Question

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Two resistors, one of 10 Ω and the other of 15 Ω, are connected in parallel. This combination is connected in series with a 24 Ω resistor and a 12 V battery. The current in the 15 Ω resistor is:

This question was previously asked in

RRB ALP Electronics Mechanic 21 Jan 2019 Official Paper (Shift 3)

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1. 0.40 A
2. 0.24 A
3. 0.12 A
4. 0.16 A

Answer (Detailed Solution Below)

Option 4 : 0.16 A

Detailed Solution

CONCEPT:

- **Resistance**: The measurement of the **opposition of the flow of electric current** through a **conductor** is called **resistance** of that conductor. It is denoted by **R.**

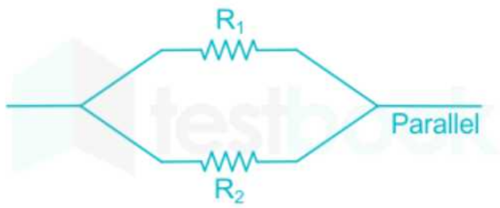
There are mainly **two ways** of the combination of resistances:

- **Resistances in series combination**: When two or more resistances are connected one after another such that the same current flows through them are called as resistances in series.

The **net resistance/equivalent resistance (R)** of resistances in series is given by:

Equivalent resistance, $R = R_1 + R_2$

- **Resistances in parallel combination**: When the terminals of two or more resistances are connected at the same two points and the potential difference across them is equal is called resistances in parallel.



The **net resistance/equivalent resistance(R)** of resistances in parallel is given by:

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

- **Ohm's law:** At constant temperature and other physical quantities, the **potential difference** across a current-carrying wire is directly proportional to the current flowing through it.

V= R I

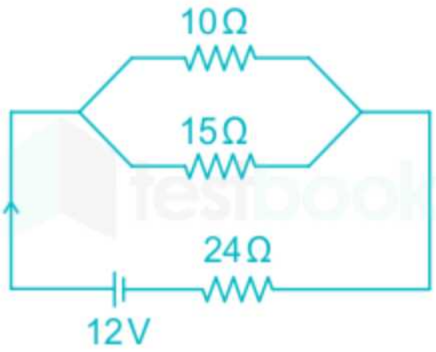
Where V is the **potential difference**, R is **resistance** and I is **current**.

CALCULATION:

Given that:

R_1 = 10 Ω and R_2 = 15 Ω
Resistance in series (R') = 24 Ω

Potential difference (V) = 12 V



The **net Resistance in Parallel combination** is given by:

$1/R = 1/R_1 + 1/R_2$

1/R = 1/10 + 1/15

So 1/R = 5/30

Hence R = 6 Ω

The combination is connected in series with a 24 Ω resistor, so the new net resistance of the circuit will be:

New Total Resistance = 6 + 24 = 30 Ω

Use Ohm's law:

Electric current (I) = V/R = 12/30 = 0.4 A

Now, Potential across 24 Ω resistor = 24 × 0.4 = 9.6 V

Now, **Potential across Parallel combination = 12 - 9.6 = 2.4 V**

This is the electric Potential that will Reach both the Resistances of 15 Ω and 10 Ω.

By Using Ohm's law:

V = I × R

2.4 = I × 15

Electric current (I) = 0.16A. So option 4 is correct.