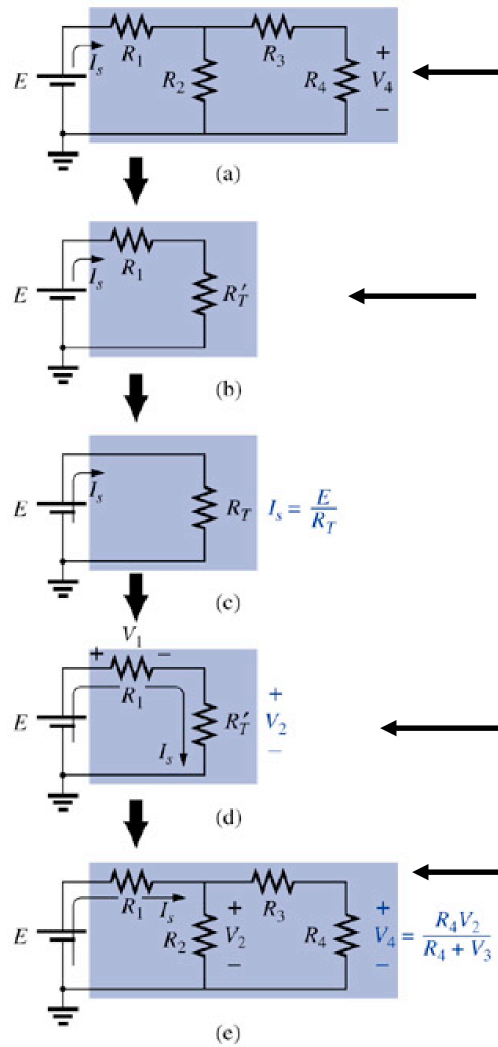
Series-Parallel Circuits

- General Approach:
  - Study the problem before “jumping in”
    - Think about the “knowns” and “unknowns”
  - Examine each region of the network w.r.t. the unknowns
    - This may yield an “obvious” solution
  - REDRAW the circuit as often as necessary
    - Reduces complexity
    - Leave the unknowns undisturbed (if you can)

