Problem 1.19

Find I and the power absorbed by each element in the network of Fig. 1.30.

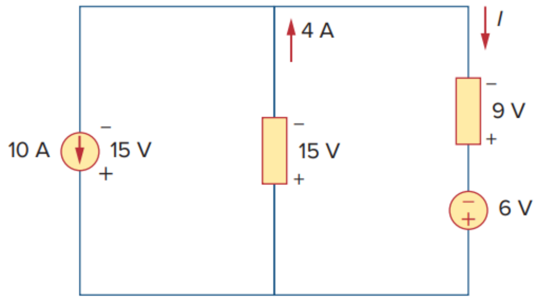
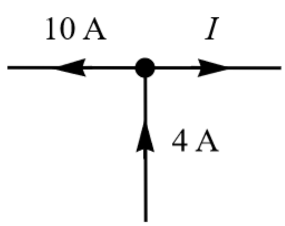


Figure 1.30
For Prob. 1.19.

Solution

Below is a close-up of the node at the top. One current (4 A) flows into it while two currents flow out of it.



According to Kirchhoff's current law (KCL), the sum of currents going into a node is zero.

$$\sum i = (4\text{ A}) - I - (10\text{ A}) = 0$$

Therefore,

$$I = -6\text{ A},$$

which means the current is actually flowing in the direction opposite to what is drawn. To get the power for a circuit element, multiply the voltage and current through it. The current is negative if it flows out of the element through the positive end.

$$p_{\text{current source}} = (15\text{ V})(-10\text{ A}) = -150\text{ W (emitted)}$$

$$p_{\text{middle 15 V}} = (15\text{ V})(4\text{ A}) = 60\text{ W (absorbed)}$$

$$p_{\text{right 9 V}} = (9\text{ V})(6\text{ A}) = 54\text{ W (absorbed)}$$

$$p_{\text{voltage source}} = (6\text{ V})(6\text{ A}) = 36\text{ W (absorbed)}$$

Observe that the sum of power in this circuit is zero, consistent with the law of conservation of energy.

$$\sum p = p_{\text{current source}} + p_{\text{middle 15 V}} + p_{\text{right 9 V}} + p_{\text{voltage source}} = (-150 + 60 + 54 + 36)\text{ W} = 0$$