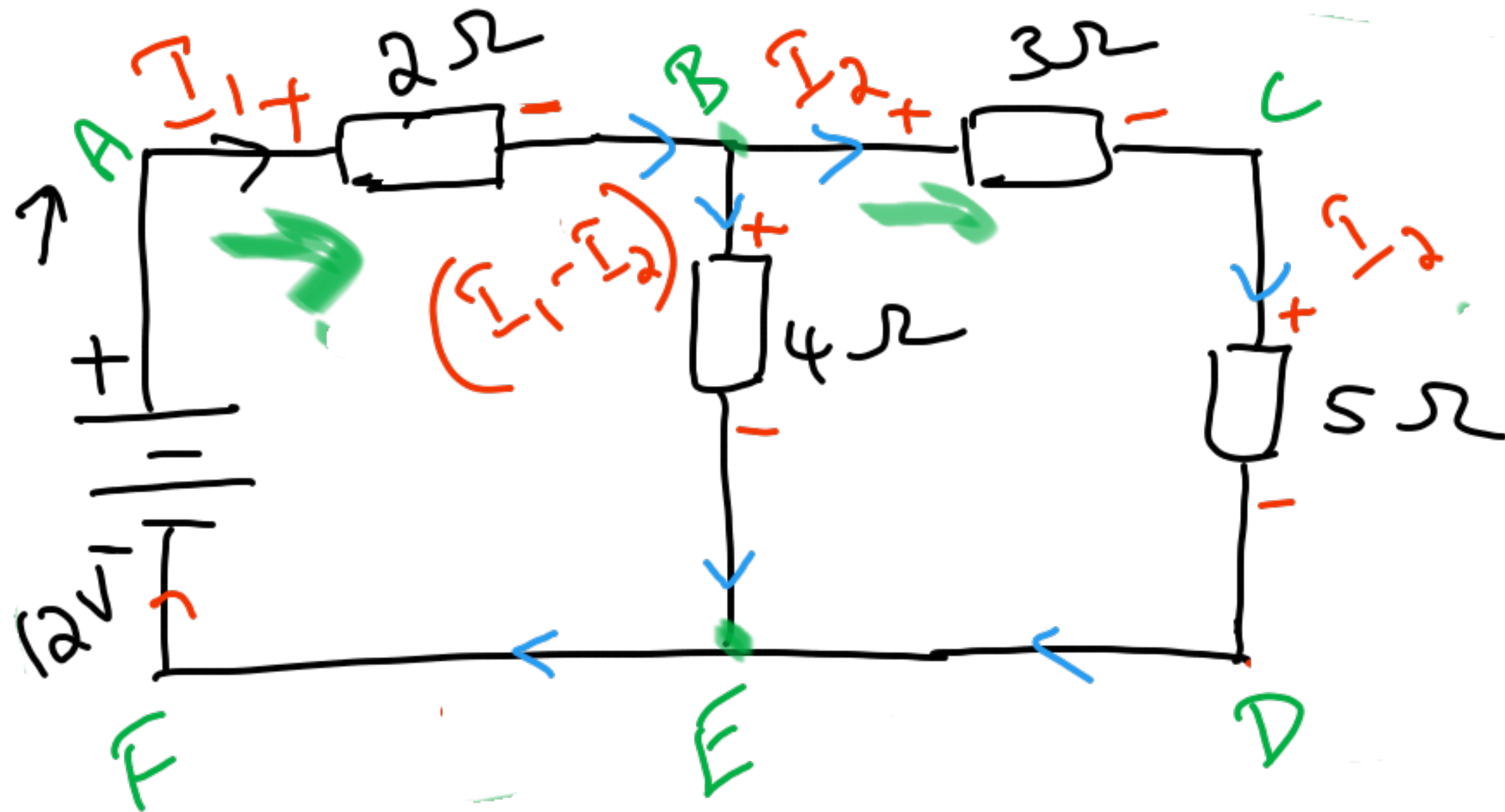


1) Calculate the current flowing through each Resistor using KVL.



Soln ∴ Apply KVL in ABEFA

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

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

Apply KVL in BCDEB

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

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

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

eq (1) $\Rightarrow$ $-6I_1 + 4I_2 = -12$

eq (2) $\Rightarrow$

$$\underline{4I_1 - 12I_2 = 0}$$

$$\text{eq ①} \times 3 \Rightarrow -18\hat{I}_1 + 12\hat{I}_2 = -36 (+)$$

$$\text{eq ②} \Rightarrow \frac{4\hat{I}_1 - 12\hat{I}_2 = 0}{-14\hat{I}_1 = -36}$$

