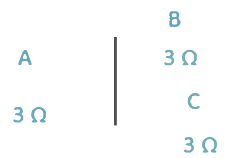
NCERT SOLUTIONS
CLASS X SCIENCE
CHAPTER 12 - ELECTRICITY

Q1. Three 3 Ω resistors, X, Y and Z are connected as shown in the figure. The maximum power each of them can withstand is 27 W. Find the maximum current that can flow through the three resistors.



Ans. Given , Power = 27W

Resistance of each resistor = 3 Ω.

Now, we know;

where I = current

Resistance X will have the maximum value of current flowing through it as it is in

Series. Therefore:

$I_X^2 = 27/3 = 9$

Therefore, $I_X = 3A$.

Let I_Y and I_Z be the current flowing through Y and Z respectively. Now since they are in parallel and have the same resistance values, the voltage drop across them will be the same. Thus;

$I_Y R_Y = I_Z R_Z$

Or, $I_Y / I_Z = R_Z / R_Y$

$= 3/3 = 1$

$I_Y = I_Z$

But, $I_Y + I_Z = I = 3A$

Therefore, $2I_y = 3$

$I_Y = 3/2 = 1.5A$

$I_Z = 1.5A$

Q2. Should an ammeter have a high or low resistance? Justify your answer.

Ans. An ammeter should have a low resistance so that it does not disrupt the current flowing through the circuit when it is connected in series to the circuit

Q3.How does a fuse wire protect an electrical equipment?

Ans. A fuse wire is connected in series with the electrical equipment and it is made to melt/ break when the current flowing through it exceeds a certain value(rated value). So during some faulty conditions when a high value of current is coming in, the fuse wire breaks thus effectively protecting the equipment from the high fault current.

Q4. Explain electrical resistivity. In an electrical circuit a current of 5A is flowing. However, the current flowing through the wire decreases by half when the length of the wire is doubled. Explain.

Ans. Electrical resistivity is the resistance offered by a conducting wire of unit cross sectional area and unit length.

We know,

$R = \rho(L/A)$, where ρ= electrical resistivity

L= length of the wire

A= unit cross sectional area.

Or, $R \propto L$

Therefore by doubling the length the resistance gets doubled and the current drops by half.

Q5. A bulb is connected in series to a 20V battery, the circuit resistance is 5Ω and a current of 2A flows through the circuit. Calculate the resistance of the bulb

Q5. A bulb is connected in series to a 20V battery, the circuit resistance is 5Ω and a current of 2A flows through the circuit. Calculate the resistance of the bulb. Now, a resistance of 10 Ω is added in parallel to the existing circuit. What is the change (if any) in the current flowing through the original 5 Ω circuit ?

Ans. Given,

$I = 2A$, $R_B = ?$, $R_C = 5\Omega$, $V = 20V$

Using Ohm's Law:

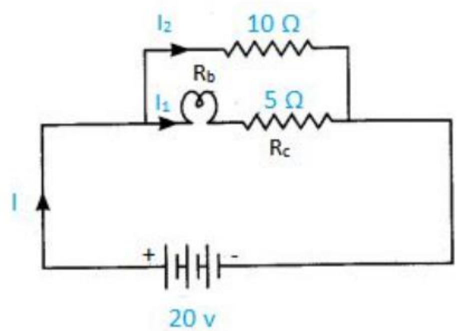
$V=IR$

$V=I(R_B + R_C)$

$20 = 2 \times (5 + R_B)$

Therefore, resistance of the bulb is $=5\ \Omega$

Now, the circuit can be redrawn as below with the changed conditions;



Here, the new parallel resistance $R_N = 10\Omega$.

So, the net resistance, $1/R_{EQ} = 1/R_N + 1/(R_B + R_C)$

$= 1/10 + 1/10$

$=1/5$

Therefore the total net resistance, $R_N = 5\ \Omega$.

Now, the current drawn from the battery $=V/R_N$

$= 10/5 = 2A$

Since it is in parallel the potential difference across the connection remains the same. Thus,

$I_1R_N = I_2(R_B + R_C)$ Where, I_1= current in the parallel circuit

I_2 = current in the original circuit.

$I_1/I_2 = 10/10 = 1$

$I_2 = I_1$

This means current is divided equally in both arms, So

$I_1 = I_2 = 1A$.

Hence, there is a change in the current. With the addition of the 10 Ω in parallel, only 1A current will flow through the 5 Ω circuit.

