Problem 3.15   Use the supernode concept to find the current $I_x$ in the circuit of Fig. P3.15.

![Figure P3.15: Circuit for Problem 3.15.](image)

Solution: The presence of a voltage source between designated nodes 1 and 2 makes the combination of nodes 1 and 2 a supernode. Hence,

$$\frac{V_1}{0.5} - 2 + \frac{V_2}{0.5} + \frac{V_2 - V_3}{0.5} = 0. \quad (1)$$

For node 3,

$$\frac{V_3 - V_2}{0.5} - 4 + 2 = 0, \quad (2)$$

and the auxiliary equation is

$$V_2 - V_1 = 6. \quad (3)$$

Combining the three equations leads to:

$$V_1 = -2 \text{ V}, \quad V_2 = 4 \text{ V}, \quad V_3 = 5 \text{ V}. \quad \text{(4)}$$

Hence,

$$I_x = \frac{V_2}{0.5} = \frac{4}{0.5} = 8 \text{ A}. \quad (5)$$