16. Electricity and Energy

Part-A

1. Question

The potential difference required to pass a current 0.2 A in a wire of resistance 20 ohm is _____.

A. 100 V

B. 4 V

C. 0.01 V

D. 40 V

Answer

As by looking at the problem we know that we have to find V - potential difference. And the data we are given with is of, current - I which is 0.2 A (ampere) and of resistance - R which is 20 ohm (Ω).

So, by using Ohm's law relation we can find the potential difference across the conductor with the help of the values of current and resistance.

Mathematically, V (potential difference) = I(current) × R(resistance)

V = 0.2A× 20ohm = 4 V.

2. Question

Two electric bulbs have resistances in the ratio 1 : 2. If they are joined in series, the energy consumed in these are in the ratio _____. (1 : 2, 2 : 1, 4 : 1, 1 : 1)

Answer

We are given with the ratio of resistance of the two bulbs, let it be R_1: R_2 = 1 : 2 , the bulbs are connected in series , so same amount of current will pass through both of the bulbs. The energy consumed by a bulb is given by,

E(electric energy) = V(potential difference) X I(current) X T(time)

As we do not know about the potential difference in this question but we know about the current (same in both bulbs) , so in order to solve this question we need to change the equation in the form of current , resistance and time only.

Put V = IR form Ohm's law relation in this electric energy equation.

E = (IR) × I × T = I^2RT, which is similar form of Joule's law of heating.

Let the electric energies of $bulb_1$ be E_1 and $bulb_2$ be E_2.

As time taken by the current to pass through both bulbs is always same ,

$$\frac{E_1}{E_2} = \frac{I^2T(R_1)}{I^2T(R_2)} = \frac{R_1}{R_2} = \frac{1}{2}$$

The ratio of the electric energies is same as the ratio of resistances of the corresponding bulbs.

3. Question

Kilowatt-hour is the unit of _____.

A. potential difference

B. electric power

C. electric energy

D. charge

Answer

As we know that the unit of power is watt or Kilowatt, and the units Kilowatt hour are representing power multiplied by time(hour). And we know that,

$$\text{P(power)} = \frac{\text{E(electric energy)}}{\text{T(time)}}$$

So, E = P× T and in the form of units ,

units of E = units of P× units of T = Kilowatt× hour.

4. Question

_____ surface absorbs more heat than any other surface under identical conditions.

A. White

B. Rough

C. Black

D. Yellow

Answer

Black body's are known for their ability to absorb every radiation, there are theories on black body radiations which you will study in higher classes, due to these reasons black body are used in solar cookers and solar heaters because they absorb all the heat radiation and do not let them escape easily, the other colors white or any other color cannot be more efficient in absorbing radiations than black body or black color.

5. Question

The atomic number of natural radioactive element is _____.

A. greater than 82

B. less than 82

C. not defined

D. atleast 92

Answer

After atomic number 82 which is Lead(Pb) , there are the radioactive elements , which are highly unstable and humans cannot go near it as it is. We cannot choose less than 82 and less than 92 because they include simple metals and non-metals too.

6. Question

Which one of the following statements does not represents Ohm's law?

(i) current / potential difference = constant

(ii) potential difference / current = constant

(iii) current = resistance x potential difference

Answer

As the resistance of the conductor is a constant quantity at constant temperature and same dimensions and also in Ohm's law resistance is specified as the constant of proportionality, so the first two options are correct,

$$\frac{V}{I} = R = \text{constant}$$

$$\text{and } \frac{I}{V} = \frac{1}{R} = \text{constant2}$$

and the statement of Ohm's law is V = I× R , not I = R× V through which the third statement is wrong but is a correct answer.

7. Question

What is the major fuel used in thermal power plants?

Answer

Thermal power plants generally use fossil fuels as their major fuel to produce heat by burning them few examples are petroleum, coal, charcoal. But the majorly used in industries is coal.

