Electric Circuits I (ELCT 301) **Quiz # 2**
Time allowed: 20 minutes **Winter 2022**

Using mesh analysis, calculate the mesh currents and the power supplied or absorbed by the independent **6V** voltage source.

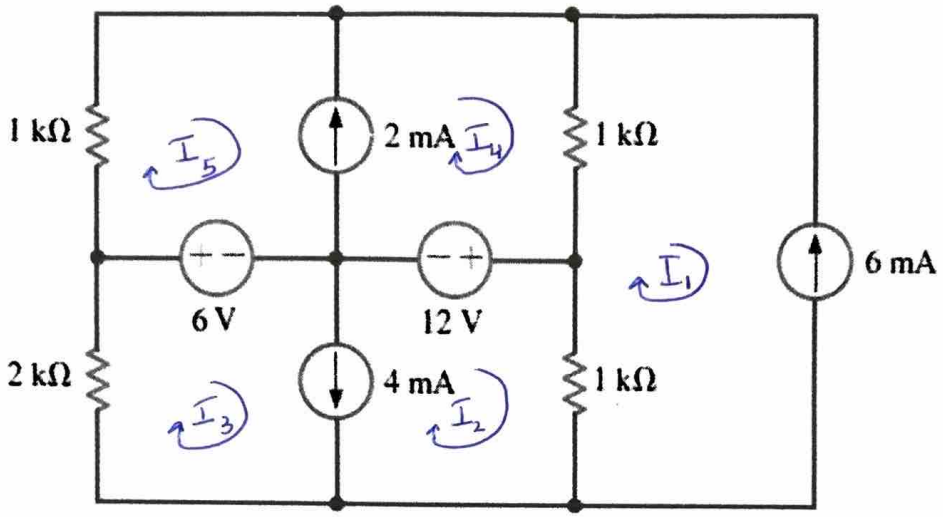

Figure 1

⇒mesh ① :-

$I_1 = -6mA$ ①

⇒Supermesh ② and ③ :-

$-12 + 1k(I_2 - I_1) + 2kI_3 + 6 = 0$ ②

$1kI_2 + 2kI_3 = 0 \rightarrow$ ①

$* I_3 - I_2 = 4mA \rightarrow$ ② ①

⇒Supermesh ④ and ⑤ :-

$1k(I_4 - I_1) + 12 - 6 + 1kI_5 = 0$ ②

$1kI_4 + 1kI_5 = -12 \rightarrow$ ③

$* I_4 - I_5 = 2mA \rightarrow$ ④ ①

Solve ① and ② :-

$I_2 = -\frac{8}{3}mA$ $I_3 = \frac{4}{3}mA$ 0.5 #

Solve ③ and ④ :-

$I_4 = -5mA$ $I_5 = -7mA$ 0.5 #

$$P_{6V} = 6 \times (I_3 - I_5) \quad (2)$$

$$= 6 \times \left(\frac{4}{3} + 7\right) = 50\,mW \;\#$$

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Using mesh analysis, calculate the mesh currents and find the power supplied or absorbed by the dependent current source

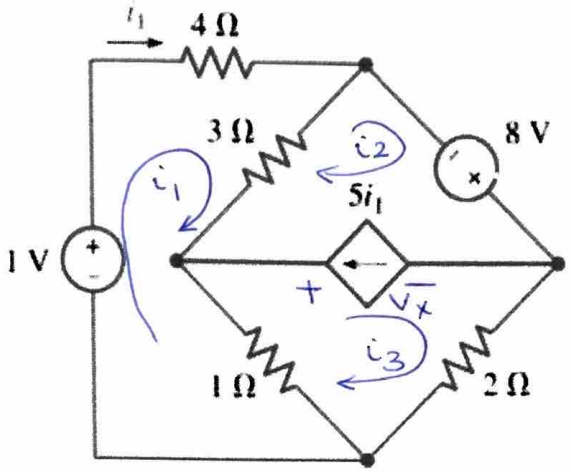

Figure 1

@ mesh 1

$$-1 + 4i_1 + 3(i_1 - i_2) + (i_1 - i_3) = 0 \longrightarrow (2)$$

$$\therefore \boxed{8i_1 - 3i_2 - i_3 = 1} \longrightarrow (A)$$

@ mesh 2 & 3 (Supermesh)

$$5i_1 = i_2 - i_3 \Rightarrow \therefore \boxed{-5i_1 + i_2 - i_3 = 0} \longrightarrow (B)$$