Reduce and Return Approach



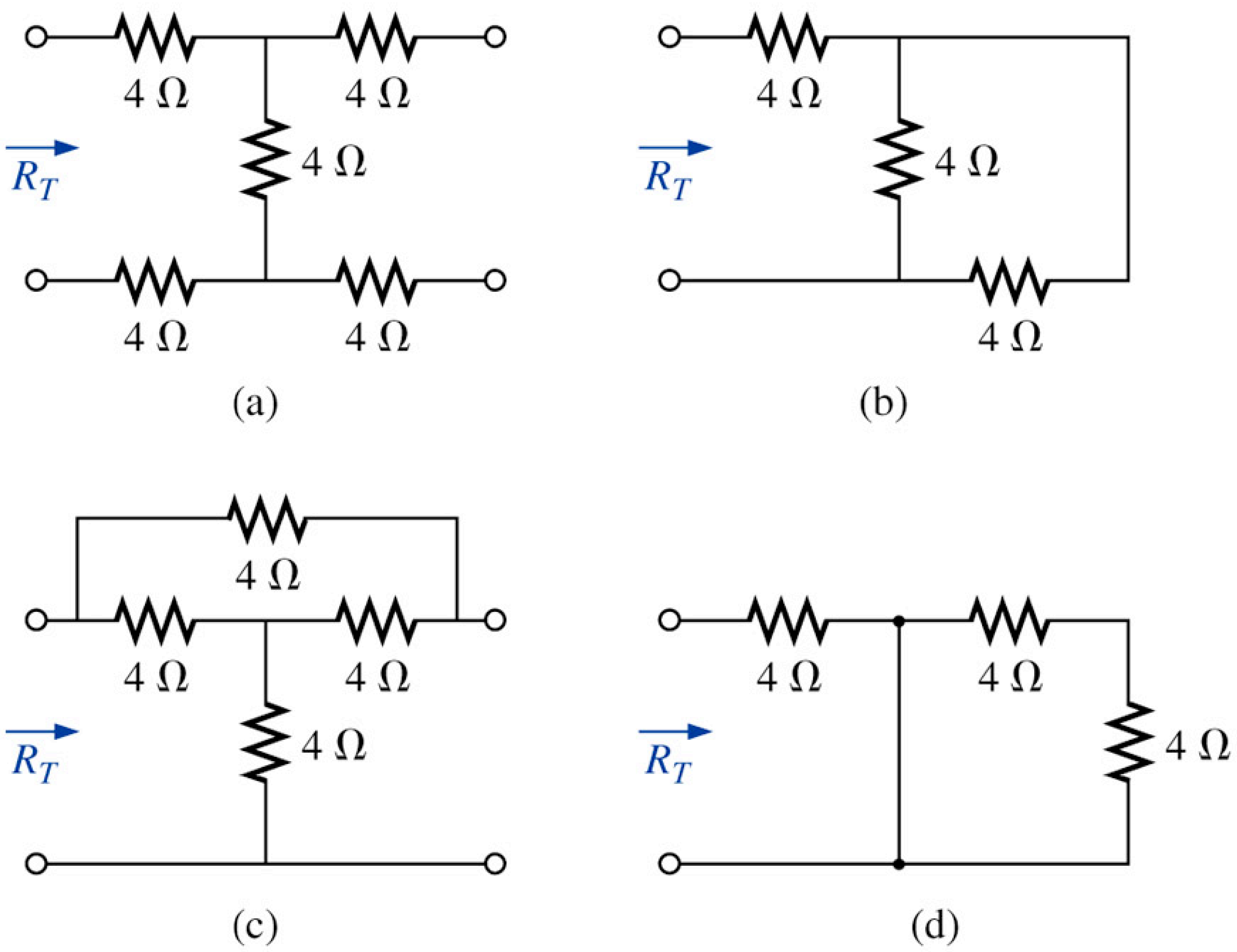
Want Is and V4

Combine R2, R3, R4
(allows us to solve for Is)

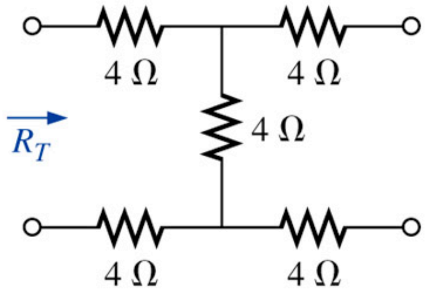
Find V2
(voltage across R2)

Use V2 to solve for V4
(voltage divider)

Example #1 – Find RT



Example #1 – Find R_T

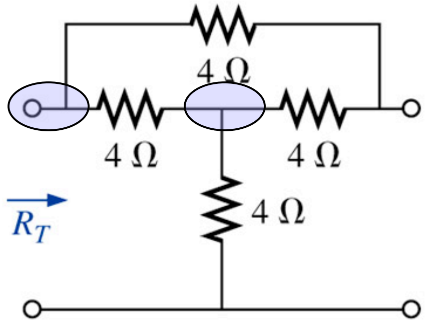


(a)

