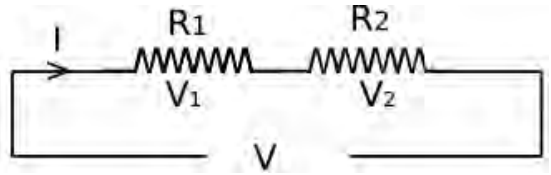
1. EFFECTS OF ELECTRIC CURRENT
CLASS.2

Arrangement of Resistors.

Resistors can be connected in series and parallel modes.

Series Connection.



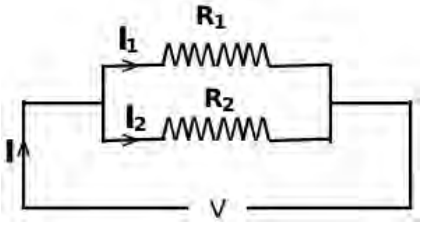
Series connection of two resistors(R_1&R_2) is shown. When resistors are connected in this mode, effective resistance increases. Here two resistors are connected R_1 & R_2 are connected in sereis.

The effective resistance of this circuit is, $R = R_1 + R_2$

That is, effective resistance of series combination is equal to the sum of resistance of the all resistors.

Note: *When 'n' resistors of equal resistance r Ω are connected in series, the effective resistance will be* ***'nr'***.

Parallel Connection.



Parallel connection of resistors are shown in the figure.

Let R be the effective resistance of the parallel connection,

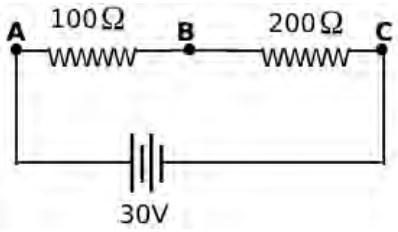
Then, $1/R = 1/R_1 + 1/R_2$ Or $R = R_1.R_2/(R_1+R_2)$

Note: *When 'n' resistors of equal resistance r Ω are connected in parallel, the effective resistance,R = r/n.*

Features of Series & Parallel connection of resistors.	
Series Connection	**Parallel Connection**
Effective resistance increases with the increase of the number of resistors.	Effective resistance decreases with the increase of the number of resistors.
Same current flows through all resistors.	Large current flows through small resistance and small current through large resistance. (current is different)
Applied voltage will be split across the resistors.	
Potential difference will be large across high resistor and it will be small across small resistor.	Same potential difference will be available at all resistors.

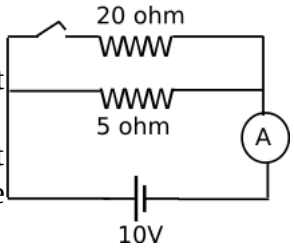
PRACTICE QUESTIONS

1.It is given 5Ω, 20Ω resistors and a 10V battery.
a. Draw the circuit diagram of series combination of these resistors to the battery.
b. What is the effective resistance of this circuit?
c. What is the current in the circuit?
d. What will be the effective resistance if they are connected in parallel.
e. What will be the current then?



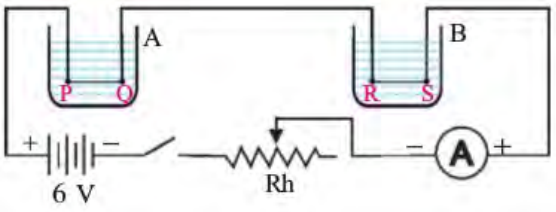
2. See the circuit,
a. The resistors are connected in …….. (series/parallel)
b. What is the effective resistance in the circuit?
c. High voltage is dropped across ……. (100Ω/200Ω)
d. More heat will be generated in …….. (100Ω/200Ω)
e. Identify the resistor through which large current passes.
f. If potential difference between 100 Ω is 10V, how much work is done by the battery to move one coulomb charge from A to B?

3. See the circuit.
a. What will be the ammeter reading in this circuit?
b. What will be the total resistance of the circuit when the switch kept on? c. What will be the ammeter reading then?



4. Draw the diagrams of connecting 3Ω resistor and 6Ω resistors, so as to get maximum resistance and minimum resistance. Also calculate the effective resistance in each case.

5. In the circuit, PQ and RS are a nichrome wire and copper wire of same length and thickness which are immersed in equal amount water at same temperature.



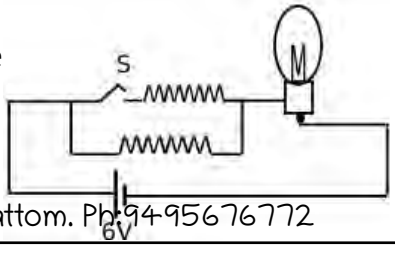
a. How are the wires connected in the circuit?
Series/Parallel
b. Of the wires PQ and RS which one gets more current?
c. Identify the beaker in which the water gets heated more when the switch kept ON for a few minutes.
d. Explain the reason for the difference in rise in temperature of water.