8. Question

Which is the ultimate source of energy?

Answer

Sun is the ultimate source of energy because with the help of sun all the processes goes on Earth, like plants making food etc.

Also Energy is produced by the sun because sun keeps on giving radiations of heat and light without having any intake, but there are certain nuclear reactions (FUSION) are going on inside it which make this all happen. Also many of the sources derive their energy from the sun.

9. Question

What must be the minimum speed of wind to harness wind energy by turbines?

Answer

The minimum speed of wind to harness wind energy by turbines is 15 km/h because at this speed the turbines manage to maintain the required speed. Also, the wind energy is set up at those places where there is wind going on for maximum time of the year.

Not only the speed but time is also the factor governing the production of electricity by using wind energy.

10. Question

What is the main raw material used in the production of biogas?

Answer

Cow dung-cakes are the main material used in the formation of biogas that is why biogas is also called gobar-gas, but animal waste and plant residue and sewage are also used in the formation of biogas. It is the improved conventional source of energy.

Part-B

1. Question

Fill in the blanks

i) Potential difference: voltmeter; then current _____.

ii) Hydro power plant: Conventional source of energy; then solar energy: _____.

Answer

(i) As the question’s pattern is telling us a quantity: and it’s measuring instrument, as the quantity is potential difference: so, it’s measuring instrument will be voltmeter, and in the second case the quantity is current: so it’s measuring instrument will be ammeter.

REMEMBERING TECHNIQUE: -

The units of potential difference are volt so it’s measuring instrument is named voltmeter and the units of current is ampere so it’s measuring instrument is named ammeter.

(ii). Alternative or Non-Conventional source of energy.

EXPLANATION – As in the question’s pattern it is first giving the name of a method of source of energy and: then asking the type of method whether it is a conventional or non-conventional source of energy.

2. Question

In the list of sources of energy given below, find out the odd one.

(wind energy, solar energy, hydroelectric power)

Answer

Out of all the three options available, if we compare the type of method of these sources of energy have, the wind energy and the hydroelectric power are the Conventional methods of energy whereas the solar energy is the Non-Conventional method of energy.

3. Question

Correct the mistakes, if any, in the following statements.

i) A good source of energy would be one which would do a small amount of work per unit volume of mass.

ii) Any source of energy we use to do work is consumed and can be used again.

Answer

(i). A good source of energy is the one which would do a large amount of work per unit volume or mass.

When we want to use something, we give it input and we desire considerable output from that thing and of course we want large amount of output or work done by that thing not a small amount of output or work done.

(ii). Any source of energy we use to do work is consumed and cannot be used again.

When we use some energy, it is in the usable form and when we apply it some energy is used and some energy is dissipated to the surroundings but the amount of energy we used is fully gone with the law of conservation of mass.

4. Question

The schematic diagram, in which different components of the circuit are represented by the symbols conveniently used, is called a circuit diagram. What do you mean by the term components?

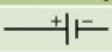
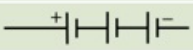
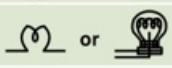
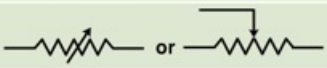
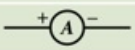
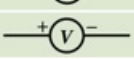
Answer

It is difficult to draw the actual parts of the circuit which are in real life so, there is a way to draw the circuit with some suitable symbols. Electric components or simply components of the circuit means, the parts with which our circuit is made. For e.g.

A plug key, connecting wires, cell or battery, resistance or bulb, etc.

It’s the simplest circuit.

Components are generally the parts through which our circuit is made.