$$R_T = 4 + 4 + 4$$
$$= 12\,\Omega$$

$$R_T = 4 + 4 \parallel 4$$
$$= 4 + 2$$
$$= 6\,\Omega$$

Example #1 – Find R_T

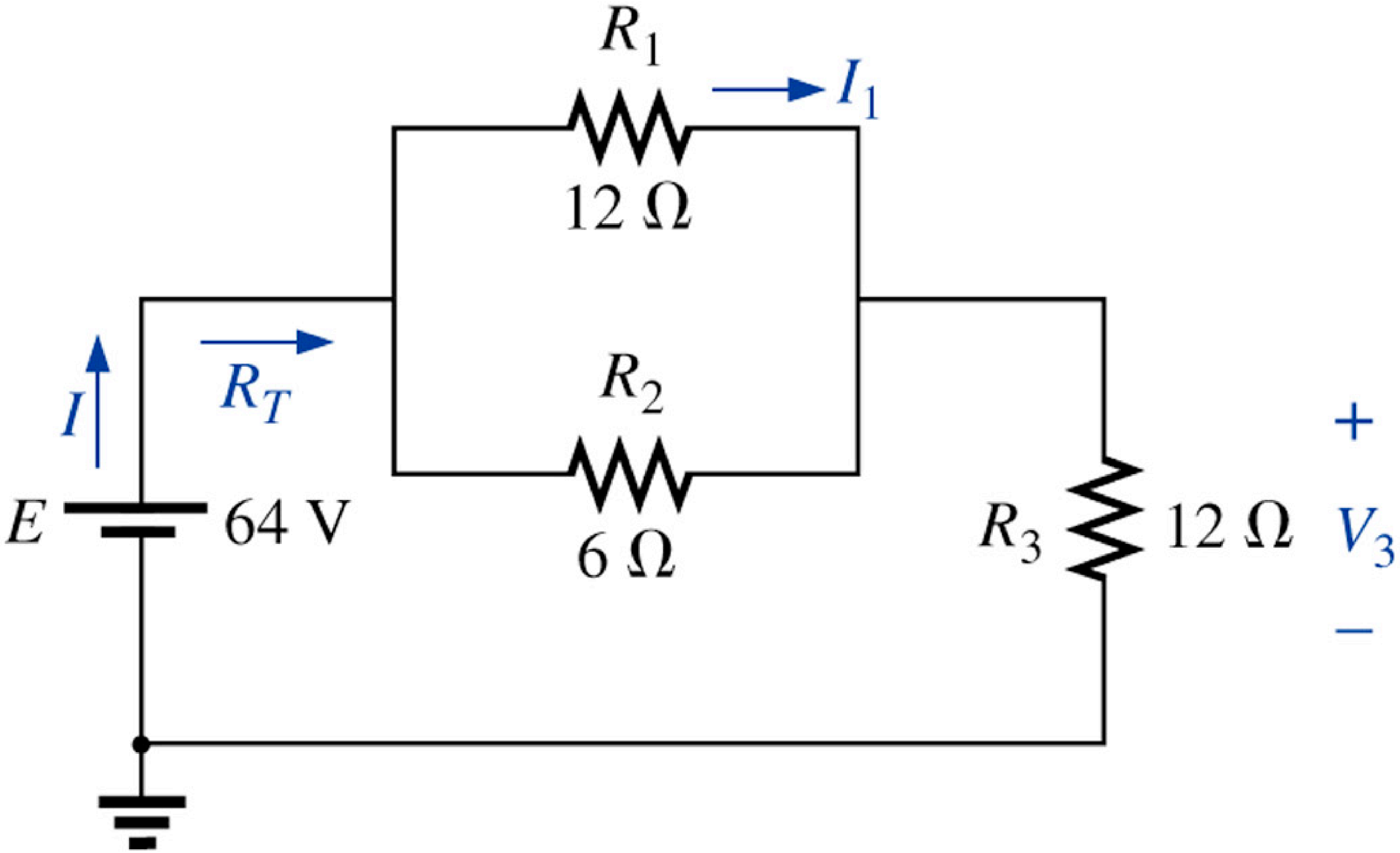


(c)

