UNIT 1

Effects of Electric Current

01/06/2020 – Class 1

Activity 1

Observe the fig and list out the names of Electrical Appliances

1. Electric Bulb
2. Electric Fan
3. Mixie
4. Micro wave Oven
5. Electric Heater
6. Induction Cooker
7. Inverter

Activity 2

Device	Use	Energy Change
Electric Bulb	**To get light**	**Electrical energy to Light Energy**
Induction Cooker	**To get heat**	**Electrical energy to Heat Energy**
Storage Battery (while charging)	**To store electric charge**	**Electrical energy to Chemical Energy**
Mixie	**To get Mechanical energy**	**Electrical energy to Mechanical Energy**
Soldering Iron	**To get heat**	**Electrical energy to Heat Energy**
Electro Magnet	**To get magnetic energy**	**Electrical energy to Magnetic Energy**
Electric Motor	**To get mechanical energy**	**Electrical energy to Mechanical Energy**

Conclusion

1.Electrical Energy can be transformed into different forms of energy

2.The useful form of energy into which a device converts electrical energy is considered as the effect of electric current of that device.

Activity 3

Electrical devices and their Effects

Name of the device	Effects of electric current
Electric Bulb	**Lighting Effect**
Electric Heater	**Heating Effect**
Electric Motor	**Mechanical Effect**
Mobile Battery	**Chemical effect**
Electric Crane	**Magnetic Effect**
Soldering Iron	**Heating effect**
Induction Cooker	**Heating Effect**
Fan	**Mechanical Effect**

Heating Effect of Electric Current

Activity 4

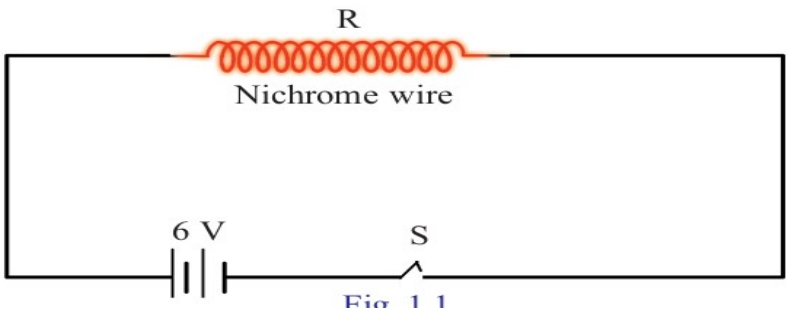


Fig. 1.1

Materials required:

- **A nichrome wire of approximate length 5 cm**
- **6 V storage battery**
- **Connection wires**

Construct a circuit as shown in fig.

Observation

When current is passed through the nichrome wire , it becomes red hot .

Inference

Here Electrical Energy is converted as Heat Energy

Some Factors must be remembered while studying about Electricity

Potential difference (Voltage) V

There should be a potential difference between two points of a conductor, if there is to be a flow of current between them . Current flows from a point of high electric potential to a point of low electric potential.

One Volt

If 1 joule of work is done to move one coulomb charge from one point to another, then the potential difference between the points is 1volt.

Unit of Potential difference – Volt (V)

Device is used to measure Potential difference – Voltmeter (It must be connected parallel in the circuit)

Electro motive force (emf)

Electromotive force (emf) is the ability to maintain the potential difference between the ends of a conductor .

emf of a Source of Current

The emf of a source of current is the potential difference between its ends when the source is in an open circuit. The emf of a cell is measured in the unit volt.

Electric Current (I)

Current or intensity of current is the quantity of charge that flows through a conductor in a circuit in one second .

Current (I) = Quantity of Charge (Q) / Time taken (t)

$$I = Q / t$$

Unit of current = ***Ampere (A)*** *{C/s}*

Device used to measure current = ***Ammeter*** *(It must be connected series in the circuit)*

Resistance (R)

Hindrance or obstacles to the flow of current is called Resistance .

Factors influencing the Resistance of a Conductor

1. Length of the Conductor – When length is increasing the resistance is also increasing

2. Area of cross section (thickness) - When thickness is increasing the resistance is decreasing .

3. Nature of the material – The resistance is varying according to the material . (Nichrome has higher resistance than aluminium)

4. Temperature - The resistance of metals increases with the increase in temperature.

Ohm's Law

When temperature remains constant, the current (I) through a conductor is directly proportional to the potential difference (V) between its ends. In other words the ratio of potential difference to the current is a constant.

$V \propto I$

$V = a \text{ constant } X \ I$

$V / I = a \text{ Constant (Resistance)}$

$R = V / I$

Resistivity (ρ)

Resistivity of a substance is the resistance of the conductor of unit length and unit area of cross section.

$$\rho = RA / l$$

$$\text{Unit} - \Omega m$$

04/06/2020 – Class 2

Activity 1

If 5 coulomb electric charge is flowing from the one end of a conductor to other end in 10 s. Then what will be the amount of charge flowing in one second .?

Amount of charge flowing in10 second = 5 C
Amount of charge flowing in one second = 5 C / 10 s = 0.5 C / s = 0.5 A

$$I = Q / t$$

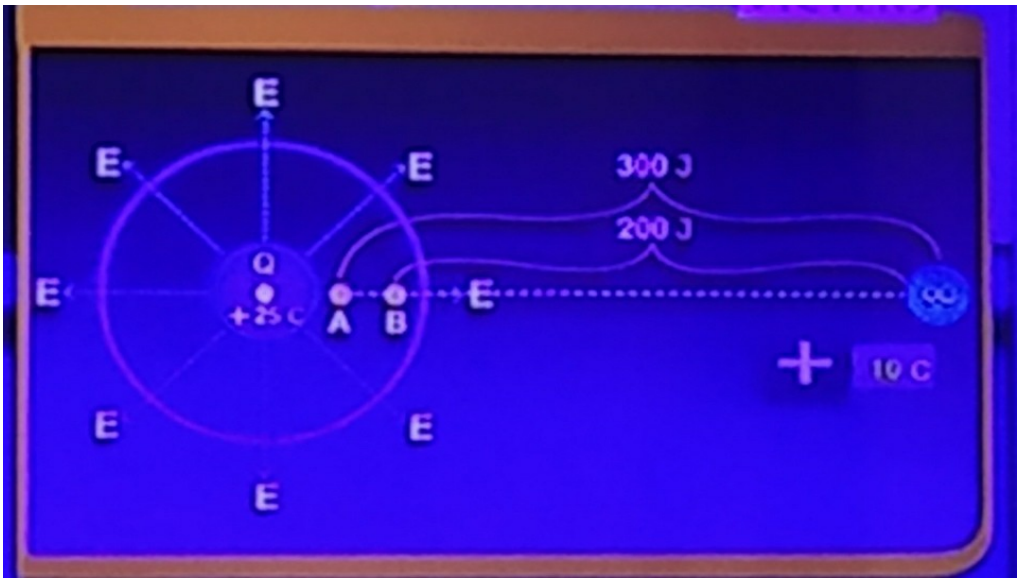
The amount of charge flowing in t second $Q = It$ ***Coulomb***

<u>Activity 2</u>

To raise an object , we must do work against gravitational force
To move any object against any force we must do work .The work done must be stored as Energy .