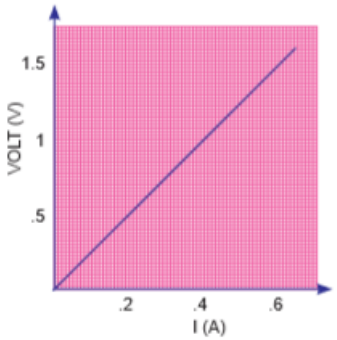
S. No.	Components	Symbols
1	An electric cell	
2	A battery or a combination of cells	
3	Plug key or switch (open)	
4	Plug key or switch (closed)	
5	A wire joint	
6	Wires crossing without joining	
7	Electric bulb	
8	A resistor of resistance R	
9	Variable resistance or rheostat	
10	Ammeter	
11	Voltmeter	

Here are the symbols of some components used in making circuits.

The simple circuit contains only the main components which should be in every circuit.

5. Question

The following graph was plotted between V and I values. What would be the values of V / I ratios when the potential difference is 0.5 V and 1 V?



Answer

Ohm's law was given by experimenting and making graph of V vs. I that is V on y axis and I on X axis and by the observations Ohm deduced that V/I is coming out to be nearly constant, and as we increase V(potential difference) I(current) increases simultaneously and linearly that is current I increases linearly with potential difference V.

He told that V/I is a constant and is named as resistance(R).

Now we know that V/I is constant, so let's calculate the ratio.

When the potential difference is 0.5 V then the value of current comes out to be 0.2 A , and when the potential difference is 1 V the value of the current comes out to be 0.4 V.

$$\frac{V}{I} = \frac{0.5}{0.2} = \frac{1}{0.4} = 2.5$$

Hence the Ohm's law is also verified that is,

$$\frac{V}{I} = \text{constant} = \text{resistance}$$

6. Question

We know that γ – rays are harmful radiations emitted by natural radioactive substances.

i) Which are other radiations from such substances?

ii) Tabulate the following statements as applicable to each of the above radiations

(They are electromagnetic radiation. They have high penetrating power. They are electrons. They contain neutrons)

Answer

(i). There are three types of radiations which emitted from natural Radioactive substances or elements, which are: -

Alpha rays or α-rays, beta rays or β-rays, gamma rays or γ-rays.

The first two alpha and beta rays consist of charges with them but the third one the gamma rays is made of energy only.

(ii). The table is here,

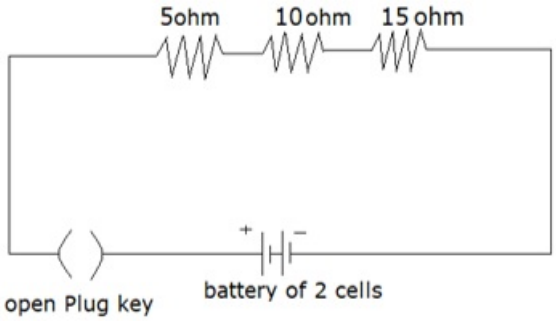
alpha rays	beta rays	gamma rays
they consist neutrons	they are electrons	they are electromagnetic radiations. They have high penetrating power.

The first two alpha and beta rays consist of charges with them but the third one the gamma rays is made of energy only.

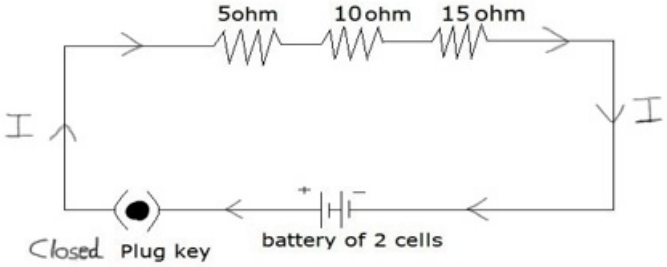
7. Question

Draw the schematic diagram of an electric circuit consisting of a battery of two cells of 1.5V each, three resistances of 5-ohm, 10 ohm and 15 ohms respectively and a plug key all connected in series.

Answer



This is the circuit having one plug key, one 5 ohm resistor, one 10 ohm resistor, one 15 ohm resistor and a battery of 2 cells each 1.5 V and everything is connected in series, so the battery is total of 3 V. As you can see there is open plug key, so, there is no current flowing in the circuit and hence we say that it is an open circuit.



