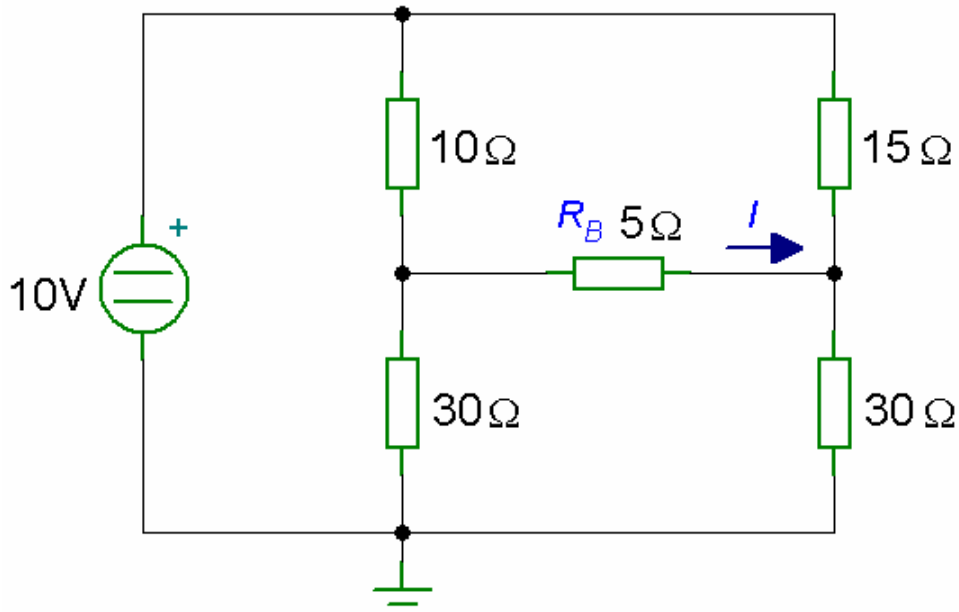


Loop Analysis

Example

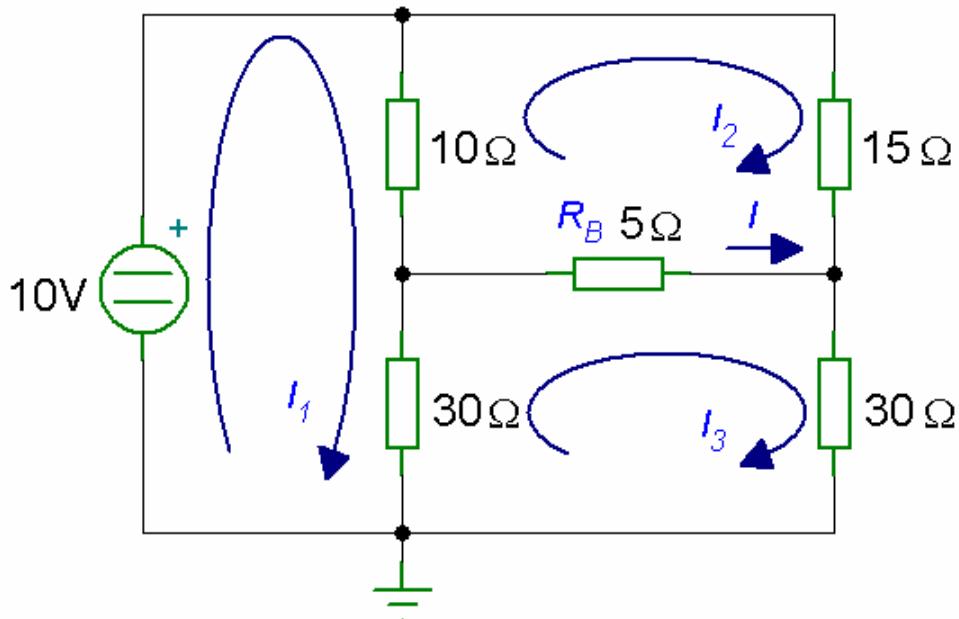
For the circuit shown below find the current flowing through the resistor R_B . In addition find the power supplied by the voltage source.



Bridge Circuit

Solution

Using loop analysis and denoting the loop currents as I_1 , I_2 , I_3 , we obtain the following figure.



Bridge Circuit with Loop Currents

Note that $I = I_3 - I_2$ and power supplied by the source is $P = 10 I_1$. The loop equations are:

$$\begin{aligned} \text{Loop 1:} \quad & 10 (I_1 - I_2) + 30 (I_1 - I_3) - 10 = 0 \\ & 40 I_1 - 10 I_2 - 30 I_3 = 10 \end{aligned}$$

$$\begin{aligned} \text{Loop 2:} \quad & 10 (I_2 - I_1) + 15 I_2 + 5 (I_2 - I_3) = 0 \\ & -10 I_1 + 30 I_2 - 5 I_3 = 0 \end{aligned}$$

$$\begin{aligned} \text{Loop 3:} \quad & 30 (I_3 - I_1) + 5 (I_3 - I_2) + 30 I_3 = 0 \\ & -30 I_1 - 5 I_2 + 65 I_3 = 0 \end{aligned}$$

In matrix form, we have

$$\begin{bmatrix} 40 & -10 & -30 \\ -10 & 30 & -5 \\ -30 & -5 & 65 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 10 \\ 0 \\ 0 \end{bmatrix}$$

The MATLAB program for solving the loop currents I_1 , I_2 , I_3 , the current I and the power supplied by the voltage source is

MATLAB Script

```
% this program computes the current
% flowing in the resistor RB and power supplied by source
% it computes the loop currents, when the impedance
% matrix Z and voltage vector U are given
% Z is the impedance matrix
% U is the voltage matrix
% initialize the matrix Z and vector U
Z = [40 -10 -30;
     -10 30 -5;
     -30 -5 65];
U = [10; 0; 0];
% solution for the loop currents
I = inv(Z)*U;
% the current through RB is calculated
IRB = I(3)-I(2);
disp(['The current through the resistor RB is ', num2str(IRB), ' A.'])
% the power supplied by source is calculated
P = 10*I(1);
disp(['The power supplied by voltage source is ', num2str(P), ' W.'])
```

The results obtained from MATLAB are

The current through the resistor RB is 0.037037 A.
The power supplied by voltage source is 4.7531 W.