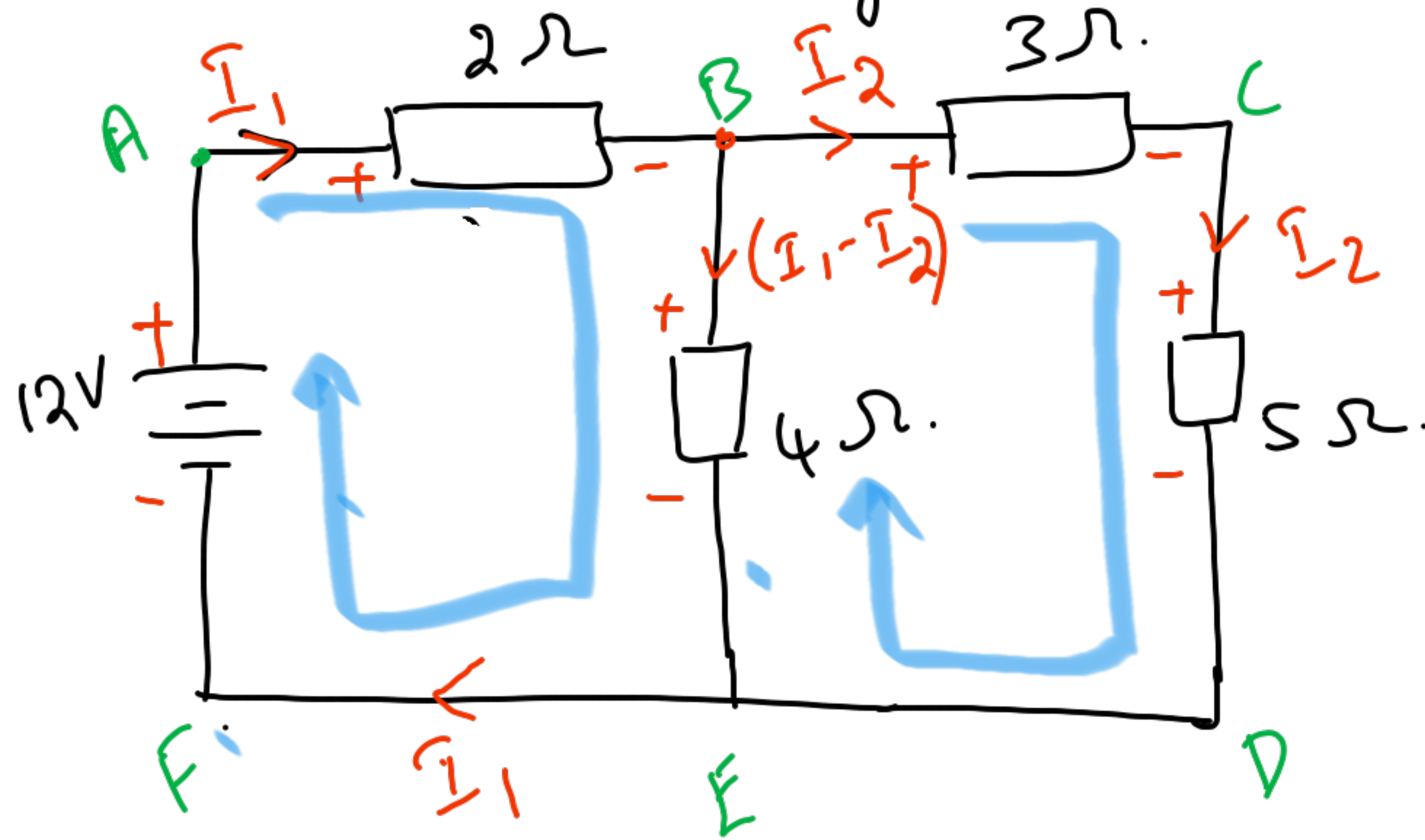


1) Calculate the Current flowing through each Resistor using KVL.



Soln.