As you can see it is the similar circuit as we have drawn the above one, but the only difference is in the plug key, this time the plug key is closed through which the circuit gets closed and gets completed connection, so, there is flow of current and remember the direction of flow of current is always in opposite direction of the flow of electrons, that is from positive to negative terminal conventionally.

8. Question

Fuse wire is made up of an alloy of _____ which has high resistance and_____.

Answer

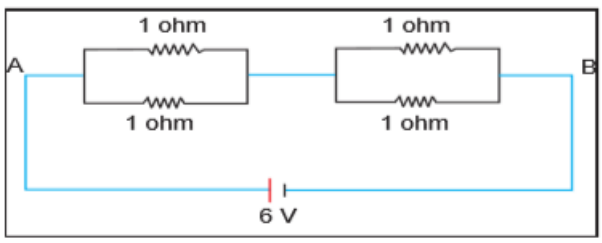
Accordingly Low melting point.

Nickel, Chromium, Manganese, Iron, Zinc, Tin type of metals and the most common Domestically used fuse wire is of an alloy Nichrome .

The alloy of fuse wire is made and tested that it should have low melting point accordingly, so that it is able to break the circuit by melting when high ampere of current passes through it which can destroy our electrical appliances.

9. Question

Observe the circuit given and find the resistance across AB.



Answer

As we can see there are two sets of resistors, one is at left and the other is at right, both have 2 resistors in parallel each of 1 ohm. As the sets have parallel resistors, so, we can simplify them and make them one

resistor to get the equivalent resistance of the circuit.

We will solve one set first and in the similar way the second set, we know that when resistors are parallel we add the reciprocals of the resistors and we equate it to the reciprocal of the total resistance after cross-multiplying we get the total resistance of the circuit.

$$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{add all of them}$$

Let the total resistance of the set A be R_A and the total resistance of the set B be R_B.

So,

$$\frac{1}{R_A} = \frac{1}{1} + \frac{1}{1} = 2 \text{ , } R_A = \frac{1}{2}$$

Similarly, $R_B = \frac{1}{2}$, Hence as the two resistors in the sets are simplified and merged to a single resistor in each set, Therefore the resistors now left are R_A in set A and R_B in set B which are in series with each other because when we resolved the 1 ohm resistors which were in parallel they got merged and attached to the main circuit wire.

Now when resistors are in series we add them algebraically or simply like we add two integer numbers.

$R = r_1 + r_2 + \ldots\ldots\ldots\ldots\ldots$ add all the resistors

As R_A and R_B are 0.5 ohm calculated by us, so when we add them we get 1 ohm as the answer.

10. Question

Complete the table choosing the right terms within the brackets.

(zinc, copper, carbon, lead, lead dioxide, aluminum.)

+ ve (positive) electrode	Lead acid accumulator	Lead dioxide, PbO_2
- ve (negative) electrode	Leclanche cell	Zinc , Zn

Answer

This is the complete table and the answers are in the third column.

These are the answers because, the lead acid battery or accumulator has positive electrode of lead dioxide and leclanche cell has negative electrode of zinc, so we just need to look out for the patterns of questions to solve them.

11. Question

How many electrons flow through an electric bulb every second, if the current that passes through the bulb is 1.6 A.

Answer

As we know the relation $I = \frac{q}{t}$, which tells us that current is equal to the flow of charge per unit time, that is in t seconds q amount of charge has flown or we can say that in 1 second $\frac{q}{t}$ amount of charge has flown.

We have studied the relation q = n× e

Where q is total amount of charge; n is the number of electrons; e is the amount of charge on 1 electron which has value 1.6 X 10^{-19} C.

And is always constant(n).