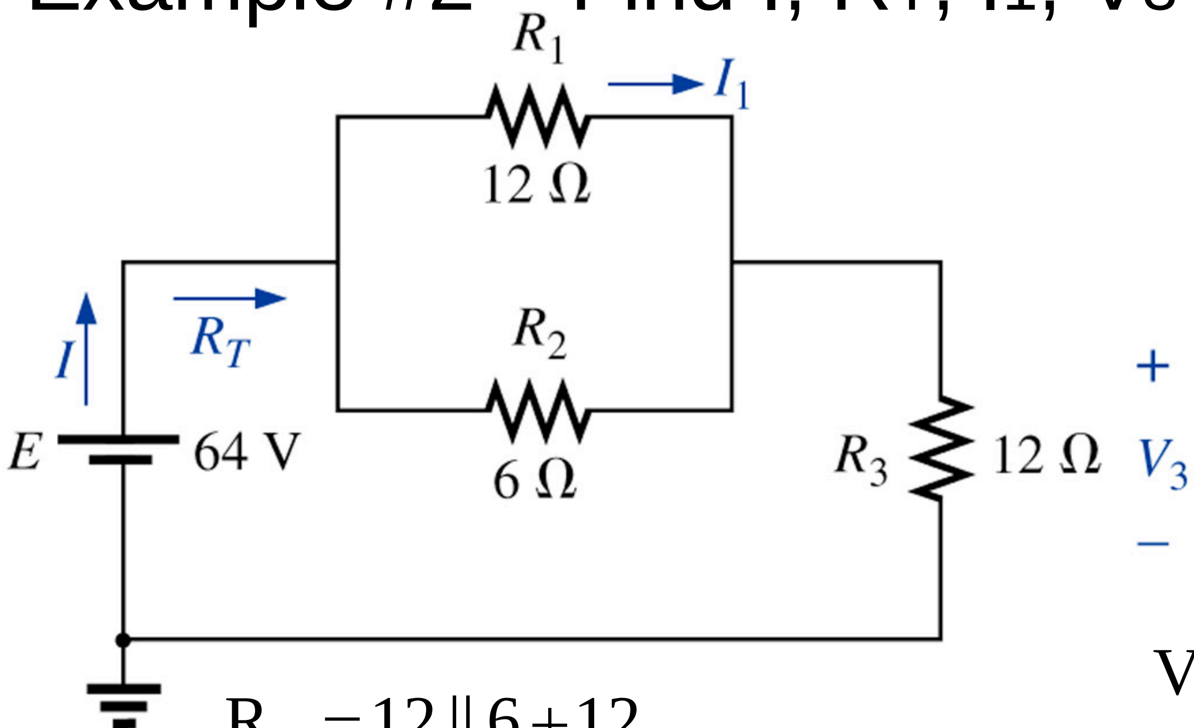
$$R_T = 4 \,||\, (4+4) + 4$$
$$= 2.667 + 4 = 6.667$$