Apply KVL in ABEFA

$$-2I_1 - 4(I_1 - I_2) + 12 = 0$$

$$-2I_1 - 4I_1 + 4I_2 + 12 = 0.$$

$$-6I_1 + 4I_2 = -12 \quad \text{--- (1)}$$

Apply KVL in BCDEB

$$-3I_2 - 5I_2 + 4(I_1 - I_2) = 0$$

$$-3I_2 - 5I_2 + 4I_1 - 4I_2 = 0$$

$$4I_1 - 12I_2 = 0 \quad \text{--- (2)}$$

$$\textcircled{1} \Rightarrow -6I_1 + 4I_2 = -12$$

$$\textcircled{2} \Rightarrow 4I_1 - 12I_2 = 0$$

$$\begin{array}{rcl} \text{eq ①} \times 3 \Rightarrow & -18I_1 + 12I_2 & = -36 \\ \text{eq ②} \Rightarrow & 4I_1 - 12I_2 & = 0 \end{array} \quad +$$

$$-14I_1 = -36$$

$$-I_1 = \frac{-36}{14}$$

$$I_1 = 2.57 \text{ A}$$

Sub. I_1 in equation ②.

$$\text{eq ②} \Rightarrow 4 \times 2.57 - 12I_2 = 0$$

$$10.28 = 12I_2$$

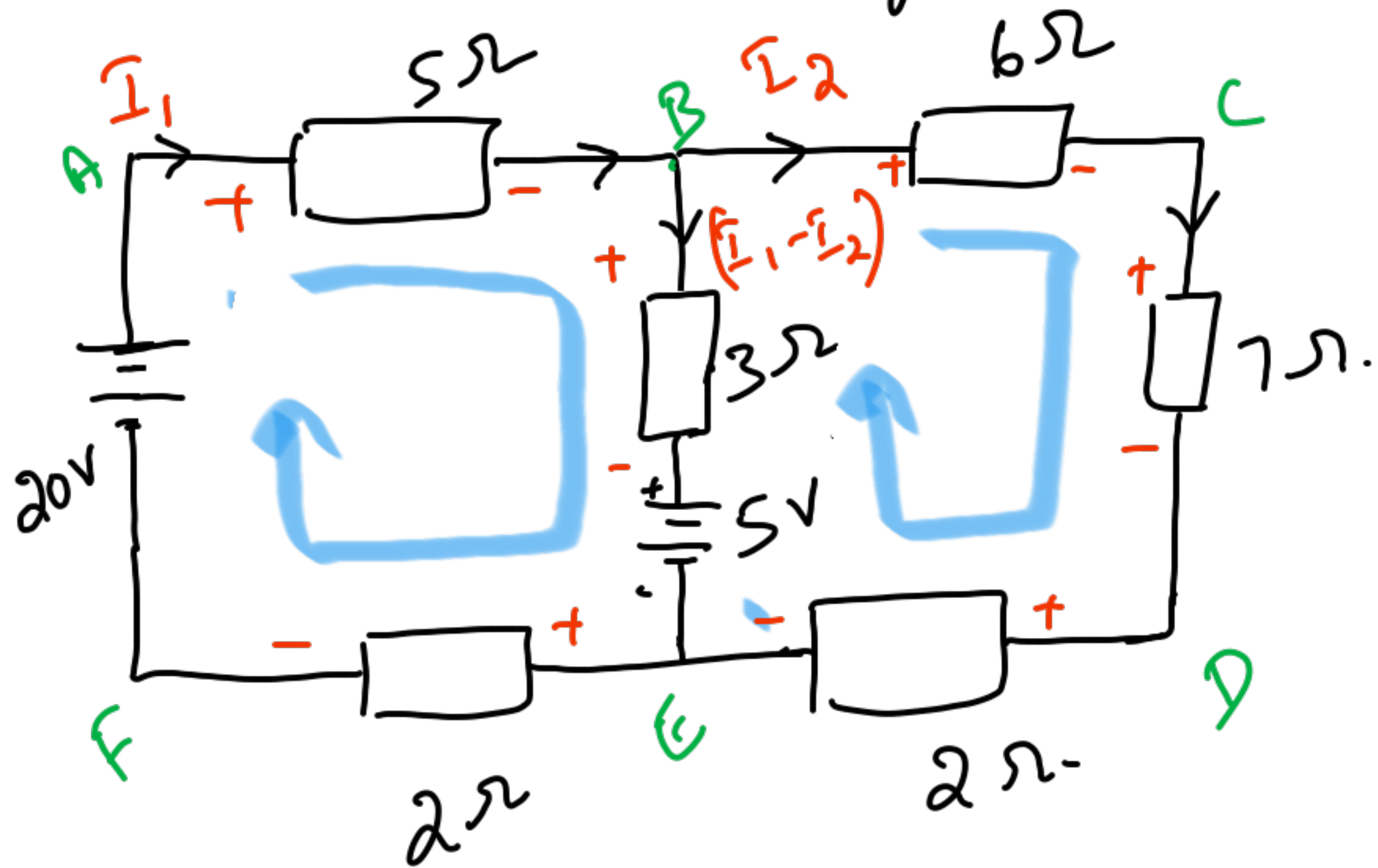
$$I_2 = \frac{10.28}{12} = 0.86 \text{ A}$$