In this problem we have to find n that is number of electrons, so we have the value of current I = 1.6 A and time t = 1 sec , and time will be 1 sec if q = 1.6C , as ,

$n = \frac{q}{e} = \frac{1.6}{1.6 X 10^{-19}} = 10^{19}$ electrons will emerge out of the bulb in one second or per second.

12. Question

Vani’s hair dryer has a resistance of 50 Ω when it is first turned on.

i) How much current does the hair dryer draw from the 230 V – line in Vani’s house?

ii) What happens to the resistance of the hair dryer when it runs for a long time?

(Hint: As the temperature increases the resistance of the metallic conductor increases.)

Answer

At time t = 0, the given initial resistance(R) of the hair dryer is 50 ohm

i). We are given with the input voltage(V) = 230 V and we have to find the amount of current withdrawn by the dryer which is actually the initial current drawn by the dryer, so,

By using ohm’s law, we will calculate the current,

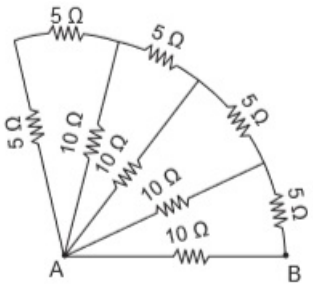
V = I× R,

$$I = \frac{V}{R} = \frac{230}{50} = 4.6\,A$$

ii). As we know that the dryer is used to dry our hair and it does by throwing hot air on us and as time passes when we are using it, it becomes hot and when it’s temperature is increased by becoming hot, the resistance of the metallic parts increases , the resistance of the metals increases with the increase in temperature till a certain temperature or within a specific range. The longer we use the hair dryer the more hot it becomes and the more resistance is offered by it.

13. Question

In the given network, find the equivalent resistance between A and B.



Answer

To find the effective resistance of any typical network , first we should look out for small structures of the main structure which can be resolved and we should solve the question diagram by diagram provided each diagram is simplified from the previous one and don’t just interpret and solve some structures in between structures because there are no resistors in parallel or in series there they have more connections and it becomes more complex to solve from between, so try to solve from outside if it does not solve then go inside to simplify the whole structure, so, first solve the outer structures then go to the inner ones if the outer ones can be solved first.

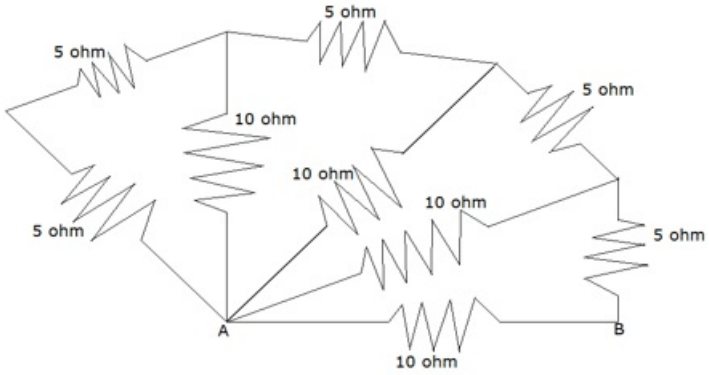
ALWAYS REMEMBER THE MAJOR RULE :-

RESISTORS IN SERIES HAVE SAME CURRENT AND

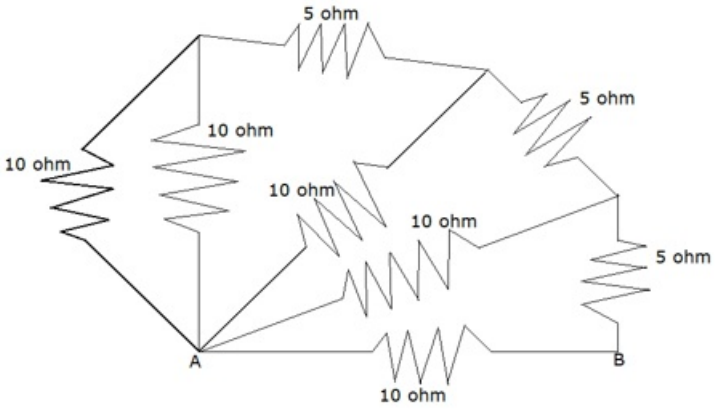
RESISTORS IN PARALLEL HAVE SAME POTENTIAL DIFFERENCE.