$$R_T = 4\Omega$$

Example #2 – Find I, R_T, I_1, V_3



Example #2 – Find I, R_T, I_1, V_3



$$I_1 = I\frac{R_1 \| R_2}{R_1}$$

$$= 4\,A\frac{4\,\Omega}{12\,\Omega} = 1.33A$$

$$V_3 = I \cdot R_3 = 4\,A \cdot 12\,\Omega$$

$$= 48\,V$$

$$R_T = 12 \| 6 + 12$$

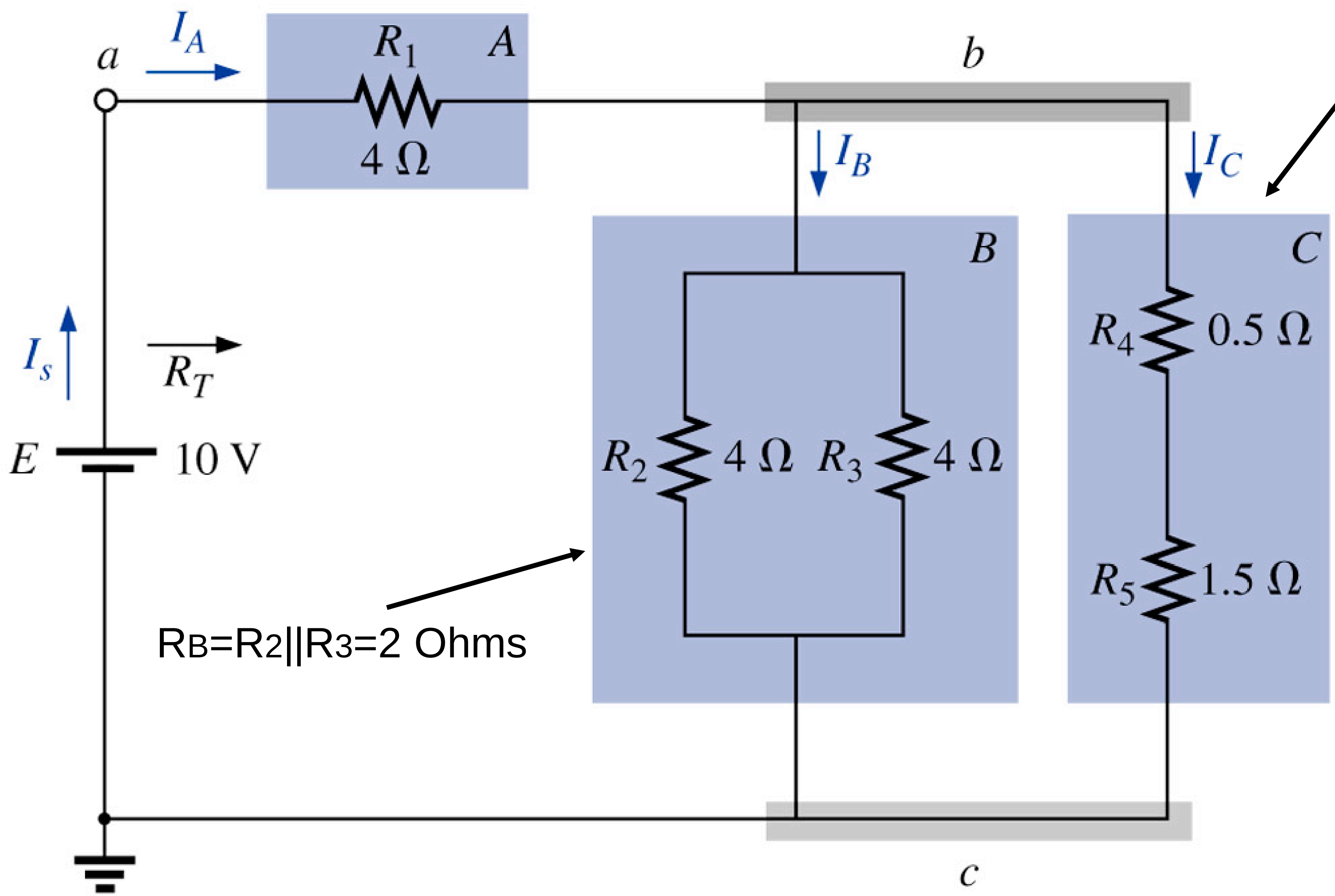
$$= 4 + 12 = 16\,\Omega$$

$$I = \frac{E}{R_T} = \frac{64\,V}{16\,\Omega}$$

$$= 4\,A$$

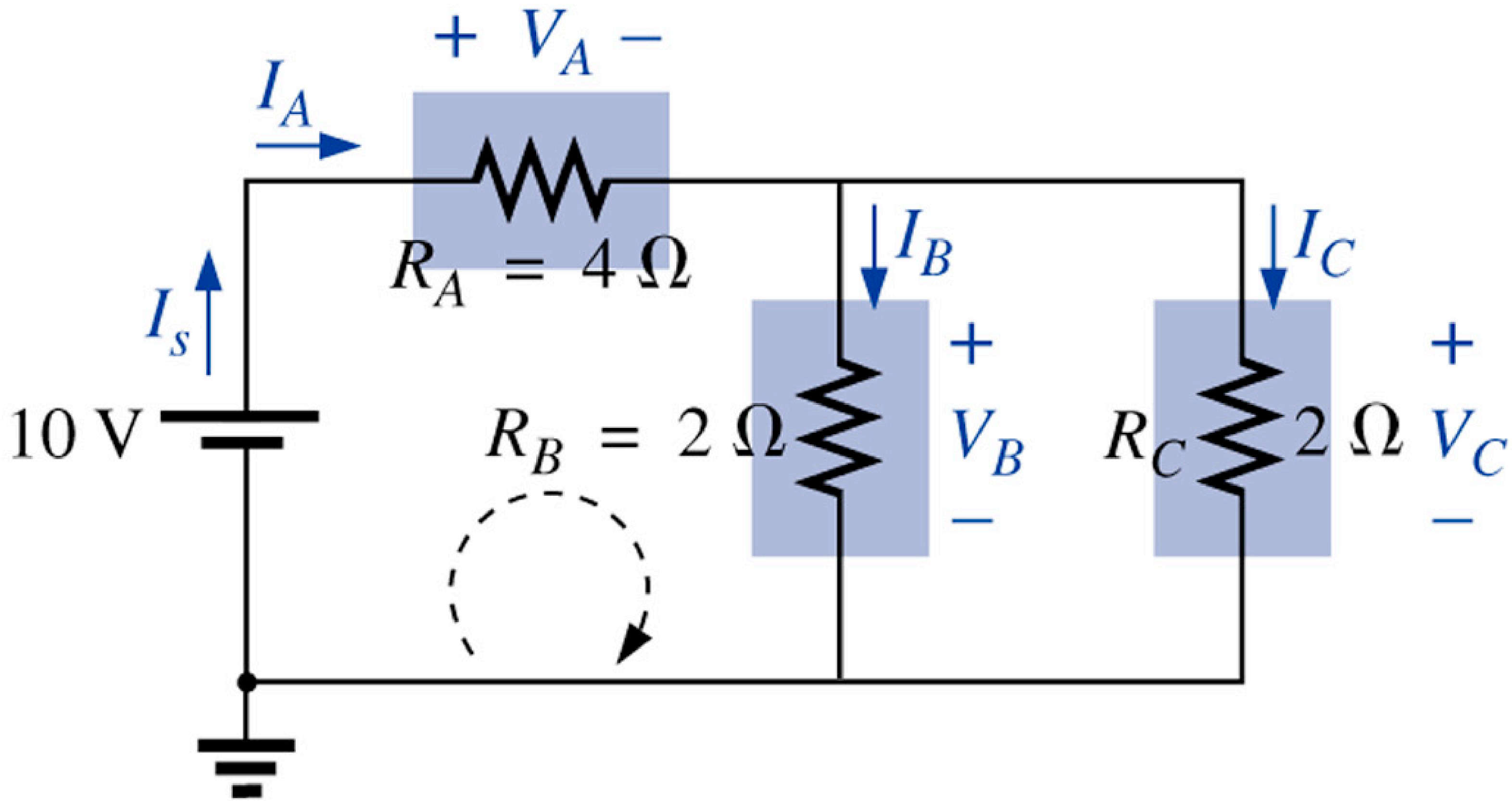
Block Diagram Approach

$R_C=R_4+R_5=2$ Ohms



