TOPIC
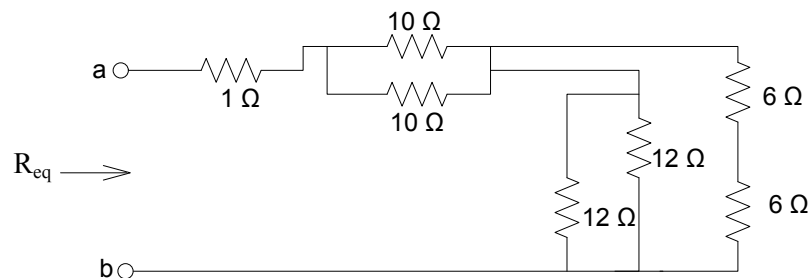Electricity and Magnetism – Section XI – Question 8

QUESTION
The equivalent resistance in ohms of the circuit most nearly is

a ○——ⱮⱮ—— 10 Ω

1 Ω   10 Ω   12 Ω   6 Ω

R_{eq} ⟶

12 Ω   6 Ω

b ○

(A) 0.93
(B) 5.0
(C) 10
(D) 15

HINT
Resistors are electrical elements designed to exhibit resistance. This resistance opposes the direction of current by producing a voltage drop. From Ohm's law the voltage drop is proportional to the current

$V = I R.$

The symbol for a resistor is a *zig-zag* line. When there is a current flowing through a resistor then a voltage drop is formed

$\xrightarrow{i}$ + v - ⱮⱮ
R
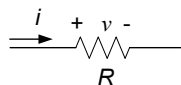
Resistance is represented with the capital letter R and it is measured in Ohms (Ω).

$$R = \frac{\rho A}{\ell}$$

where

ρ is the resistivity of the material (Ω.m),
A is the cross sectional area (m²) and
ℓ is the length (m).

Resistors do not save electrical energy. Resistors absorb or dissipate energy as heat. As mentioned earlier power of any electrical element is the product of current and voltage;

$P=IV$

Only for resistors, power is also given by

$$P_R = i^2 R = \frac{v^2}{R},$$
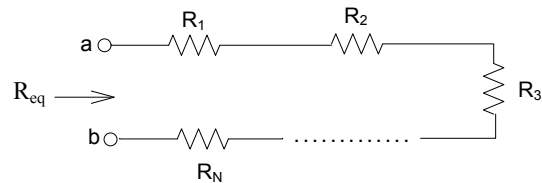
where

i is the current through the resistor and

v is the voltage drop across it.

Two more useful terminologies to know are the short and open circuit.

A short circuit is when R = 0 Ω and voltage is zero for any given current.

An open circuit is when R = ∞ Ω and current is zero for any given voltage.
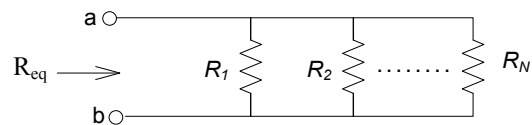
Resistors in series:

Resistors in series are added.

$$R_{eq} = R_1 + R_2 + R_3 + \ldots + R_N.$$

Note that a piece of wire (or short circuit) is a resistor with zero resistance ($R = 0\Omega$) and does not change the series resistance.
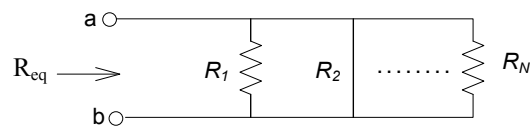
Resistors in Parallel: The notation is

$$R_{eq} = R_1 \mathbin{/\!/} R_2 \mathbin{/\!/} \ldots \mathbin{/\!/} R_N$$

$$R_{eq} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_N}}$$

Note that a short circuit in parallel with a number of resistors connected in parallel is not insignificant as is the case with resistors connected in the series.

Even if one resistor becomes a short circuit ($R = 0$ Ω) then

$$R_{eq} = R_1 \mathbin{/\!/} 0 \mathbin{/\!/} \ldots \mathbin{/\!/} R_N = 0\ \Omega.$$

CONTRIBUTOR

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