By using this rule you can create a passage of current from any point where there is potential difference given in the question

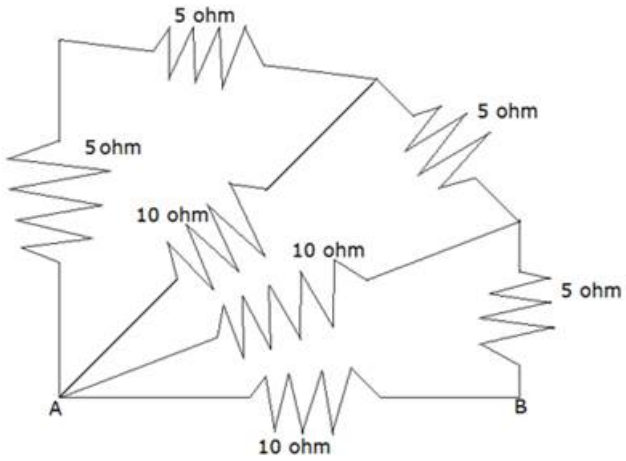
In this question the point can be any but from only A and B the two points given in the circuit because between these points there is potential difference , THESE ARE CALLED GIVEN POINTS between which we have to calculate the effective resistance.



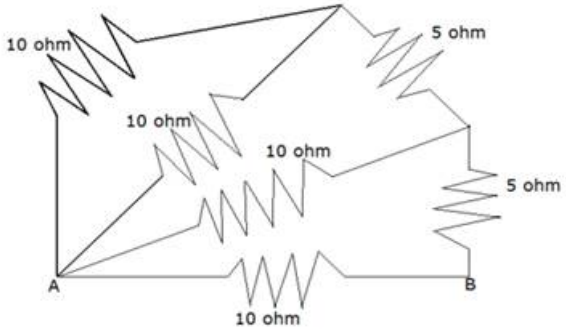
First the extreme left resistors will be solved as they are in series, so we will get, they will get added normally as integers.



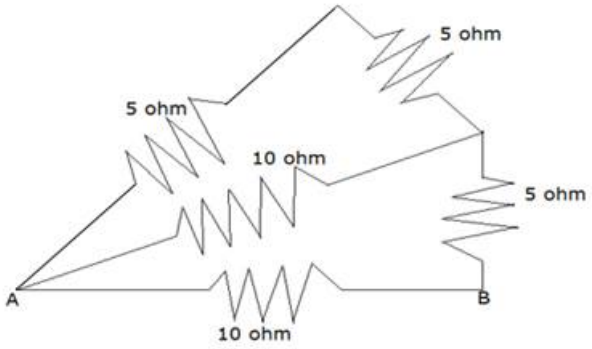
Now again the left most resistors are to be solved but now they are parallel and to be calculated by parallel method of evaluation.



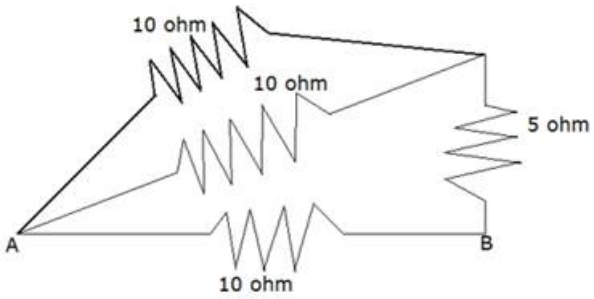
Now again we have to solve the left most two resistors at the top which are in series and will be added like integers.