$$\hat{I}_1 = \frac{36}{14}$$

$$\hat{I}_1 = 2.57 \text{ A}$$

$$\hat{I}_1 = 2.57 \text{ A}$$

Sub. $\hat{I}_1$ in eq ②

$$4(2.57) - 12\hat{I}_2 = 0$$

$$12\hat{I}_2 = 10.28$$

$$\hat{I}_2 = \frac{10.28}{12} = 0.86 \text{ A}$$

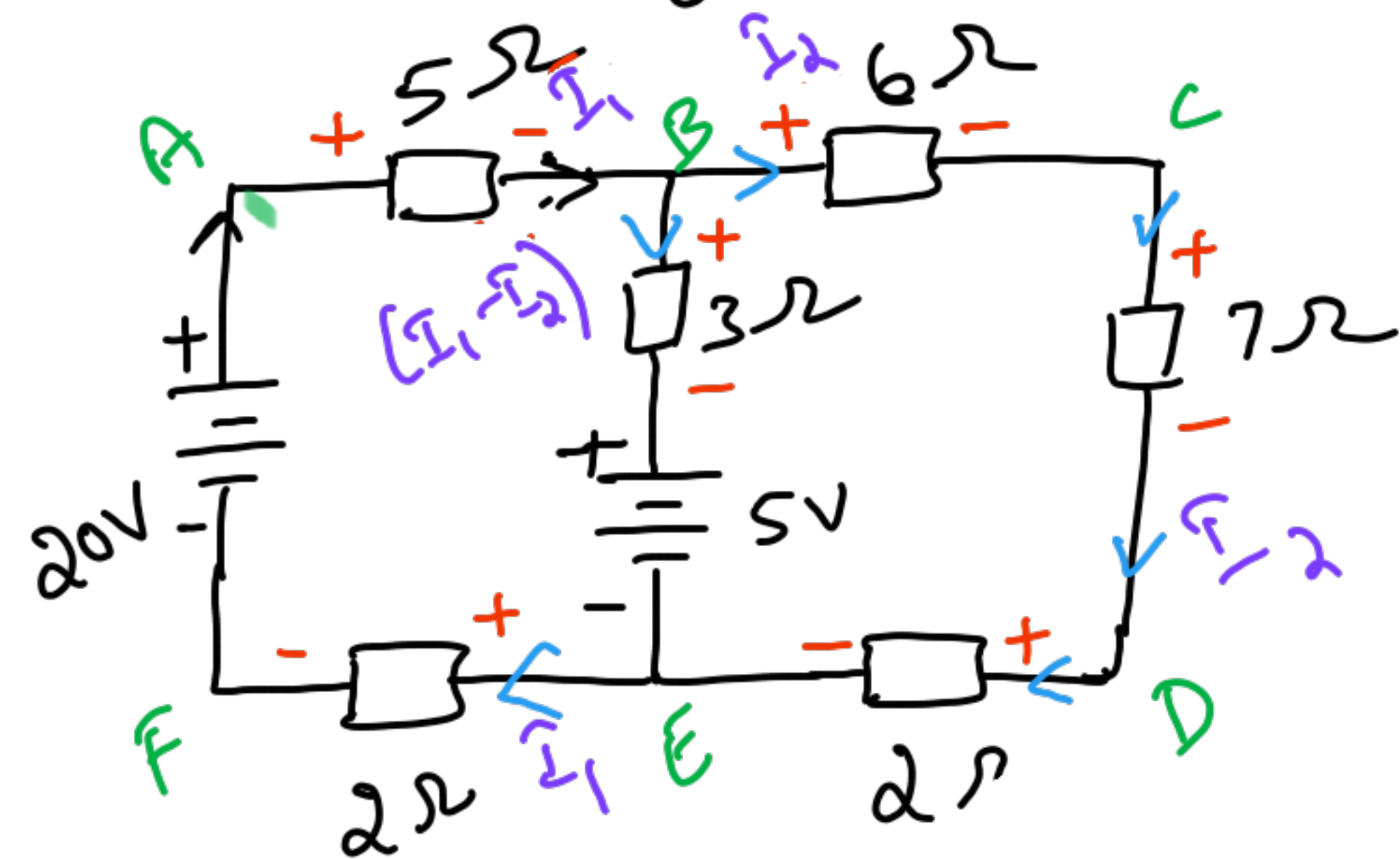
Current flowing through $2\Omega = \hat{I}_1 = 2.57 \text{ A}$

Current flowing through 3Ω & 5Ω
 $\hat{I}_2 = 0.86 \text{ A}$

Current flowing through 4Ω

$$\hat{I}_1 - \hat{I}_2 = 2.57 - 0.86 = 1.71 \text{ A}$$

2) Determine the current across each resistor 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

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

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

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

Solve equation (1) and (2)