(1)

Analysis → 0.5

$$-8 + 2i_3 + (i_3 - i_1) + 3(i_2 - i_1) = 0 \longrightarrow (2)$$

$$\therefore \boxed{3i_3 + 3i_2 - 4i_1 = 8} \longrightarrow (C)$$

Solving eq.s A, B & C

$$\therefore i_1 = 19\,A$$

$$i_2 = \frac{123}{2} = 61.5A$$

$$i_3 = \frac{-67}{2} = -33.5A$$

→ 0.5

$P_{5i_1} = -5i_1 v_x$ → 1.5

@ mesh 2 → 1.5

$$\therefore -8 - v_x + 3(i_2 - i_1) = 0 \Rightarrow \therefore v_x = -8 + 3(i_2 - i_1) = \boxed{119.5V} \rightarrow 0.5$$

$$\therefore P_{5i_1} = \boxed{-11352.5W} \rightarrow 0.5$$

"This Source Supplies 11352.5 W"

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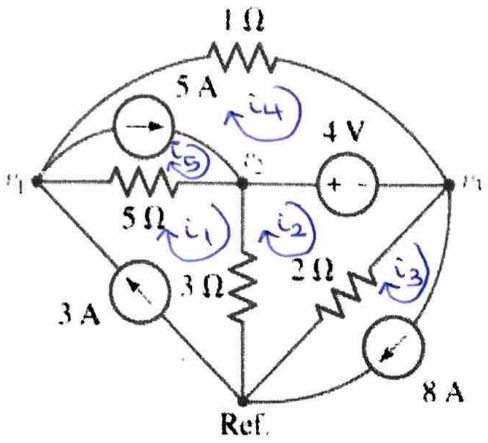

Figure 1

@ mesh 1

$\boxed{i_1 = 3\,A}$ ⟶ (1)

@ mesh 3

$\boxed{i_3 = 8\,A}$ ⟶ (1)

@ mesh 2

$4 + 2(i_2 - i_3) + 3(i_2 - i_1) = 0$ ⟶ (1.5)

$\therefore 5i_2 - 2i_3 - 3i_1 + 4 = 0$

$\therefore 5i_2 = 2i_3 + 3i_1 - 4, \quad i_2 = \frac{21}{5} = \boxed{4.2\,A}$

Analysis ⟹ (0.5)

Final answers for i_2, i_4, i_5 ⟹ (0.5)

(for all of them Not for each current)

@ mesh 5 & 4 (Supermesh)

$\therefore \boxed{5 = i_5 - i_4}$ ⟶ (A) ⟶ (1)

$i_4 - 4 + 5(i_5 - i_1) = 0$ ⟶ (1.5)

Sub. by i_1

$\therefore i_4 - 4 + 5(i_5 - 3) = 0$

$\therefore i_4 - 4 + 5i_5 - 15 = 0$

$\therefore \boxed{i_4 + 5i_5 = 19}$ ⟶ (B)

Analysis ⟹ (1)

Solving eq.s A & B

$\therefore \boxed{i_4 = -1\,A}$

$\boxed{i_5 = 4\,A}$

$\therefore P_{4V} = 4(i_2 - i_4)$ ⟶ (1.5)

$\therefore P_{4V} = \frac{104}{5} = \boxed{20.8\,W}$ ⟶ (0.5)

"This Source absorbs 20.8 W"