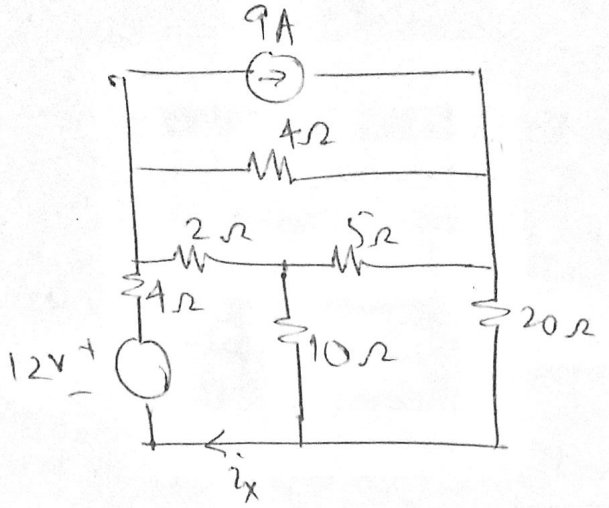
Example 2-5



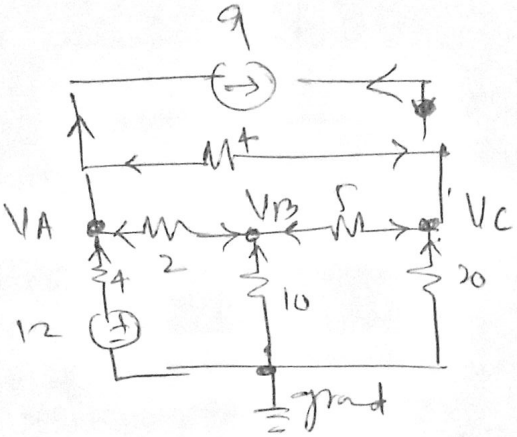
(1)

Find $V_{5\Omega}$ and i_x using KCL

Solution

KCL = sum of current on a junction equals zero
⇒ entering = leaving

Mark all junctions and consider one as zero potential ground.



Σ entry I = Σ leaving I

Current Leaving.

at VA (all current toward A are $V_A - V_x$)

$$\frac{V_A - 0 - 12}{4} + \frac{V_A - V_B}{2} + \frac{V_A - V_C}{4} + 9 = 0$$

$$V_A\left(\frac{1}{4} + \frac{1}{2} + \frac{1}{4}\right) - V_B\left(\frac{1}{2}\right) - V_C\left(\frac{1}{4}\right) = 3 - 9 = -6$$

$$V_A(1) - 0.5(V_B) - 0.25\,V_C = -6 \quad \text{——(1)}$$

at V_B

$$\frac{V_B - V_A}{2} + \frac{V_B - 0}{10} + \frac{V_B - V_C}{5} = 0$$

$$-0.5\,V_A + 0.8\,V_B - 0.2\,V_C = 0 \quad \text{——(2)}$$

Current leaving

$$\frac{V_C - 0}{20} + \frac{V_C - V_B}{5} + \frac{V_C - V_A}{4} - 9 = 0$$

$$-0.25\,V_A - 0.25\,V_B + 0.5\,V_C = 9 \quad \text{——(3)}$$

(2)

$V_A = 4$ V $V_B = 8.33$ V $V_C = 23.31$ V

$V_{5\Omega} = V_B - V_C$

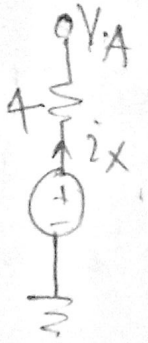
$\boxed{V_{5\Omega} = -15\text{V}}$

$-i_x = \dfrac{V_A - 0 - 12}{4}$

$-i_x = \dfrac{4 - 12}{4} = \dfrac{-8}{4} = -2\text{ A}$

$\boxed{i_x = 2\text{A}}$

OR



$\dfrac{0 - V_A + 12}{4} = i_x$

$\dfrac{-4+12}{4} = i_x$

$\boxed{i_x = 2}$