Work = Force X Displacement

<u>Activity 3</u>



Consider +25 C charge in a point . We must bring +10 C charge from infinity to that point . Consider two points A , and B near the +25 C charge

Let the work done will be 200 J for bringing +10 C charge from infinity to point B .

There for the potential of +10C charge at B is 200 J.

Let the work done will be 300 J for bringing the +10C charge from infinity to A .

so the work done to move +10 C charge from B to A = 300 - 200 = 100 J

There for the work done to move one coulomb charge from B to A = 100 J / 10 C = 10 J / C = 10 V

The amount of work done to move unit positive charge from one point to another point is the potential difference between that points . There for the potential difference between point A and B is 10 V

Potential difference (V) = Work (W) / Charge (Q)

$$V = W/ Q$$

If Charge Q = 1 C , and Work W = 1 J , then

$$V= 1 / 1 = 1 V$$

<u>One Volt</u>

The potential difference between two points will be one volt if one joule of work is done in moving one coulomb of charge from one point to the other.

$$V = W/ Q$$
$$W = QV$$

One joule of work is required to move one coulomb of charge under one volt potential difference.

Hence the work W to be done to move one coulomb of charge under a potential difference V will be, W = V joule.

If so, the work to be done to move a charge Q under a potential difference V is

$$W = QV$$

The work required for moving the electric charge through the conductor is done by the battery connected to the circuit.

The power P supplied by the battery to the circuit in a time t second is

$$P = W / t$$

Substituting the value of W = QV in the above equation .

$$P = V Q / t$$

But I = Q / t , substituting this value in the above equation ,

$$P = VI$$

$P = W / t$, so $W = Pt$

Therefore the energy supplied by the battery to the circuit in t second
$= P t = V I t$

The electrical energy expended by the battery in the circuit containing the nichrome wire is converted into heat.

Therefore $H = V I t$

According to ohm's law V = IR , substituting this value on the above equation ,

$$H = IR(It) = I^2Rt$$

Why Nichrome becomes red hot when current is passing ?

From the above equation it is clear that , when the Resistance (R) is increasing more heat is produced . The resistance of Nichrome wire is more , so more heat is produced and nichrome becomes red hot.

Joule Heating or Ohmic Heating.

The process by which heat is developed in a circuit on passing current through it is known as the Joule Heating or Ohmic Heating.

Activity 4

According to Ohm's law I = V / R , Substituting this value of I in the equation $H = I^2Rt$

$$H = (V/R)^2 Rt$$

$$H = \left(\frac{V}{R}\right)^2 Rt \qquad = V^2 t / R$$

Inference

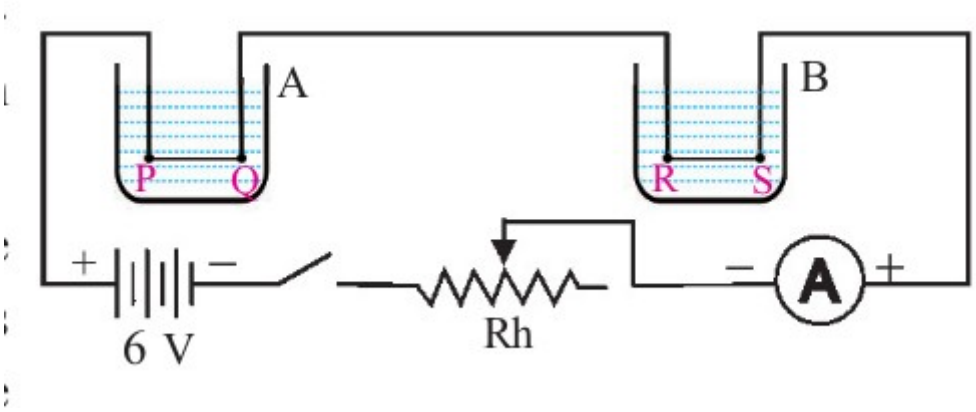
Equations to find heat produced in a conductor due to the flow of current

$$H = V I t$$
$$H = I^2Rt$$
$$H = V^2t / R$$

H = Heat , V = Voltage , I = Current , R = Resistance , t = Time

Activity 5 .a

Observe the video



A and B are two beakers of 200 mL capacity. Each beaker contains 100 mL of water. PQ is a nichrome wire. RS is a copper wire of the same length and diameter as the nichrome wire. Measure the temperature of water in the beakers A and B using a thermometer . Measure the temperatures of water in the two beakers after three minute.

Observation

After three minutes .

Temperature of beaker A (Nichrome wire is placed) = 36 ^{0} C

Temperature of beaker B (Copper wire is placed) = 33 ^{0} C

Inference

a. Current flowing through both the wire are same.

b. Nichrome is heated more, because it has more resistance .

c . Heat is directly proportional to resisrtance

$$H \propto R$$

Activity 5 . b

Take 100 ml of water at 30 ^{0} C on each beaker. Increase the current to 2 A . Switch on the circuit for three minutes. Again measure the temperatures.

Observation

After three minutes .

Temperature of beaker A (Nichrome wire is placed) = 40 ^{0} C

Inference

a. When current in the circuit is increasing more heat is produced .

b. Heat is directly proportional to the square of the current (I)

$$H \propto I^2$$

Activity 5.c .

Increase the time for passing current to 5 minutes , and measure the temperature .

Observation

After Five minutes .

Temperature of beaker A (Nichrome wire is placed) = 44 ^{0} C

Temperature of beaker B (Copper wire is placed) = 37 ^{0} C

Inference

a*. When time (t) is increasing more heat is produced .*

$$H \propto t$$

Combine the above inferences we get Joule's Law

Joule's Law

The heat generated (H) in a current carrying conductor is directly proportional to the product of the square of the current (I) in the conductor, the resistance of the conductor (R) and the time (t) of flow of current.

$H \propto I^2Rt$ $\quad\quad$ $\therefore H = I^2Rt$ joule

I is the current in ampere, R is the resistance in ohm and t is the time in second.

Assignments

Complete the following table on the basis of Joule's Law.