$R_B=R_2||R_3=2$ Ohms

Block Diagram Approach

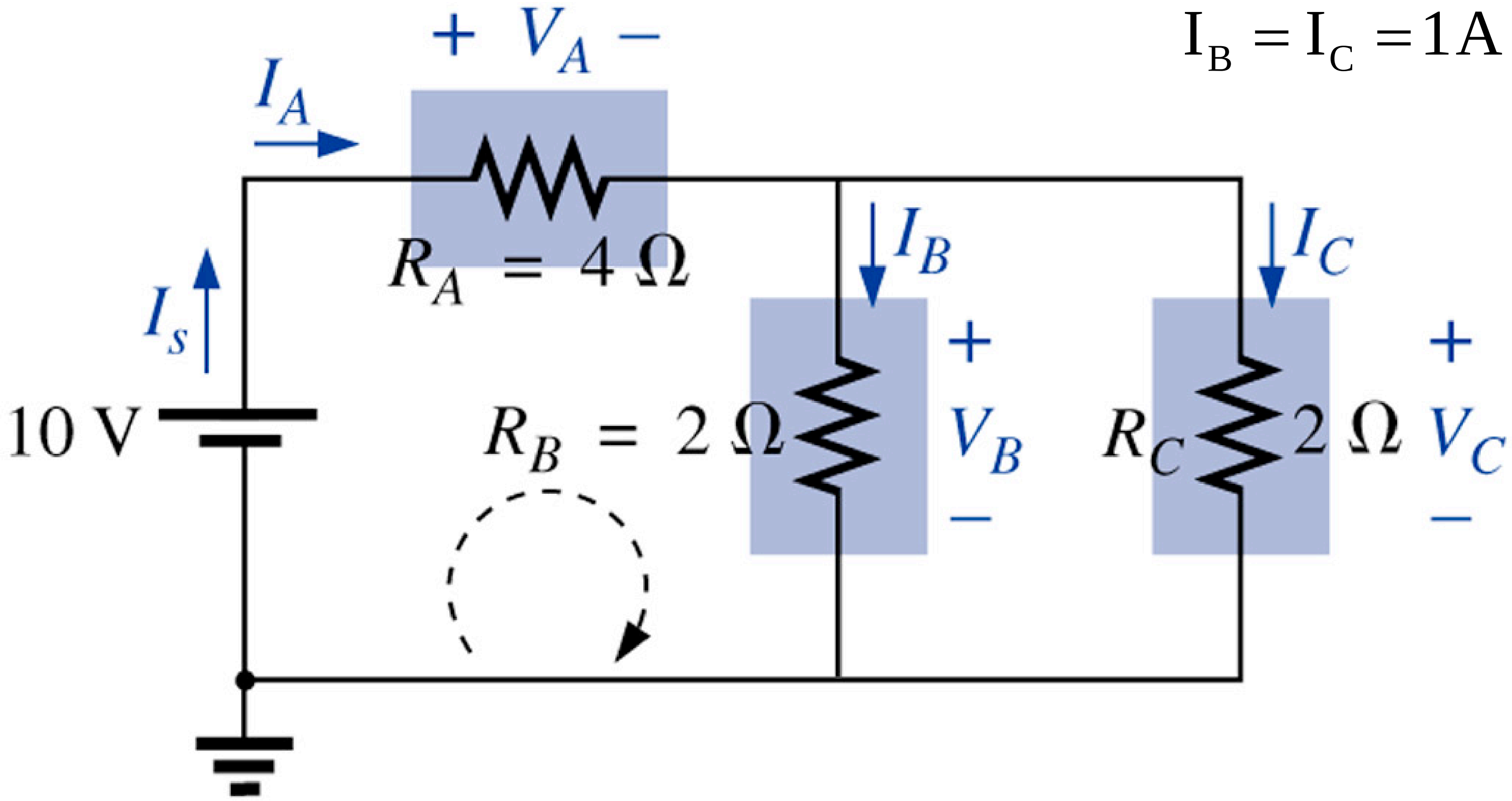


Block Diagram Approach

$R_T=R_A+(R_B||R_C)=5$ Ohms

$$I_S = \frac{10\,V}{5\Omega} = 2\,A$$

$$I_B = I_C = 1A$$



Breakout #1 – Find I_1, I_B, I_C, V_{R4}