6. Insert the the following statements in the table given.
* When the number of resistors increases current also increases.
* When number of resistors increases effective resistance decreases.
* Same amount of current passes through all the resistors.
* Potential difference is same for all the resistors.
* High resistor gets heated more.
* Applied voltage will be split among the resistors.
* Effective resistance is minimum.

Series connection of resistors.	Parallel connection of resistors.

7. If 2Ω, 3Ω, 4Ω, 5Ω resistors are connected in parallel, the effective resistance will be …
14 Ω/ greater than 2Ω / less than 2Ω / none of these

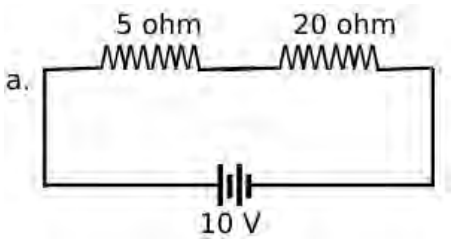
8. See the circuit.
What happens to the brightness of the bulb, if when the switch S is ON? Justify your answer.



9. 20 resistors of 2Ω each are connected in parallel. Calculate the effective resistance.
10. Three resistors of 2Ω, 3Ω, 6Ω are given in the class.
a. What is the highest resistance that you can get using all of them?
b. What is the least resistance that you can get using all of them?
c. Can you make resistance of 4.5Ω using these three. Draw the circuit.
11. A boy has many resistors of 2Ω each. He needs a circuit of 9 Ω resistance. For this draw a circuit with the minimum number of resistors.
12. If 0.2 Ω, 0.3 Ω, 0.4 Ω, 0.5 Ω and 12 Ω resistors are connected to a 9V battery in parallel, what will be the current through the 12 Ω resistor?
13. How many resistors of 176 Ω should be connected in parallel to get 5A current from 220V supply?
14. Depict a figure showing the arrangement of three resistors in circuit to get an effective resistance of (I). 9 Ω and (ii). 4 Ω

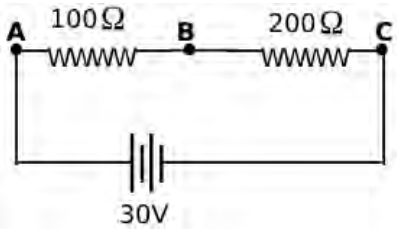
PRACTICE QUESTIONS & ANSWERS

1.It is given 5Ω, 20Ω resistors and a 10V battery.
a. Draw the circuit diagram of series combination of these resistors to the battery.
b. What is the effective resistance of this circuit?
c. What is the current in the circuit?
d. What will be the effective resistance if they are connected in parallel.
e. What will be the current then?

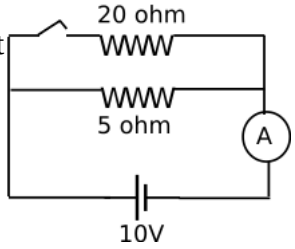


Ans.
b. Effective resistance, $R_S = R_1 + R_2 = 5+20 = 25\ \Omega$
c. Current, $I = V/R = 10/25 = 0.4$ A
d.Effective resistance, $R_P = R_1.R_2/(R_1+R_2) = 5x20/(5+20)$
$= 100/25 = 4\ \Omega$
e. Current, $I = V/R = 10/4 = 2.5$A

2. See the circuit,

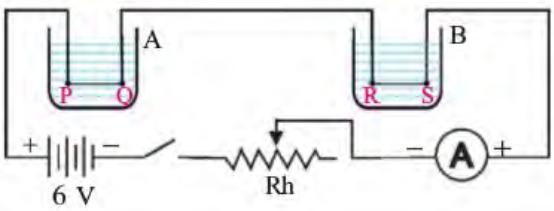


a. The resistors are connected in …….. (series/parallel)
b. What is the effective resistance in the circuit?
c. High voltage is dropped across ……. (100Ω/200Ω)
d. More heat will be generated in …….. (100Ω/200Ω)
e. Identify the resistor through which large current passes.
f. If potential difference between 100 Ω is 10V, how much work is done by the battery to move one coulomb charge from A to B?
Ans. a. Series.
b. 300Ω ($R = R_1+R_2$)
c. 200Ω (When resistors are connected in series more voltage is dropped across high resistor)
d. 200Ω (When resistors are connected in series more heat is generated in high resistor)
e. Same current passes through both resistors. (When resistors are connected in series same current passes through all the resistors)
f. 10J (If potential difference between two point is V volt, V joule of work is to be done to move one coulomb charge from one point to other).
3. See the circuit.
a. What will be the ammeter reading in this circuit?
b. What will be the total resistance of the circuit when the switch kept on? c. What will be the ammeter reading then?



Answer:a. Ammeter reading (Current I) = $V/R = 10/5 = 2$A
b. When the switch is ON, the two resistors are in parallel.
Effective resistance $R = R_1.R_2/(R_1+R_2) = 20x5/(20+5) = 100/25 = 4\ \Omega$
c. Then the Current $I = V/R = 10/4 = 2.5$ A
4. Draw the diagrams of connecting 3Ω resistor and 6Ω resistors, so as to get maximum resistance and minimum resistance. Also calculate the effective resistance in each case.