Resistance of conductor R (Ω)	Intensity of Current I (A)	Time for which current flows t (s)	Heat generated I^2Rt (J)	Change in Heat (H)
2 R	I	t	2 I^2Rt	Twice (2H)
R	2 I	t	.....	.....
R/2	I	t	.....	.....
R	I/2	t	.....	.....
R	I	2t	.....	.....
R	I	t/2	.....	.....

Table 1.2

Answer of Assignments

പ്രതിരോധം R (Ω)	വൈദ്യുത പ്രവാഹത്തിന്റെ തീവ്രത I (A)	വൈദ്യുതി പ്രവഹിച്ച സമയം	ഉല്പാദിപ്പിക്കപ്പെട്ട താപം H(J)	താപത്തിൽ വന്ന മാറ്റം (H)
2 R	I	t	$2I^2Rt$	2 മടങ്ങ് (2H)
R	2I	t	$4I^2Rt$	നാല് മടങ്ങ് (4H)
R/2	I	t	$I^2Rt/2$	പകുതി ആകുന്നു (H/2)
R	I/2	t	$I^2Rt/4$	നാലിൽ ഒന്നായി കുറയുന്നു (H/4)
R	I	2t	$2I^2Rt$	2 മടങ്ങ് (2H)
R	I	t/2	$I^2Rt/2$	പകുതി ആകുന്നു (H/2)

15/06/2020 – Class 3

Activity 1

List the name of some heating devices used in our home.

1. Electric Iron
2. Electric water heater
3.Immersion Heater
4. Room Heater
5. Soldering Iron

Activity 2

How heat is produced in the heating devices ?

Discussion

- *What is the energy change in such devices ?* ***Electrical energy to heat energy***
- *Through which part is electricity given to such devices ?* ***Conducting wires***
- *Which is the part that gets heated ?* ***Heating coil***
- *Are there any parts designed to get heated ? If so which are they ?* ***Heating coil***

Conclusion

Heating Coil

- ***The part of a heating device which converts electrical energy to heat energy is called heating coil .***
- ***Heating coils is made of Nichrome. Nichrome is an alloy of Nickel , Chromium and Iron.***
- ***When electricity is passed through the heating coil , electrical energy is converted into heat energy .***

Why Nichrome is made as a coil , when it is used as heating element in a heating device ?

A very thin wire with very long length can only be accommodated in a small area when it is coiled . Resistance of a conductor is directly proportional to it's length. So by adjusting the length of the heating coil we can control the heat energy produced by the device .

What advantages of nichrome are made use of in electric heating appliances ?

- *High resistivity*
- *High melting point*
- *Ability to remain in red hot condition for a long time without getting oxidised.*
- *Sufficient ductility .*

Heating devices without heating coil

- *Induction cooker (use eddy current to produce heat)*
- *Microwave oven (Use microwaves to get heat)*

Activity 3

Observe the video

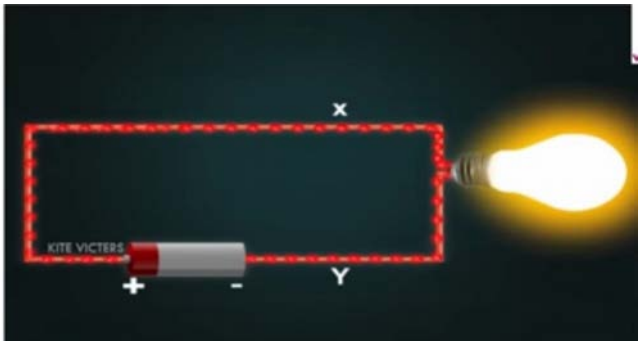


Fig. 1

A circuit is created as shown in fig 1.

Observation – ***Bulb is glowing***

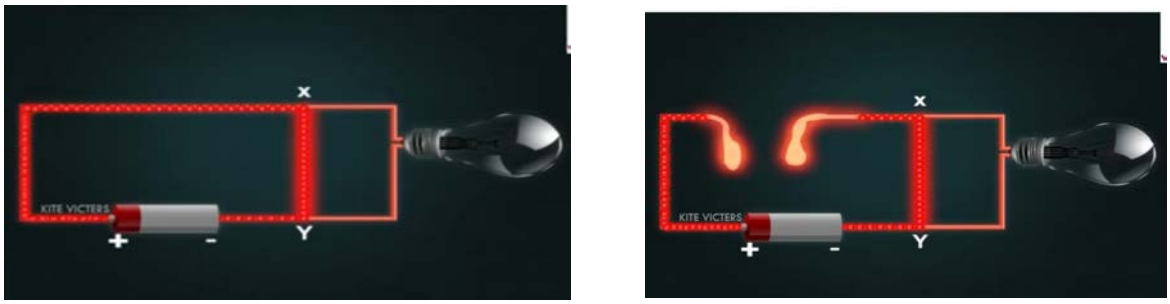


Fig 2

Using a conducting wire connects the points X and Y as shown in fig 2 . So a low resistance path is created through XY.

Observation – ***The bulb is turned off . The current in the circuit is increased and the conductor wire is heated and melt.***

Inference

When we connect X and Y , a low resistance path is created and current in the circuit is increased and more heat is produced .

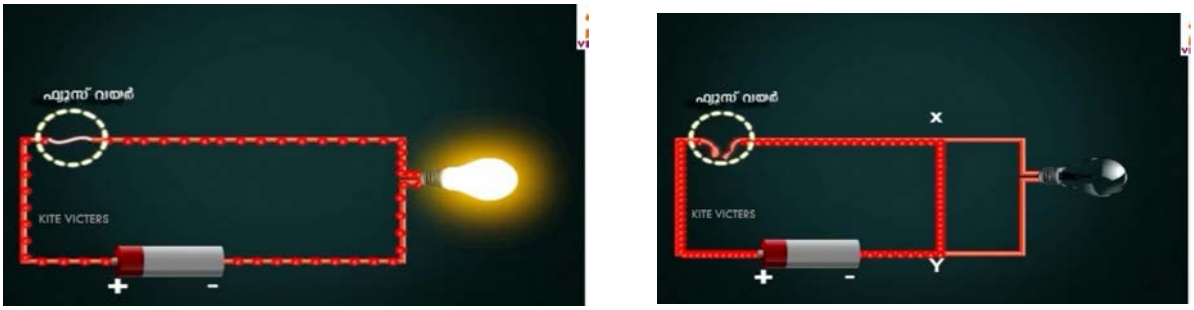


Fig 3

A fuse wire is connected in the circuit as shown in the fig 3

Observation – ***When we connect X and Y using a conductor , the fuse wire melt and break the circuit .***

Features of Fuse wire

- *Fuse wire is an alloy of tin and lead.*
- *Fuse wire has low melting point*

Inference

Short Circuit

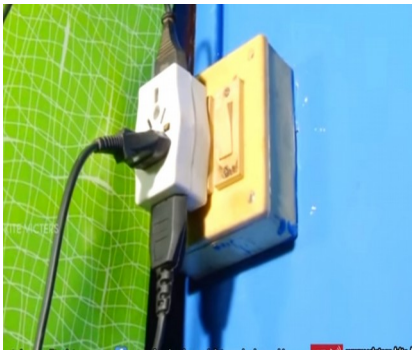
If the positive and the negative terminals of a battery or the two wires from the mains come into contact without the presence of a resistance in between, they are said to be short-circuited.