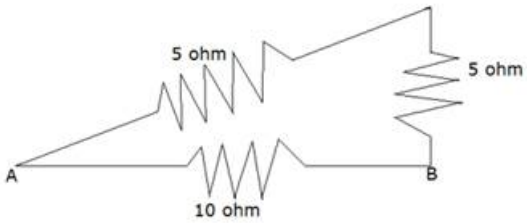
Now again solve the left most resistors which are parallel, we will get,



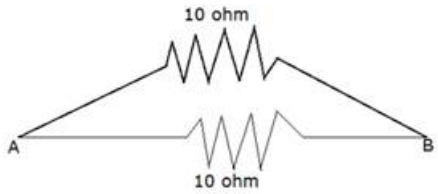
Now solve the resistors in series, which will be,



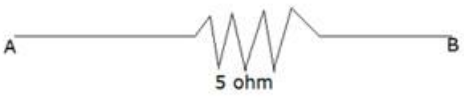
Now solve the resistors in parallel which are at the top, which are evaluated to,



Now add the two 5 ohm resistors like integers because they are in series, for the last time,



Solve the two remaining 10 ohm resistors which are in parallel combination to each other,



Thus, we get the resultant or the final calculated resistance.

14 A. Question

Old – fashioned serial lights were connected in a series across a 240V household line.

If a string of these lights consists of 12 bulbs, what is the potential difference across each bulb?

Answer

We should not get afraid if there is no number data or less number data as there is everything in the question itself, As in the question there is given that the 12 bulbs are identical and there is the input voltage of 240 V, and the bulbs are connected in series which means the current is same in each and every bulb.

Suppose that each bulb has resistance ‘R’ and ‘I’ is the current passing through each bulb,

We have to find the potential difference across each bulb, which will come out to be same because the current passing and resistance of each bulb is same, and V = I× R, so V is same which is potential difference

across one bulb.

By adding the resistance of all bulbs, we get,

Potential difference across all bulbs = (current through one bulb) × (resistance of all bulbs)

Which is, 240 = I× 12R = 12 IR, $IR = \frac{240}{12} = 20$

Now potential difference through one bulb is,

$V = I \times R = IR = \frac{240}{12} = 20$ V, which is the required potential difference across each bulb.

14 B. Question

Old – fashioned serial lights were connected in a series across a 240V household line.

If the bulbs were connected in parallel, what would be the potential difference across each bulb?

Answer

We know that potential difference across each bulb is same when they are connected in parallel and in this case the bulbs too are identical that is they have same resistance and so the current will be divided in same proportion in each branch (to each resistor).

The conditions are same as in the previous case,

Effective resistance of the network is,

$$\frac{1}{R_t} = \frac{1}{R} + \frac{1}{R} + \ldots\ldots\ldots\ldots \text{upto 12 terms.}$$

We get,

$R_t = \frac{R}{12}$, Let the current flowing in circuit is I,

By Ohm's law, 240 = I× $R_t = I\frac{R}{12}$,

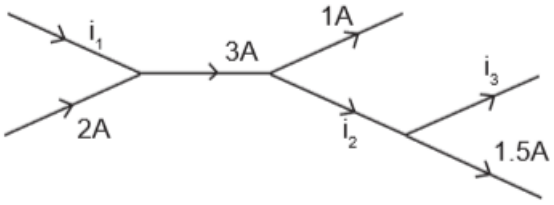
As current through circuit is I, so current through each bulb will be $\frac{I}{12}$, because there are 12 bulbs through which current I is flowing so through one bulb the current will be $\frac{I}{12}$,

By Ohm's law, $V = \frac{I}{12} \times R = \frac{IR}{12}$, which is equal to 240 V.

Hence now we know the rule works always.

