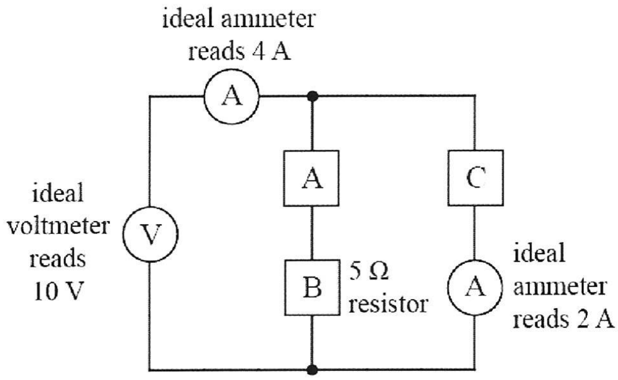
1.

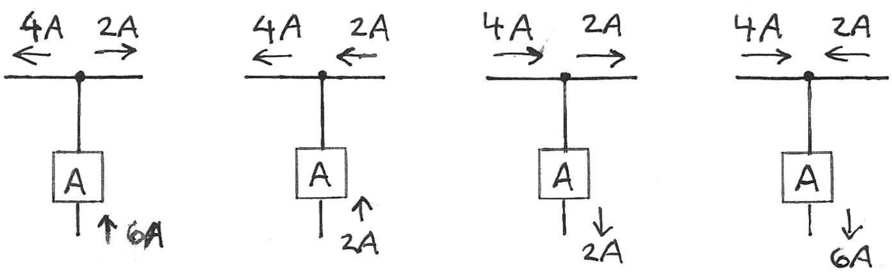


If box A contains a resistor, find the value of that resistor.

sol'n: By Kirchhoff's current law, the total current flowing into a node equals the total current flowing out of a node.

At the top center node, we have 4A flowing to the left (or from the left) and 2A flowing to the right (or from the right). Note that the current of 2A on the lower right flows everywhere in the right branch.

We lack information about the polarity of measurements, so we have four possible scenarios for the currents at the top node.

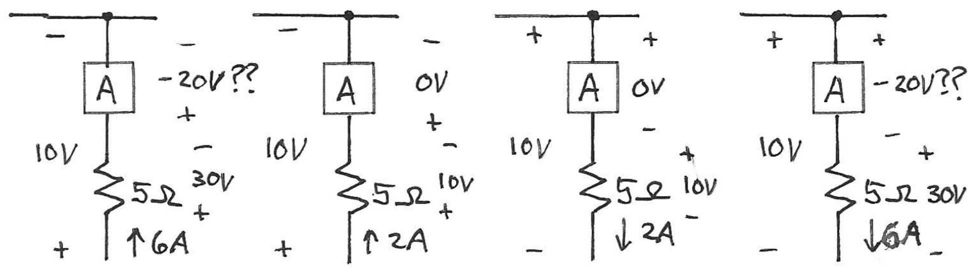


The current flowing in A is chosen to make the sum of currents at the node equal zero.

Note that the current flowing in B is the same as the current flowing in A.

Now we consider Kirchhoff's voltage law applied to the loop on the left. The sum of voltage drops around the loop must be zero. The ideal ammeter has no voltage drop, so the voltage drop across A and B must be 10V to cancel the 10V across the voltmeter.

Again, we don't know the polarity of the 10V drop, but we know the current in a resistor flows from higher voltage to lower voltage. This allows us to specify the v-drop across A and B for each of our four current scenarios of the top node.



The voltage drop across the 5Ω resistor is given by Ohm's law: $V = IR$. The voltage drop across A plus the voltage drop across the 5Ω resistor in B equals 10V. This means we have either −20V across A or 0V across A.

Since resistance is positive for a resistor, we must have a positive (or at least non-negative) V-drop across A (by Ohms law).

Thus, we must have 0V across A, and $R = V/I = 0V/I = 0\,\Omega$

$A = 0\,\Omega$ = wire