Main reason for Short Circuit

Insulation failure.

Activity 4

Observe the fig .



We use Multi Pin Sockets to connect more devices in the circuit . While doing that what happened to the power and current in the circuit ?

The current and power in the circuit is increasing .

Inference

Over loading

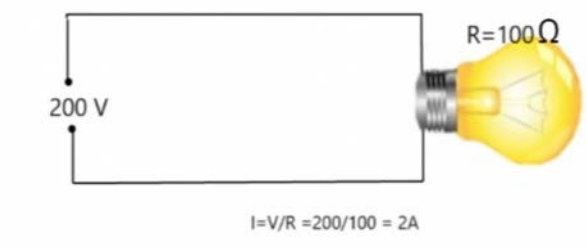
A circuit is said to be overloaded if the total power of all the appliances connected to it is more than what the circuit can withstand.

Activity 5.

Why current is increasing during short circuit

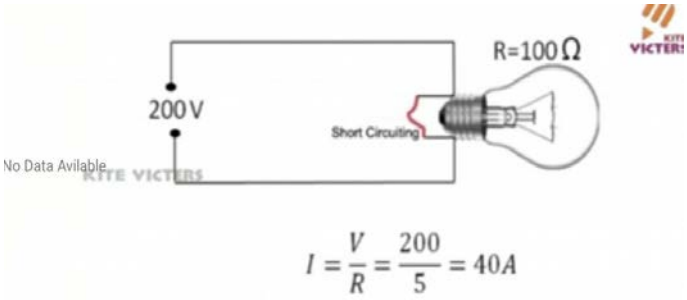
Observe the fig .

200 V is applied to a bulb with resistance 100 Ω.



The current in the circuit I = V / R = 200/ 100 = 2 A

Connect a conducting wire of resistance 5 Ω. in between the terminals of bulb as shown in the fig .



observation

Current doesn't flow through the bulb . Because current flows through the low resistance conducting wire .

Now the current I = V / R = 200 / 5 = 40 A

Inference

During short circuit the resistance in the circuit is decreasing , so current is increasing.

Conclusion

During over loading and short circuit current in the circuit is increasing.

Activity 6

Parts of Safety Fuse

1. *Porcelain Socket*
2. *Fuse carrier*
3. *Fuse wire – which is connected on the fuse carrier.*

Which are the circumstances that cause high electric current, leading to the melting of fuse wire?

- ***Short Circuit***
- ***Over loading***

Safety Fuse

Safety fuse is a device which protects us and the appliances from danger when an excess current flows through the circuit.

Current is always flowing through the fuse wire . But it doesn't melts all the time , why ?

During the entire time of the passing of current through a circuit, a small amount of heat is generated in the fuse wire. But this heat will be transmitted to the surroundings. So fuse wire doesn't melt.

How safety fuse ensure safety to the circuit and appliances ?

When the current that flows into the circuit exceeds the permissible limit, the heat generated becomes excessive. Since more heat is generated in unit time than the heat transmitted. Because of it's low melting point the fuse wire melts and break the circuit .

When a fuse wire is included in a household wiring, what are the precautions to be taken?

- ***The ends of the fuse wire must be connected firmly at appropriate points.***
- ***The fuse wire should not project out of the carrier base***
- ***Use fuse wire of appropriate amperage .***
- ***Fuse wire is connected in series .***

Amperage

Amperage (A) is the ratio of the power of an equipment to the voltage applied. Amperage increases with the thickness of the conductor ***.***

Amperage = Power / Voltage

Assignments

In the fig . A cartridge type of fuse is given

1. Name the devices which used this type of fuse and find there amperages ?

17/06/2020 – Class 4

Activity 1

Solving mathematical problems using equations of Joule's law .

Equations to find heat in a current carrier conductor

$$H = I^2 R t$$
$$H = V I t$$
$$H = V^2 t / R$$
$$H = P X t$$

Question 1

How much will be the heat developed if 0.2 A current flows through a conductor of resistance 200 Ω for 5 minute?

I = 0.2 A
R = 200 Ω
t = 5 X 60 = 300 s
$H = I^2Rt = 0.2 X 0.2 X 200 X 300$
$= 0.04 X 200 X 300$
$= 2400 . 00$
$= 2400 J$

Question 2

How much will be the heat developed in in a bulb of resistance 920 Ω working for 3 minute at 230 V ?

R = 920 Ω
V = 230 V
t = 3X60 =180 s
$H = V^2t / R = 230 X 230 X 180 / 920 = 10350 J$

Another Method

R = 920 Ω
V = 230 V
t = 3X60 =180 s
$I = V / R = 230 / 920 = 1 / 4 = 0.25 A$
$H = I^2Rt = 0.25 X 0.25 X 920 X 180 = 10350 J$

Assignments

1. Solve the above problem using the equation ***H = V I t*** *,*

2. Details of two electric heaters are given below. How much will be the heat developed if they are made to work for 5 minute each? Is there any difference in the heat developed ? If so give reason ?

Heater - A		Heater - B	
Working voltage	: 230 V	Working voltage	: 230 V
Resistance	: 1150 Ω	Resistance	: 460 Ω
Working time	: 5 minute	Working time	: 5 minute

3 . 0.5 A current flows though an electric heating device connected to 230 V supply.

(a) the quantity of charge that flows through the circuit in 5 minute is

(i) 5 C (ii) 15 C (iii) 150 C (iv) 1500 C

(b) How much is the resistance of the circuit?

(c) Calculate the quantity of heat generated when current flows in the circuit for 5 minute.

4 . According to Joule s Law the heat generated due to the flow of current is H = I 2 Rt. Will the heat developed increase on increasing the resistance without changing the voltage? Explain.

22/06/2020 – Class 5

Activity 1

Discuss about the previous class assignment answer

Heater - A		Heater - B	
Working voltage	: 230 V	Working voltage	: 230 V
Resistance	: 1150 Ω	Resistance	: 460 Ω
Working time	: 5 minute	Working time	: 5 minute
$H = \frac{V^2t}{R}$		$H = \frac{V^2t}{R}$	
$= \frac{230^2 \times 300}{1150}$		$= \frac{230^2 \times 300}{460}$	
$= 13800$ J		$= 34500$ J	

- Which heater produce more heat? **Heater B**
- The voltage given to both the heaters? **(230 V)**
- Working time for both the heaters? **(5 minutes)** .