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

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

$$\text{eq (1)} \times 6 \Rightarrow -60I_1 + 18I_2 = -90 \quad (+)$$

$$\text{eq (2)} \Rightarrow \begin{array}{r} 3I_1 - 18I_2 = -5 \\ \hline -57I_1 = -95 \end{array}$$

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

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

Sub $\hat{I}_1$ in eq ①

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

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

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

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

Current across 5Ω and 2Ω $\hat{I}_1 = 1.67 \text{ A}$

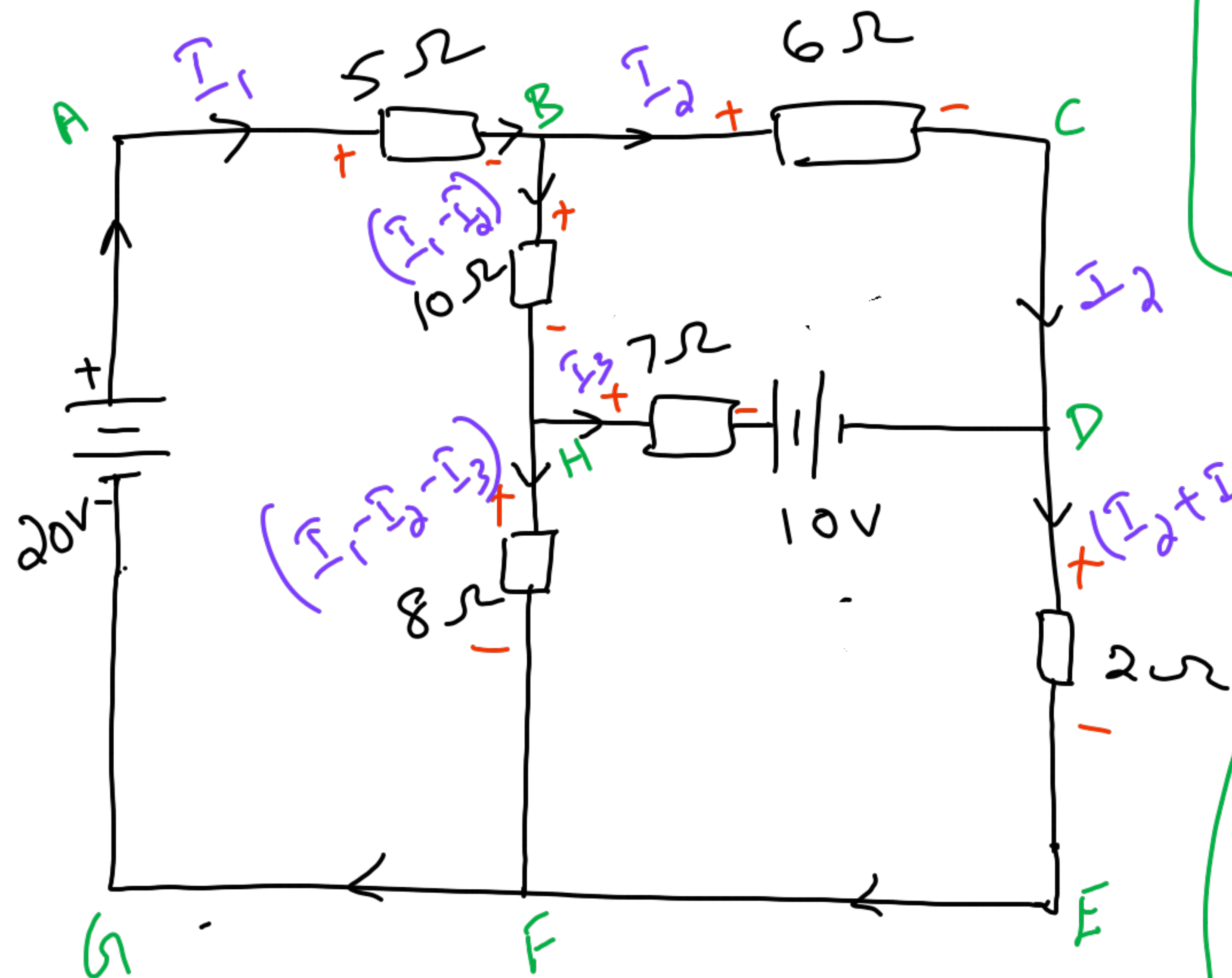
Current across $6\Omega, 7\Omega$ & 2Ω , $\hat{I}_2 = 0.56 \text{ A}$

Current across 3Ω is $(\hat{I}_1 - \hat{I}_2)$

$$= 1.67 - 0.56$$

$$= 1.11 \text{ A}$$

3) Determine the current across each Resistor Using KVL



Apply KVL in ABHFGA

$$-5\hat{I}_1 - 10(\hat{I}_1 - \hat{I}_2) - 8(\hat{I}_1 - \hat{I}_2 - \hat{I}_3) + 20 = 0$$

$$-5\hat{I}_1 - 10\hat{I}_1 + 10\hat{I}_2 - 8\hat{I}_1 + 8\hat{I}_2 + 8\hat{I}_3 = -20$$