Current flowing through $2\Omega = 2.57 \text{ A}$

Current flowing through 3Ω & $5\Omega = 0.86 \text{ A}$

Current flowing through $4\Omega = I_1 - I_2$
 $= 2.57 - 0.86$
 $= 1.71 \text{ A}$

2) Determine the Current across each Resistor in the following Circuit using KVL



Apply KVL in ABEFA

$$-5I_1 - 3(I_1 - I_2) - 5 - 2I_1 + 20 = 0$$

$$-5I_1 - 3I_1 + 3I_2 - 2I_1 + 15 = 0$$

$$-10I_1 + 3I_2 = -15 \quad \text{--- (1)}$$

Apply KVL in BCDEB

$$-6I_2 - 7I_2 - 2I_2 + 5 + 3(I_1 - I_2) = 0$$

$$-6I_2 - 7I_2 - 2I_2 + 5 + 3I_1 - 3I_2 = 0$$

$$3I_1 - 18I_2 = -5 \quad \text{--- (2)}$$

$$\text{eq ①} \Rightarrow -10\hat{I}_1 + 3\hat{I}_2 = -15$$

$$\text{eq ②} \Rightarrow 3\hat{I}_1 - 18\hat{I}_2 = -5$$

$$\text{eq ①} \times 6 \Rightarrow \begin{array}{r} -60\hat{I}_1 + 18\hat{I}_2 = -90 \end{array} +$$

$$\text{eq ②} \Rightarrow \begin{array}{r} 3\hat{I}_1 - 18\hat{I}_2 = -5 \end{array}$$

$$-57\hat{I}_1 = -95$$

$$\hat{I}_1 = 1.67 \text{ A}$$

Sub. $\hat{I}_1$ in eq. ①.

$$-10 \times 1.67 + 3\hat{I}_2 = -15$$

$$-16.7 + 3\hat{I}_2 = -15$$

$$3\hat{I}_2 = -15 + 16.7$$

$$3\hat{I}_2 = 1.7$$

$$\hat{I}_2 = \frac{1.7}{3} = 0.56 \text{ A}$$

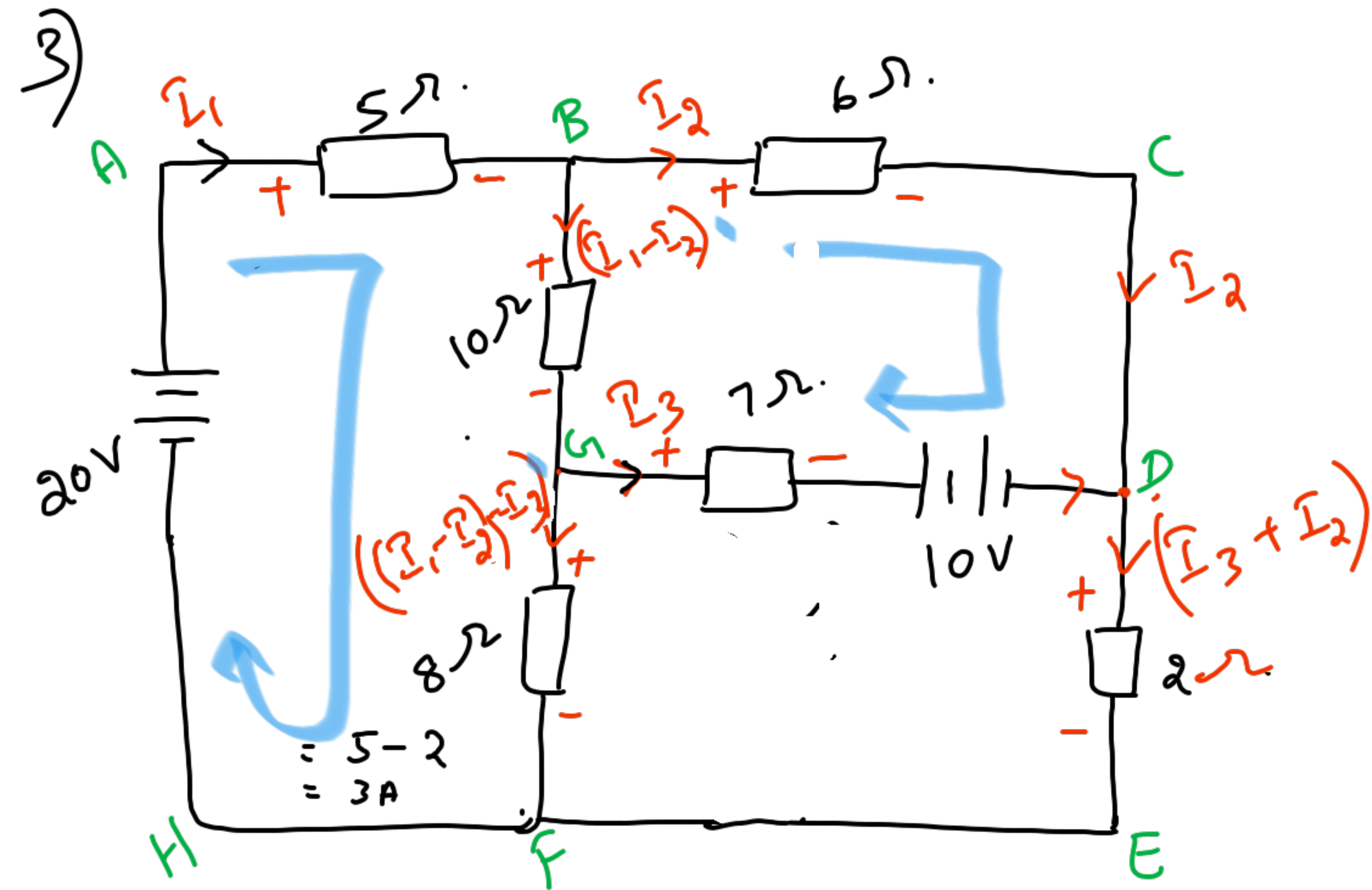
$$(\hat{I}_1 - \hat{I}_2) = 1.67 - 0.56$$