- The resistances of heaters ? . (**Heater A = 1150 Ω , Heater B = 460 Ω)**

From Joule's law ***(H = I^2Rt)*** when the resistance is increasing the heat energy produced is also increasing.

- But, here Heater B , with low resistance produces more Heat . Why ?

Calculate the current flowing through both the heaters using ohm's law .

Heater A	***Heater B***
V = 230 V , R = 1150 *Ω* *V = IR* *I = V / R = 230 V / 1150 Ω = **0.2 A***	V = 230 V , R = 460 *Ω* *V = IR* *I = V / R = 230 V / 460 Ω = **0.5 A***

Inferences

- *Current flowing through Heater A = **0.2 A***
- *Current flowing through Heater B = **0.5 A***
- *More current is flowing through **Heater B** , (with low resistance)*
- *Heater B produces more heat , because more current is flowing through it.*

Conclusion

- ***From Joule's law H = I^2Rt , heat is directly proportional to square of the current .***
- ***So when current is increasing more heat is produced .***

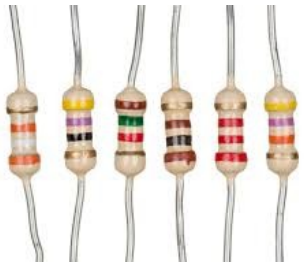
What is the relation between heat produced and Resistance .

From Joule's Law H = I^2Rt

- *If current (I) is constant, then heat is directly proportional to resistance . (H ά R)*
- *Otherwise Heat is inversely proportional to resistance*

Activity 2

Resistors



For the working of electrical appliances , we must regulate current and voltage .For doing that we include resistors in the circuit .
The value of resistance is measured using colour code .

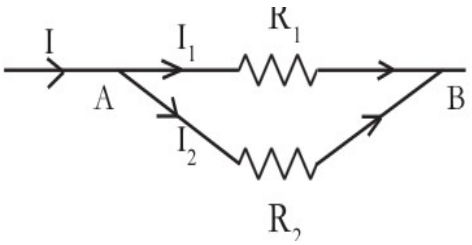
How the voltage and current changes when resistors are arranged in different ways in circuits.

Series Method

When a circuit is completed by connecting the resistors one after the other, it is called series connection.

Parallel Method

In parallel method the ends of resistors are commonly connecting together at points A and B as shown in the fig. .



During series & parallel connection how current and potential difference are changing .

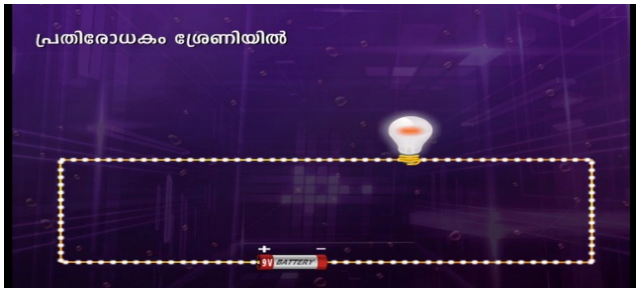
Activity 3

Scanned the QR code and find the features of series connection.

9YHTUH

Activity 3.a

A cell of 9 V is connected to a bulb .

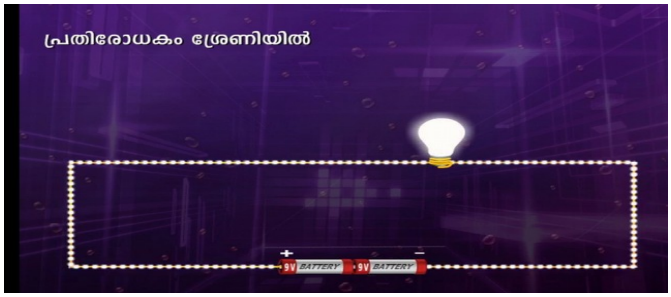


Observation

Bulb is glowing with less brightness

Activity 3.b

One more cell is included in the circuit



Observation

- *Voltage and current is increased .*
- *Brightness of bulb is increased.*

Activity 3.c

Replace the bulb by a 5 Ω resistor , an ammeter is also included in the circuit to measure current .

Observation

*Ammeter reading (Current in the circuit) = **1.8 A***

Activity 3.d

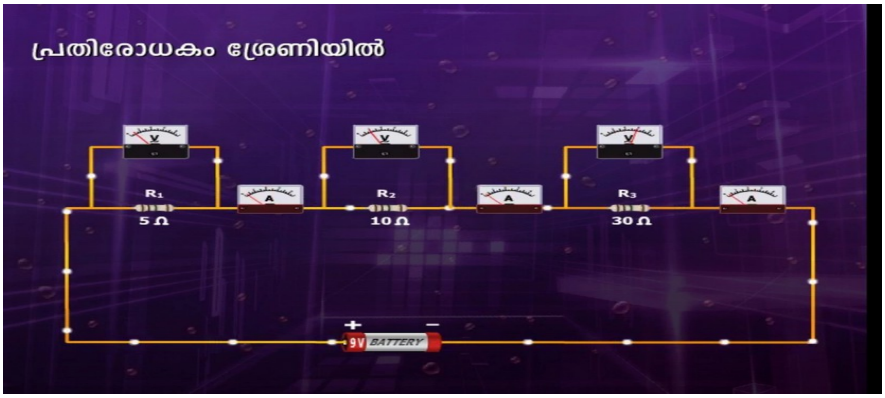
Another resistor of 10 Ω is connected series to the 5 Ω resistor .

Observation

- *Current in the circuit = **0.6 A***
- *current is decreased when another resistor is added in the circuit .*

Activity 3.e

Another resistor of 30 Ω is added in the circuit .



Observation

- *Current in the circuit = **0.2A** (current is again decreased)*
- *All the three ammeter shows same reading . (Same current is flowing through all the resistors)*
- *All three voltmeters shows different reading . (Voltages are different for different resistors)*
- *Voltmeter across 30 Ω resistor shows higher value and voltmeter across 5 Ω resistor shows lower value .(Voltage is high for high resistance and low for low resistance)*
- *Voltage is divided*

How to calculate effective resistance (total resistance) in series connection

If the effective resistance in the circuit is R , and current in the circuit is I , then

Potential difference across R_1 is $V_1 = IR_1$

Potential difference across R_2 is $V_2 = IR_2$

Potential difference across R_3 is $V_3 = IR_3$

Total Voltage $V = IR$

$$V = V_1 + V_2 + V_3$$

$$IR = IR_1 + IR_2 + IR_3$$

$$IR = I(R_1 + R_2 + R_3)$$

$$R = R_1 + R_2 + R_3$$

Effective Resistance in series connection , $R = R_1 + R_2 + R_3$

In series connection the effective resistance increasing.

