in numerator)

(17) USING BRANCH CURRENT ANALYSIS, FIND "I" THROUGH EACH RESISTOR



KVL: $E_1 - V_{R_1} - V_{R_3} + E_3 = 0$

$-I_1R_1 - I_3R_3 = -E_1 - E_3$ $\xrightarrow{\text{MULTIPLY (-1)}}$ $5.6k\,I_1 + 0\,I_2 + 2.2k\,I_3 = 30$ (EQ 1)

KVL: $-E_3 + V_{R_3} + V_{R_2} - E_2 = 0$

$I_3R_3 + I_2R_2 = E_2 + E_3$

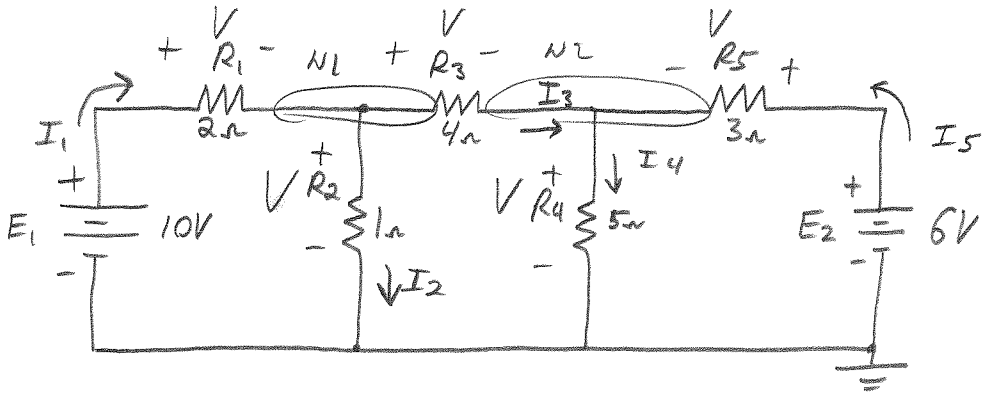
$3.3k\,I_2 + 2.2k\,I_3 = 50$ $\longrightarrow$ $0\,I_1 + 3.3k\,I_2 + 2.2k\,I_3 = 50$ (EQ 2)

KCL: $I_1 + I_2 = I_3$ $\longrightarrow$ $I_1 + I_2 - I_3 = 0$ (EQ 3)

SOLVING EQ 1 - EQ 3 YIELDS:

I_1	= 1.45 mA	$\uparrow I_{R_1}$
I_2	= 8.51 mA	$\leftarrow I_{R_2}$
I_3	= 9.96 mA	$\downarrow I_{R_3}$

(19)



a) WRITE THE EQS TO SOLVE FOR THE BRANCH CURRENTS

kVL: $E_1 - V_{R_1} - V_{R_2} = 0$

$E - R_1 I_1 - R_2 I_2 = 0$

$2I_1 + I_2 = 10 \rightarrow 2I_1 + I_2 + 0I_3 + 0I_4 + 0I_5 = 10$ (1)

kVL: $V_{R_2} - V_{R_3} - V_{R_4} = 0$

$R_2 I_2 - R_3 I_3 - R_4 I_4 = 0$

$I_2 - 4I_3 - 5I_4 = 0 \rightarrow 0I_1 + I_2 - 4I_3 - 5I_4 + 0I_5 = 0$ (2)

kVL: $V_{R_4} + V_{R_5} - E_2 = 0$

$R_4 I_4 + R_5 I_5 = E_2$

$5I_4 + 3I_5 = 6 \rightarrow 0I_1 + 0I_2 + 0I_3 + 5I_4 + 3I_5 = 6$ (3)

kCL @ N1: $I_1 = I_2 + I_3 \rightarrow I_1 - I_2 - I_3 + 0I_4 + 0I_5 = 0$ (4)

kCL @ N2: $I_3 + I_5 = I_4 \rightarrow 0I_1 + 0I_2 + I_3 - I_4 + I_5 = 0$ (5)

b) REDUCE THE SET TO 3 EQS BY SUBSTITUTION OF KCL

FROM (4): $I_3 = I_1 - I_2$ > INTO (1), (2), (3):

(5): $I_5 = I_4 - I_3$

(1): $2I_1 + I_2 + 0I_4 = 10 \rightarrow 2I_1 + I_2 + 0I_4 = 10$ (1A)

(2): $I_2 - 4(I_1 - I_2) - 5I_4 = 0 \rightarrow -4I_1 + 5I_2 - 5I_4 = 0$ (2A)

(3): $5I_4 + 3(I_4 - I_3) = 6$

$5I_4 + 3I_4 - 3I_3 = 6$

$5I_4 + 3I_4 - 3(I_1 - I_2) = 6 \rightarrow -3I_1 + 3I_2 + 8I_4 = 6$ (3A)

(18) CONTINUED

c) REWRITE THE EQS IN A FORMAT TO SOLVE W/ 3RD ORDER DETERMINANTS
- SEE PART b

d) SOLVE FOR I_3

SOLVING (1A) − (3A) YIELDS: $I_1 = 3.312A$
$I_2 = 3.376A$
$I_4 = 726.1mA$

FROM (4) $I_3 = I_1 - I_2$
$I_3 = -64mA$, LEFT TO RIGHT

(19) CONTINUED

b) FIND V_B, V_C & V_E

$$V_B = I_E R_E + V_{BE} = (4.479\,mA)(510\,\Omega) + 0.7\,V$$

$$\boxed{V_B = 2.98\,V}$$

$$V_C = I_E R_E + V_{CE} = 2.284\,V + 8\,V$$

$$\boxed{V_C = 10.28\,V}$$

$$V_E = I_E R_E = \boxed{2.28\,V}$$

c) FIND $\frac{I_C}{I_B} = \beta_{dc}$

$$\beta_{dc} = \frac{4.416\,mA}{63.02\,\mu A} = \boxed{70.07}$$