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3. Find the current $i_o$ in the circuit below using any method. [Points: (10) for correctly setting up the problem, labeling, and clearly stating your approach, (10) for correctly executing your approach, (15) for the correct answer]

Loop $I_1$ is not needed: $-V_3 + 4I_1 + 4(I_1 - I_3) + 4(I_1 - I_2) = 0$

Loop $I_2$ $(I_2 - I_1)4 + (I_2 - I_3)2 + I_2 \cdot 10 = 0$ V

Loop $I_3$ $(I_3 - I_1)4 + I_3 \cdot 3 + (I_3 - I_2)2 = 0$ V

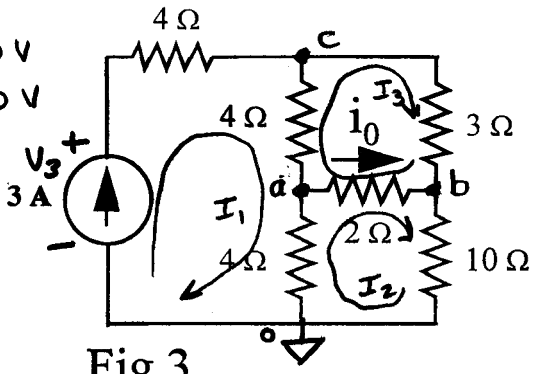


Fig 3.

② $4I_2 - 4I_1 + 2I_2 - 2I_3 + 10I_2 = 0$ V

$16I_2 - 2I_3 = 4I_1 = 12$ V

$8I_2 - I_3 = 6$ V

$16I_2 - 2I_3 = 12$ V

③ $4I_3 - 4I_1 + 3I_3 + 2I_3 - 2I_2 = 0$ V

$-2I_2 + 9I_3 = 4I_1 = 12$ V

$-2I_2 + 9I_3 = 12$ V

FACTS: $i_o = I_2 - I_3$

$I_1 = 3$ A

System of Equations $16I_2 - 2I_3 = 12$ V

$-2I_2 + 9I_3 = 12$ V

$144I_2 - 18I_3 = 108$ V

$-4I_2 + 18I_3 = 24$ V

$140I_2 = 132$ A

$I_2 = \frac{132}{140}$ A

$I_2 = 0.943$ A

$2\left(\frac{132}{140}\right) + 9I_3 = 12$ V

$I_3 = \frac{1}{9}[12 + .886] = 1.543$

$I_2 = 0.943$ A

$I_3 = 1.543$ A

$I_2 = \frac{33}{35}$

$I_3 = \frac{54}{35}$

$i_o = I_2 - I_3$ (0.943 1.543) A

$I_2 - I_3 = -\frac{21}{35} = \left(-\frac{3}{5}\right) = i_o$

$\boxed{i_o = -0.6 \text{ A}}$

System of Equations with $I_2$ & $I_3$ interchanged

$16I_3 - 2I_2 = 12$

$-2I_3 + 9I_2 = 12$