Activity 4

Experiment

Three 40 W bulbs are connected in series . Switches are turned on .

Observation

- Bulbs are glowing with less brightness .
- All bulbs are glowing with same intensity .

Activity 4 .b

One 40 W, bulb alone is connected in a circuit .

Observation

- Bulb is glowing with more intensity .

Discussion

Why the intensity is decreasing when the bulbs are connected in series?

- What is the apply voltage in both the situations ? **230 V**
- Is bulbs offers resistance to the current? **Yes**
- When bulbs are connected in series what happened to the total resistance in the circuit ? **Increased**
- What happened to the current in the circuit ? **Decreased**
- Is the current is same for all bulbs? **Yes**

Inference

- **When bulbs are connected in series the effective resistance in the circuit is increased.**
- **Current is decreased.**
- **Intensity of bulb is decreased.**

Activity 5

Repeat the experiment using bulbs of different powers . 40W , 60 W, 100 W , bulbs are connected in series .

Observation

- All bulbs are glowing with different intensities.
- 40 W bulb is glowing with more intensity
- 60 W bulb is glowing with less intensity.
- 100 W bulb is glowing with least intensity.

Discussion

Why bulbs are glowing with different intensities ?

- Which bulb has more resistance ? **40 W**
- Which bulb has least resistance ? **100 W**
- What is the applied voltage in the circuit? **230 V**
- What about the current in the circuit ? **Same current is flowing through all bulbs**.

Inference

- According to Ohm's law V = IR
- If current is same, then bulb with highest resistance (40 W) getting more voltage .
- Bulb with lowest resistance (100 W) getting less voltage .

Conclusion

- In series connection bulbs with less power (more resistance) is glowing with more intensity.
- Bulbs with more power (less resistance) is glowing with less intensity.

Activity 5

If the voltage in the first bulb $\mathbf{V_1}$ second bulb V_2 and third bulb V_3

Effective Voltage $V = V_1 + V_2 + V_3$

From ohm's law $\mathbf{V = IR}$

$$V_1 = IR_1$$
$$V_2 = IR_2$$
$$V_3 = IR_3$$

If ***R*** *is the effective resistance , and* ***V*** *is the effective potential difference of the circuit ,*

$$V = IR$$
$$IR = IR_1 + IR_2 + IR_3$$
$$IR = I\,(R_1 + R_2 + R_3)$$
$$R = R_1 + R_2 + R_3$$

Conclusion

When resistors are connected in series effective resistance is the sum of individual resistances . $R = R_1 + R_2 + R_3$

Eg*. If* $2\ \Omega, 4\ \Omega, 6\ \Omega$ *resistors are connected in series. Find the effective resistance in the circuit .*

$$R = R_1 + R_2 + R_3$$
$$= 2 + 4 + 6 = 12\ \Omega$$

Summary

When Resistors are connected in series

- *Effective resistance is increasing.*
- *Current is decreasing.*
- *Current is same for all devices .*
- *Voltage is divided among various devices according to their resistance.*
- *Total voltage is the sum of individual voltages of devices.*

Assignments

1. What is the current if 4 Ω *and 2* Ω *resistors are connected in series and 6 V potential difference is applied ?*

UNIT 1

വൈദ്യുതപ്രവാഹത്തിന്റെ ഫലങ്ങൾ

29/06/2020 – Class 6

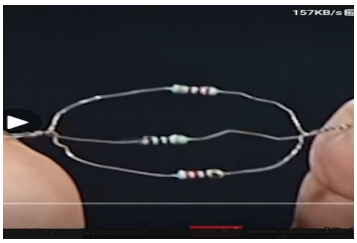
Activity 1

Answer of Assignments

1. 4 Ω , 2 Ω പ്രതിരോധകങ്ങളെ ശ്രേണിയിൽ 6 V ബാറ്ററിയുമായി ബന്ധിപ്പിച്ചാൽ സർക്യൂട്ടിലെ കറന്റ് കാണുക?

R_1 = 4 Ω , R_2 = 2 Ω, V = 6 V
R= R_1 + R_2 = 4 + 2= 6 Ω
I = V / R = 6 / 6 = 1 A

Activity 2



പ്രതിരോധകങ്ങൾ സമാന്തരമായി

ചർച്ച

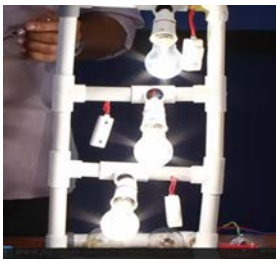
ചിത്രത്തിൽ കാണുന്നതുപോലെ മൂന്ന് പ്രതിരോധകങ്ങളെ ബന്ധിപ്പിച്ചിരിക്കുന്നു.

- പ്രതിരോധകങ്ങളുടെ ഈ രീതിയിലുള്ള ക്രമീകരണത്തിന്റെ പേരെന്ത്? **സമാന്തര രീതി**
- ഈ രീതിയിൽ പ്രതിരോധകങ്ങളുടെ സ്വതന്ത്ര അഗ്രങ്ങൾ എങ്ങനെയാണ് ബന്ധിപ്പിച്ചിരിക്കുന്നത് ? **പൊതുവായി ഒരുമിച്ച് ഒരു ബിന്ദുവിൽ ബന്ധിപ്പിച്ചിരിക്കുന്നു.**
- 6 V ന്റെ ഒരു സെല്ല് പൊതുവായ അഗ്രങ്ങൾക്കിടയിൽ ബന്ധിപ്പിച്ചാൽ ഒന്നാമത്തെ പ്രതിരോധകത്തിന്റെ അഗ്രങ്ങൾക്കിടയിലെ വോൾട്ടേജ് എത്രയാണ് ? **6V**
- മറ്റ് രണ്ട് പ്രതിരോധകങ്ങൾക്ക് ലഭിക്കുന്ന വോൾട്ടേജ്എത്രയാണ് ? **6 V**

നിഗമനം

പ്രതിരോധകങ്ങളെ സമാന്തരമായി ബന്ധിപ്പിക്കുമ്പോൾ എല്ലാ പ്രതിരോധകങ്ങൾക്കും ഒരേ വോൾട്ടേജ് ലഭിക്കുന്നു. (നൽകുന്ന വോൾട്ടേജ് തന്നെ)

Activity 3.a



40 W ന്റെ മൂന്ന് ബൾബുകളെ സമാന്തരമായി ബന്ധിപ്പിച്ച് സ്വിച്ചുകൾ ഓൺ ചെയ്യുന്നു.

നിരീക്ഷണം

മൂന്ന് ബൾബുകളും ഒരേ തീവ്രതയിൽ പ്രകാശിക്കുന്നു.