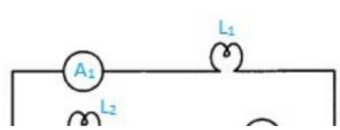
Q6. Why do electricians incorporate parallel connection of wires in domestic wiring?

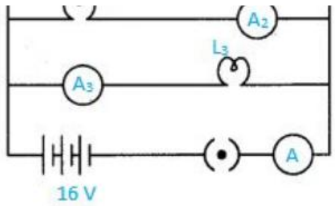
Ans. Parallel connection is incorporated in domestic wring because:

Voltage does not drop from one electrical appliance to another.
It is safer for the equipments, as in case of a fault in one branch, it can be easily identified and stopped.
Switching of one appliance does not cutoff the supply for other appliances.

Q7. L1, L2 and L3 are three identical light bulbs connected to a 16V source as shown in the diagram. A current of 6A is observed in the ammeter when all three light bulbs are glowing.

If L1 gets fused, what happens to the glow of L2 and L3?
If L2 gets fused, what do the ammeters A1, A2, A3 and A read?
When all three bulbs are glowing, how much power is dissipated in the circuit?





Ans.

(i) Since all the three lamps are in parallel, they have equal potential differences across them. Thus, even if L1 gets fused the other two glows with the same intensity.

(ii) The total resistance when all the bulbs are glowing:

$1/R_T = 1/R + 1/R + 1/R$

$= 3/R$

$R_T = R/3$

Given, ammeter A reads 6 A.

So, $V = IR_T$

$16 = 6 \times (R/3)$

$R = 8\Omega$.

So resistance of each bulb is 8 Ω.

Now when L2 gets fused the equivalent resistance of the parallel circuit for L1 and L3 is :

$R_{P'} = (8 \times 8)/(8 + 8)$

$= 4\ \Omega$.

Therefore ammeter A now reads , $I' = V/R_{P'}$

$I' = 16/4$

$=4A$.

Since the resistance of each arm is the same and the potential difference across each arm is also the same, the 4A current will divide equally between the two arms.

Thus, ammeter A1 and A3 will read 2A, ammeter A2 read zero and ammeter A will read 4A.

(iii)In parallel connection total power used, $P_{eq} = P + P + P$

$= 3P = 3 \times V \times I$

$= 3 \times 16 \times 2 = 96$ W (Current through each bulb is 2A)

Q8. Three bulbs are connected in series and in another circuit three bulbs are connected in parallel to the same source.

(a)Will the bulbs in the two circuits glow with same intensity?

(b)If a bulb gets fused in both the circuits, will the other bulbs still glow?

Ans.

(a) Resistance for three identical bulbs in series, $R_S = 3R$

Resistance for three identical bulbs in parallel, $R_P = R/3$

The current in series, $I_S = V/R_S = V/3R$

The current in parallel, $I_p = 3V/R$

So, $I_P > I_S$.

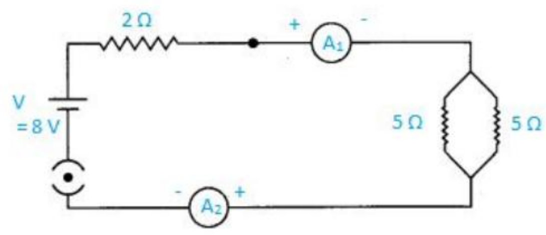
Thus, the bulbs glow with different intensities in the two circuits.

(b)As one bulb fuses, the series circuit will be an open circuit so current stops flowing

Hence the bulbs stop glowing. In the parallel circuit, however the two bulbs continue to

Glow because the flow of the current to the bulbs isn't disrupted.

Q9.Calulate the following circuit parameters:



Equivalent resistance of two 5Ω resistors in combination.
Current flowing through 2 Ω resistor.
Potential difference across the 2 Ω resistor.
Power consumed by the 2 Ω resistor.
Will there be any difference in ammeter A1 and A2 readings?

Ans.

(a)Equivalent resistance , R_{EQ} = (5 x 5)/(5+5)

=2.5 Ω

(B) R_{TOTAL} = 2 + R_{EQ}

= 2 + 2.5 = 4.5 Ω

So current through 2 Ω = I = V/R = 8 / 4.5

= 1.77A

(c)Potential difference across the 2 Ω resistor = V' = IR = 1.77 x 2

=3.54V

(d)Power consumed = I^2R = 1.77^2 x 2 =6.26 W

(e) Both ammeters will read the same value as they are in series.