Ans. Maximum resistance is obtained when they are connected in series.
And the effective value $R = R_1 + R_2 = 3+6 = 9\ \Omega$
Minimum value is obtained by connecting them in parallel.
Effective value in parallel combination, $R = R_1.R_2/(R_1+R_2) = 3x6/(3+6) = 18/9 = 2\ \Omega$
5. In the circuit, PQ and RS are a nichrome wire and copper wire of same length and thickness which are immersed in equal amount water at same temperature.



a. How are the wires connected in the circuit?
Series/Parallel
b. Of the wires PQ and RS which one gets more current?
c. Identify the beaker in which the water gets heated more when

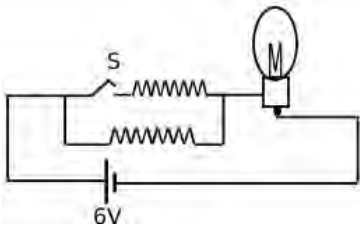
the switch kept ON for a few minutes.
d. Explain the reason for the difference in rise in temperature of water.
Ans:a. Series. b. Same amount of current passes through both the wires.
c. Water in beaker A (water in which nichrome wire is immersed)heats up more.
d. When current passing through resistors in series connection, more heat will be generated in highest resistor.
6. Insert the the following statements in the table given.
* When the number of resistors increases current also increases.
* When number of resistors increases effective resistance decreases.
* Same amount of current passes through all the resistors.
* Potential difference is same for all the resistors.
* High resistor gets heated more.
* Applied voltage will be split among the resistors.
* Effective resistance is minimum.

Series connection of resistors.	**Parallel connection of resistors.**

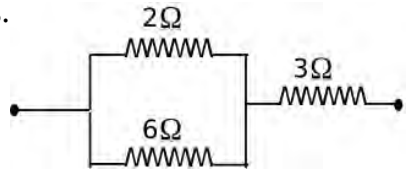
Ans.

Series connection of resistors.	**Parallel connection of resistors.**
Same amount of current passes through all the resistors.	When number resistors increases current also increases.
Applied voltage will be split among the resistors.	When number of resistors increases effective resistance decreases.
High resistor gets heated more.	Potential difference is same for all the resistors.
	Effective resistance is minimum.

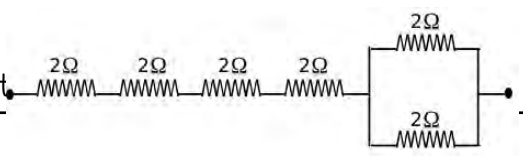
7. If 2Ω, 3Ω, 4Ω, 5Ω resistors are connected in parallel, the effective resistance will be...
14 Ω/ greater than 2Ω / less than 2Ω / none of these
Ans. Less than 2Ω
Explanation. When a number of resistors are connected in parallel, the effective resistance will be less than the the least one among them.



8. See the circuit.
What happens to the brightness of the bulb, if when the switch S is ON? Justify your answer.
Ans. The brightness will increase. Because when the switch is ON, the second resistor is also included in the circuit. Since they are connected in parallel the effective resistance decreases and hence increases the current in the circuit.
9. 20 resistors of 2Ω each are connected in parallel. Calculate the effective resistance.
Ans. Effective resistance R = r/n = 2/20 = 0.1 Ω
10. Three resistors of 2Ω, 3Ω, 6Ω are given in the class.
a. What is the highest resistance that you can get using all of them?
b. What is the least resistance that you can get using all of them?
c. Can you make resistance of 4.5Ω using these three. Draw the circuit.
Ans.a. Highest resistance is obtained when they are connected in series.
Hence $R = R_1 + R_2 + R_3 = 2+3+6 = 11\ \Omega$
b. Least resistance is obtained when they are connected in parallel.
Then $1/R = 1/R_1 + 1/R_2 + 1/R_3 = ½ + 1/3 + 1/6 = 18/18 = 1\ \Omega$
Or $R = 1\ \Omega$



c. If they are arranged as shown in the figure, 4.5 Ω can be made available.



11. A boy has many resistors of 2Ω each. He needs a circuit of 9 Ω resistance. For this draw a circuit with the minimum number of resistors.

Ans.

12. If 0.2 Ω, 0.3 Ω, 0.4 Ω, 0.5 Ω and 12 Ω resistors are connected to a 9V battery in parallel, what will be the current through the 12 Ω resistor?

Answer.As the resistors are connected in parallel, all the resistors will get 9V.

So current through 12 Ω resistor, I= V/R = 9/12 = 3/4 A = 0.75A

13. How many resistors of 176 Ω should be connected in parallel to get 5A current from 220V supply?

Answer. The required net resistance R = V/I = 220/5 = 44 Ω

When four 176 Ω resistors are connected in parallel, we get 44 Ω effective resistance.

14. Depict a figure showing the arrangement of three resistors in circuit to get an effective resistance of (I). 9 Ω and (ii). 4 Ω

Ans.