Activity 3.b

40 W ന്റെ ഒരു ബൾബ് മാത്രം പ്രത്യേകം സർക്യൂട്ടിൽ ബന്ധിപ്പിച്ച് പ്രകാശിപ്പിക്കുന്നു.

നിരീക്ഷണം

സമാന്തര രീതിയിൽ പ്രകാശിപ്പിച്ച ബൾബുകളുടെ അതേ തീവ്രതയിൽ ബൾബ് പ്രകാശിക്കുന്നു.

ചർച്ച

- പ്രത്യേകം ബന്ധിപ്പിച്ച ബൾബിന് നൽകിയ വോൾട്ടേജ് എത്രയാണ്? **230 V**
- ബൾബുകൾ സമാന്തരമായി ബന്ധിപ്പിച്ചപ്പോൾ നൽകിയ വോൾട്ടേജ് എത്രയാണ്? **230 V**
- ഒന്നാമത്തെ ബൾബിന് ലഭിച്ച വോൾട്ടേജ് എത്രയാണ്? **230 V**
- മറ്റ് രണ്ട് ബൾബുകൾക്കും ലഭിച്ച വോൾട്ടേജ് എത്രയാണ് ? **230 V**

നിഗമനം

സമാന്തരമായി ബന്ധിപ്പിക്കുമ്പോൾ എല്ലാ ബൾബുകൾക്കും ഒരേ വോൾട്ടേജ് ലഭിക്കുന്നു .

Activity 4

സർക്യൂട്ടിലെ ഓരോ സ്വിച്ചുകളും ഒന്നിനു പിറകെ മറ്റൊന്നായി ഓഫ് ചെയ്യുന്നു.

ഒരു സ്വിച്ച് മാത്രം ഓഫ്

രണ്ട് സ്വിച്ചുകൾ ഓഫ്

മൂന്ന് സ്വിച്ചും ഓഫ്

നിരീക്ഷണം

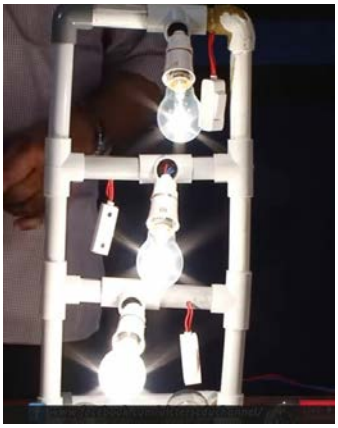
ഓരോ സ്വിച്ചുകളും ഓഫ് ചെയ്യുമ്പോൾ ആ ബൾബുകൾ മാത്രം ഓഫാകുന്നു. മറ്റ് ബൾബുകൾ പ്രകാശിക്കുന്നു

നിഗമനം

- **വൈദ്യുത ഉപകരണങ്ങൾ സമാന്തരമായി ബന്ധിപ്പിക്കുമ്പോൾ പ്രത്യേക സ്വിച്ചുകൾ ഉപയോഗിച്ച് അവയെ നിയന്ത്രിക്കാം.**
- **ഗൃഹവൈദ്യുത സർക്യൂട്ടിൽ ഉപകരണങ്ങൾ സമാന്തരമായാണ് ബന്ധിപ്പിച്ചിരിക്കുന്നത്.**

Activity 5

40 W, 60 W, 100 W ന്റെ ഓരോ ബൾബുകൾ സമാന്തരമായി ബന്ധിപ്പിച്ച് സ്വിച്ചുകൾ ഓൺ ആക്കുന്നു.



നിരീക്ഷണം

- ഓരോബൾബും അതിന്റെ പവറിനനുസരിച്ച് പ്രകാശിക്കുന്നു.
- 100 W ബൾബ് കൂടുതൽ തീവ്രതയിൽ പ്രകാശിക്കുന്നു .

- 60 W ബൾബ് 100 W ബൾബിനെക്കാൾ കുറഞ്ഞ തീവ്രതയിൽ പ്രകാശിക്കുന്നു.
- 40 ബൾബ് ഏറ്റവും കുറഞ്ഞ തീവ്രതയിൽ പ്രകാശിക്കുന്നു.

നിഗമനം

എല്ലാ ബൾബുകൾക്കും ഒരേ വോൾട്ടേജ് ലഭിക്കുന്നു

ചർച്ച

- ഒരു ബൾബിന്റെ പ്രതിരോധവും പവറും തമ്മിലുള്ള ബന്ധമെന്താണ് ?

  കുറഞ്ഞ പവറുള്ള ബൾബിന് പ്രതിരോധം കൂടുതലാണ്.

  കൂടിയ പവറുള്ള ബൾബിന് പ്രതിരേധം കുറവാണ്.

- ഏത് ബൾബിനാണ് പ്രതിരോധം കൂടുതൽ? **40 W**
- ഏത് ബൾബിനാണ് പ്രതിരോധം കുറവ് ? **100 W**
- ഏത് ബൾബിലൂടെയാണ് കൂടിയ കറന്റ് പ്രവഹിക്കുന്നത്? **100 W (കുറഞ്ഞ പ്രതിരോധമുള്ള)**
- ഏത് ബൾബിലൂടെയാണ് കുറഞ്ഞ കറന്റ് പ്രവഹിക്കുന്നത് ? **40 W (കൂടിയ പ്രതിരോധമുള്ള)**

Activity 6.a

സമാന്തര രീതിയിലെ കറന്റ്

ഒന്നാമത്തെ ബൾബിന്റെ പ്രതിരോധം 50 Ω ഉം രണ്ടാമത്തെ ബൾബന്റേത് 25 Ω ഉം മൂന്നാമത്തെ ബൾബിന്റേത് 10 Ω ഉം ആണെന്ന് സങ്കൽപ്പിക്കുക. സർക്യൂട്ടിൽ നൽകുന്ന വോൾട്ടേജ് 100 V ഉം ആയാൽ ഓരോ ബൾബിലൂടെയും പ്രവഹിക്കുന്ന കറന്റ് കാണുക ?