$$= 1.1 \text{ A}$$

Current flowing through 2Ω and $5\Omega = 1.67 \text{ A}$

Current flowing through $6\Omega, 7\Omega$ & $2\Omega = 0.56 \text{ A}$

Current flowing through $3\Omega = 1.1 \text{ A}$



Determine current across each Resistor using KVL.

Soln.

Apply KVL in ABCFA

$$-5I_1 - 10(I_1 - I_2) - 8(I_1 - I_2 - I_3) + 20 = 0$$

$$-5I_1 - 10I_1 + 10I_2 - 8I_1 + 8I_2 + 8I_3 + 20 = 0$$

$$-23I_1 + 18I_2 + 8I_3 = -20 \quad \text{--- (1)}$$

Apply KVL in BCDFA

$$-6I_2 + 10 + 7I_3 + 10(I_1 - I_2) = 0$$

$$-6I_2 + 7I_3 + 10I_1 - 10I_2 = -10$$

$$10I_1 - 16I_2 + 7I_3 = -10 \quad \text{--- (2)}$$

Apply KVL in CDEF G.

$$-7\hat{I}_3 - 10 - 2(\hat{I}_3 + \hat{I}_2) + 8(\hat{I}_1 - \hat{I}_2 - \hat{I}_3) = 0$$

$$-7\hat{I}_3 - 2\hat{I}_3 - 2\hat{I}_2 + 8\hat{I}_1 - 8\hat{I}_2 - 8\hat{I}_3 = 10$$

$$8\hat{I}_1 - 10\hat{I}_2 - 17\hat{I}_3 = 10 \quad \text{--- (3)}$$

$$\text{eq (1)} \Rightarrow -23\hat{I}_1 + 18\hat{I}_2 + 8\hat{I}_3 = -20$$

$$\text{eq (2)} \Rightarrow 10\hat{I}_1 - 16\hat{I}_2 + 7\hat{I}_3 = -10$$

$$\text{eq (3)} \Rightarrow 8\hat{I}_1 - 10\hat{I}_2 - 17\hat{I}_3 = 10$$

from eq (1) to find $\hat{I}_1$

$$-23\hat{I}_1 = -20 - 18\hat{I}_2 - 8\hat{I}_3$$

$$-\hat{I}_1 = \frac{-20 - 18\hat{I}_2 - 8\hat{I}_3}{23}$$

⊗ by (-)

$$\hat{I}_1 = \frac{20 + 18\hat{I}_2 + 8\hat{I}_3}{23}$$

Sub. $\hat{I}_1$ in eq (2) and (3)

$$\text{eq (2)} \Rightarrow 10\hat{I}_1 - 16\hat{I}_2 + 7\hat{I}_3 = -10$$

$$10\left(\frac{20 + 18\hat{I}_2 + 8\hat{I}_3}{23}\right) - 16\hat{I}_2 + 7\hat{I}_3 = -10$$