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

Apply KVL in BCDH

$$-6\hat{I}_2 + 10 + 7\hat{I}_3 + 10(\hat{I}_1 - \hat{I}_2) = 0$$

$$-6\hat{I}_2 + 7\hat{I}_3 + 10\hat{I}_1 - 10\hat{I}_2 = -10$$

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

Apply KVL in HDEFH

$$-7I_3 - 10 - 2(I_2 + I_3) + 8(I_1 - I_2 - I_3) = 0$$

$$-7I_3 - 2I_2 - 2I_3 + 8I_1 - 8I_2 - 8I_3 = 10$$

$$8I_1 - 10I_2 - 17I_3 = 10 \quad \text{--- (3)}$$

from eq (1),

$$-23I_1 = -18I_2 - 8I_3 - 20$$

$$-I_1 = \frac{-18I_2 - 8I_3 - 20}{23}$$

(X) by (-)

$$I_1 = \frac{18I_2 + 8I_3 + 20}{23}$$

Sub. I_1 in eq (2)

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

$$10 \left(\frac{18I_2 + 8I_3 + 20}{23} \right) - 16I_2 + 7I_3 = -10$$

$$0.43(18I_2 + 8I_3 + 20) - 16I_2 + 7I_3 = -10$$

$$7.7I_2 + 3.44I_3 + 8.6 - 16I_2 + 7I_3$$

$$-8.3I_2 + 10.44I_3 = -18.6 \quad \text{--- (4)}$$

Sub. I_1 in eq (3)

$$8I_1 - 10I_2 - 17I_3 = 10$$

$$8(18I_2 + 8I_3 + 20) - 10I_2 - 17I_3 = 10$$

23

$$0.35(18I_2 + 8I_3 + 20) - 10I_2 - 17I_3 = 10$$

$$6.3I_2 + 2.8I_3 + 7 - 10I_2 - 17I_3 = 10$$

$$-3.7I_2 - 14.2I_3 = 3 \quad \text{--- (5)}$$

Solve eq (4) and (5)

$$-8.3I_2 + 10.44I_3 = -18.6 \quad \text{--- (4)}$$

$$-3.7I_2 - 14.2I_3 = 3 \quad \text{--- (5)}$$

$$\text{eq (4)} \times 3.7 \Rightarrow -30.71I_2 + 38.63I_3 = -68.82 \quad \text{--- (6)}$$

$$\text{eq (5)} \times 8.3 \Rightarrow \overset{(+)}{-30.71}I_2 \overset{(+)}{-} \overset{(-)}{117.86}I_3 \overset{(-)}{=} 26.1 \quad \text{--- (7)}$$

$$156.83I_3 = -94.92$$

$$I_3 = \frac{-94.92}{156.83}$$

$$I_3 = -0.61A$$

Sub. $\hat{I}_3$ in eq (4)

$$-8.3\hat{I}_2 + 10.44(-0.61) = -18.6$$

$$-8.3\hat{I}_2 - 6.37 = -18.6$$

$$-8.3\hat{I}_2 = -18.6 + 6.37$$

$$-8.3\hat{I}_2 = -12.23$$

$$\hat{I}_2 = \frac{12.23}{8.3}$$

$$\hat{I}_2 = 1.47 \text{ A}$$

Sub. $\hat{I}_2$ and $\hat{I}_3$ in eq (3)

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

$$8\hat{I}_1 - 10(1.47) - 17(-0.61) = 10$$

$$8\hat{I}_1 - 14.7 + 10.37 = 10$$

$$8\hat{I}_1 = 14.33$$

$$\hat{I}_1 = \frac{14.33}{8}$$

$$\hat{I}_1 = 1.8 \text{ A}$$

Current across 5Ω is $\hat{I}_1 = 1.8\text{ A}$

Current across 6Ω is $\hat{I}_2 = 1.47\text{ A}$

Current across 10Ω is $(\hat{I}_1 - \hat{I}_2) = (1.8 - 1.47)$
 $= 0.33\text{ A}$

Current across 7Ω is $\hat{I}_3 = -0.61\text{ A}$
(Assumed direction is opposite
to actual direction)

Current across 8Ω is $\hat{I}_1 - \hat{I}_2 - \hat{I}_3$
 $= 1.8 - 1.47 - (-0.61)$
 $= 0.94\text{ A}$

Current across 2Ω is $\hat{I}_2 + \hat{I}_3 = 1.47 + (-0.61)$
 $= 0.86\text{ A}$