ഒന്നാമത്തെ ബൾബ്

$V = 100\ V$
$V = I_1\ R_1$
$100 = I_1 \times 50$
$I_1 = 100/50 =$ **2 A**

രണ്ടാമത്തെ ബൾബ്

$V = 100\ V$
$V = I_2\ R_2$
$100 = I2 \times 25$
$I_2 = 100/25 =$ **4 A**

മൂന്നാമത്തെ ബൾബ്

$V = 100\ V$
$V = I_3\ R_3$
$100 = I_3 \times 10$
$I_3 = 100/10 =$ **10 A**

നിഗമനങ്ങൾ

- പവർ കൂടിയ ബൾബിലൂടെ കൂടുതൽ കറന്റ് പ്രവഹിക്കുന്നു. (പ്രതിരോധം കുറഞ്ഞ)
- പവർ കുറഞ്ഞ ബൾബിലൂടെ കുറഞ്ഞ കറന്റ് പ്രവഹിക്കുന്നു. (പ്രതിരോധം കൂടിയ)
- ഓരോ ബൾബുകൾക്കായി കറന്റ് വിഭജിക്കപ്പെടുന്നു.

Activity 6.b

സർക്യൂട്ടിൽ പ്രവഹിക്കുന്ന കറന്റ് $I = I_1 + I_2 + I_3$

ഓം നിയമം അനുസരിച്ച് , $I = V/R$

$$I_1 = V / R_1$$
$$I_2 = V / R_2$$
$$I_3 = V / R_3$$
$$I = I_1 + I_2 + I_3$$

V സർക്യൂട്ടിൽ നൽകിയ വോൾട്ടേജും **R** സഫലപ്രതിരോധവും ആയാൽ,

$$V/R = V/R_1 + V/R_2 + V/R_3$$
$$V/R = V (1/ R_1 + 1/ R_2 + 1/R_3)$$

രണ്ടു വശത്തുമുള്ള V ക്യാൻസൽ ആയാൽ,

$$I/R = 1/R_1 + 1/R_2 + 1/ R_3$$

നിഗമനം

പ്രതിരോധകങ്ങളെ സമാന്തരമായി ബന്ധിപ്പിച്ചാൽ,

$$\mathbf{I/R = 1/R_1 + 1/R_2 + 1/ R_3}$$

സഫല പ്രതിരോധത്തിന്റെ വ്യൽക്രമം എന്നത് ഓരോ പ്രതിരോധകത്തിന്റെയും വ്യൽക്രമങ്ങളുടെ തുകയ്ക്ക് തുല്യമാണ്.

Activity 7

രണ്ട് പ്രതിരോധകങ്ങളെ മാത്രം സർക്യൂട്ടിൽ ഉൾപ്പെടുത്തിയാൽ,

$$I/R = 1/R_1 + 1/R_2$$
$$1 / R = \frac{R_1 + R_2}{R_1R_2}$$

$$\mathbf{R = \frac{R_1R_2}{R_1 + R_2}}$$

Activity 7.b

2 Ω, 4 Ω പ്രതിരോധകങ്ങളെ സമാന്തരമായി ബന്ധിപ്പിച്ചാൽ സഫല പ്രതിരോധം കാണുക?

$R_1 = 2\ \Omega, R_2 = 4\ \Omega$
$I/R = 1/R_1 + 1/R_2$
$= 1/2 + 1/4$
$= 6/8 = 3/4$
$R = 4 / 3 = 1.33\ \Omega$

- സർക്യൂട്ടിലെ കുറഞ്ഞ പ്രതിരോധം എത്രയാണ്? **2Ω**
- സർക്യൂട്ടിലെ സഫല പ്രതിരോധം എത്രയാണ്? **1.33Ω**

നിഗമനം

പ്രതിരോധകങ്ങളെ സമാന്തര രീതിയിൽ ബന്ധിപ്പിക്കുമ്പോൾ സഫല പ്രതിരോധം, ആ സർക്യൂട്ടിലുള്ള ഏറ്റവും കുറഞ്ഞ പ്രതിരോധകത്തിന്റെ പ്രതിരോധത്തേക്കാൾ കുറവായിരിക്കും..

Activity 8

മൂന്ന് 2 Ω പ്രതിരോധകങ്ങളെ സമാന്തരമായി ബന്ധിപ്പിച്ചാൽ സർക്യൂട്ടിലെ സഫല പ്രതിരോധം കാണുക?

$I/R = 1/R_1 + 1/R_2 + 1/R_3$

$1/R = 1/2 + 1/2 + 1/2 = 3/2$

$R = 2/3\ \Omega$

ഇവിടെ **3** എന്നത് പ്രതിരോധകങ്ങളുടെ എണ്ണവും **(n)**,2 എന്നത് ഒരു പ്രതിരോധകത്തിന്റെ പ്രതിരോധവും**(r)** ആയാൽ

നിഗമനം

r Ω പ്രതിരോധമുള്ള **n** പ്രതിരോധകങ്ങളെ സമാന്തരമായി ബന്ധിപ്പിച്ചാൽ,

സഫല പ്രതിരോധം **R = r/n**

Activity 9

3 Ω ന്റെ പത്ത് പ്രതിരോധകങ്ങളെ സമാന്തരമായി ബന്ധിപ്പിച്ചാൽ സഫല പ്രതിരോധം കാണുക?

ഇവിടെ, n= 10 , r= 3 Ω

R= r/n = 3/10 = **0.3 Ω**

ക്രോഡീകരണം

പ്രതിരോധകങ്ങളെ സമാന്തരമായി ബന്ധിപ്പിക്കുമ്പോൾ,

- സഫല പ്രതിരോധം കുറയുന്നു
- കറന്റ് കൂടുന്നു.
- ഓരോ പ്രതിരോധകത്തിലൂടെയും ഒഴുകുന്ന കറന്റ് വ്യത്യസ്തമാണ്. (കുറഞ്ഞ പ്രതിരോധകത്തിലൂടെ കൂടിയ കറന്റ് ഒഴുകുന്നു)
- ഓരോ പ്രതിരോധകത്തിനുമായി കറന്റ് വിഭജിക്കപ്പെടുന്നു.
- ഓരോ പ്രതിരോധകത്തിലൂടെയും ഒഴുകുന്ന കറന്റുകളുടെ തുകയായിരിക്കും സർക്യൂട്ടിലെ ആകെ കറന്റ്.
- എല്ലാ പ്രതിരോധകത്തിനും ഒരേ വോൾട്ടേജായിരിക്കും ലഭിക്കുക.
- പ്രത്യേക സ്വിച്ചുകൾ വഴി ഓരോ ഉപകരണങ്ങളെയും നിയന്ത്രിക്കാൻ കഴിയുന്നു.

Assignments

2 Ω , 4 Ω പ്രതിരോധകങ്ങളെ സമാന്തരമായി 12 V ബാറ്ററിയുമായി ബന്ധിപ്പിച്ചിരിക്കുന്നു. സർക്യൂട്ടിലെ കറന്റ് കണ്ട് പിടിക്കുക?