$$\frac{10}{23} (20 + 18\hat{I}_2 + 8\hat{I}_3) - 16\hat{I}_2 + 7\hat{I}_3 = -10$$

$$0.43 (20 + 18\hat{I}_2 + 8\hat{I}_3) - 16\hat{I}_2 + 7\hat{I}_3 = -10$$

$$8.6 + 7.7\hat{I}_2 + 3.44\hat{I}_3 - 16\hat{I}_2 + 7\hat{I}_3 = -10$$

$$-8.3\hat{I}_2 + 10.44\hat{I}_3 = -10 - 8.6$$

$$-8.3\hat{I}_2 + 10.44\hat{I}_3 = -18.6 \quad \text{--- (4)}$$

Sub. $\hat{I}_1$ in eq (3)

$$8\hat{I}_1 - 10\hat{I}_2 - 17\hat{I}_3 = 10$$

$$\frac{8}{23} (20 + 18\hat{I}_2 + 8\hat{I}_3) - 10\hat{I}_2 - 17\hat{I}_3 = 10$$

$$0.35 (20 + 18\hat{I}_2 + 8\hat{I}_3) - 10\hat{I}_2 - 17\hat{I}_3 = 10$$

$$7 + 6.3\hat{I}_2 + 2.8\hat{I}_3 - 10\hat{I}_2 - 17\hat{I}_3 = 10$$

$$-3.7\hat{I}_2 - 14.2\hat{I}_3 = 10 - 7$$

$$-3.7\hat{I}_2 - 14.2\hat{I}_3 = 3 \quad \text{--- (5)}$$

Solve equation (4) and (5)

$$\text{(4)} \Rightarrow -8.3\hat{I}_2 + 10.44\hat{I}_3 = -18.6$$

$$\text{(5)} \Rightarrow -3.7\hat{I}_2 - 14.2\hat{I}_3 = 3$$

$$\text{eq ④} \times 3.7 \Rightarrow -30.71 \cancel{\hat{I}_2} + 38.63 \hat{I}_3 = -68.82 \quad (-)$$

$$\text{eq ⑤} \times 8.3 \Rightarrow -30.71 \cancel{\hat{I}_2} - 117.86 \hat{I}_3 = 24.9 \quad (+)$$

$$+156.49 \hat{I}_3 = -93.72$$

$$\hat{I}_3 = \frac{-93.72}{156.49}$$

$$\hat{I}_3 = -0.60 \text{ A}$$

Sub. $\hat{I}_3$ in eq ⑤ to find $\hat{I}_2$.

$$\text{⑤} \Rightarrow -3.7 \hat{I}_2 - 14.2(-0.60) = 3$$

$$-3.7 \hat{I}_2 + 8.52 = 3$$

$$-3.7 \hat{I}_2 = 3 - 8.52$$

$$-3.7 \hat{I}_2 = -5.52$$

$$-\hat{I}_2 = \frac{-5.52}{3.7}$$

$$\hat{I}_2 = 1.49 \text{ A}$$

Sub. $\hat{I}_2$ and $\hat{I}_3$ in equation 3.

$$\textcircled{3} \Rightarrow 8\hat{I}_1 - 10\hat{I}_2 - 17\hat{I}_3 = 10$$

$$8\hat{I}_1 - 10(1.49) - 17(-0.60) = 10$$

$$8\hat{I}_1 - 14.9 + 10.2 = 10$$

$$8\hat{I}_1 - 4.7 = 10$$

$$8\hat{I}_1 = 10 + 4.7$$

$$8\hat{I}_1 = 14.7$$

$$\hat{I}_1 = \frac{14.7}{8} = 1.83 \text{ A}$$

Current across 5Ω is $\hat{I}_1 = 1.83 \text{ A}$

Current across 6Ω is $\hat{I}_2 = 1.49 \text{ A}$

Current across 7Ω is $\hat{I}_3 = -0.6 \text{ A}$
(Assumed direction is opposite.)

Current across 10Ω is $(\hat{I}_1 - \hat{I}_2) = 1.83 - 1.49$
 $= 0.34 \text{ A}$

Current across 8Ω is $(\hat{I}_1 - \hat{I}_2 - \hat{I}_3) = 1.83 - 1.49 - (-0.6)$
 $= 0.94 \text{ A}$

Current across 2Ω is $(\hat{I}_2 + \hat{I}_3) = 1.49 + (-0.6)$
 $= 0.89 \text{ A}$