15. Question

The figure is a part of a closed circuit. Find the currents i_1, i_2 and i_3



Answer

IMPORTANT RULE :- WHENEVER THERE ARE CURRENTS COMING FROM DIFFERENT WIRES AND GOING INTO SINGLE ANOTHER DIFFERENT WIRE (THROUGH WHICH THERE IS NO CURRENT COMING) THEN THE CURRENTS ARE ADDED AND IF CURRENT THROUGH ONE WIRE IS GOING INTO TWO DIFFERENT WIRES (WHICH DO NOT HAVE ANY CURRENT RUNNING THROUGH THEM INSTEAD OF THIS CURRENT) THEN THE CURRENT IS DIVIDED IN THEM ACCORDINGLY AND SUBTRACTED FROM THE MAIN COMING CURRENT.

If we know the main current one partition we can find other by using simple maths.

For example- 3A is the main current for forward going 1A and i_2 , and 1A and i_2 are the partitions of 3A current.

As there is law of conservation of energy.

There is always conservation of current(charge) ,

So 3 = 1 + i_2 , by which we can get i_2 which is = 3-1 = 2A.

Now to calculate i_1 we must obtain the equation of it , which is

i_1 + 2 = 3 , i_1 = 3-2 = 1A.

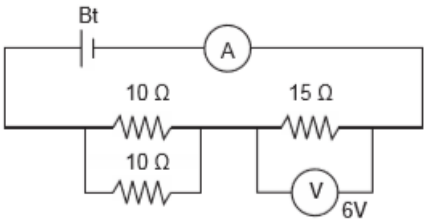
Now to calculate i_3 we will look at the point where it is getting divided and by whom that is , what is the main current of i_3 and the second partition of the main current which is companion with i_3,

As i_2 = 2A is the main current and it's one partition is 1.5A and second partition is i_3 , so ,

$i_2 = i_3 + 1.5$, $2 = i_3 + 1.5$, $i_3 = 2 - 1.5 = 0.5A$

16. Question

If the reading of the Ideal voltmeter (V) in the given circuit is 6V, then find the reading of the ammeter (A).



Answer

We are given with potential difference across 15 ohm resistor and we have to calculate the amount of current flowing in the circuit which will be the reading of ammeter.

Let the potential difference across 15 ohm resistor be V and the current flowing in the circuit be I. As we are given that the voltmeter is ideal which means that no current or very less current passes through it and hence nearly all the current passes through the 15 ohm resistor.

V = 6 V , R = 15 ohm , by using Ohm's law , we get

V = I× R , $I = \frac{V}{R} = \frac{6}{15} = 0.4\,A$,

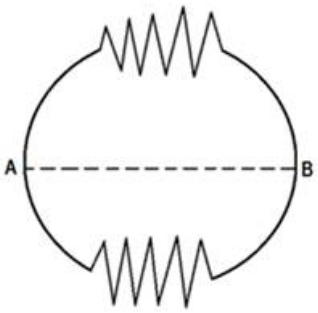
Always remember current passing through ideal voltmeter is always zero , Mathematically

I = 0 A, through an ideal voltmeter.

17. Question

A wire of resistance 8 Ω is bent into a circle. Find the resistance across the diameter.

Answer



As in this question we have to calculate net resistance across the diameter of the circle and we are given with the resistance of the wire across it's free ends which is 8 ohm.

If we remember our previous questions in which we have calculate net resistance, we will know that the given points are whom across there is potential difference and these two points will not merge and form one-point, potential difference at one point is different from another point that is A and B have different potential.

But the potential difference across each resistor is same as they have same ending points A and B.

So, we are at conclusion, that the two resistors are parallel to each other and we can calculate the net resistance now, as the resistance of the full wire across it's free ends is 8 ohm, So by the relation

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

We can say that by dividing the length to half of the original keeping other things constant which they are in this question, the resistance will reduce to half of the original, that is now the resistance of the two parallel wires is 4 ohm instead of 8 ohm.

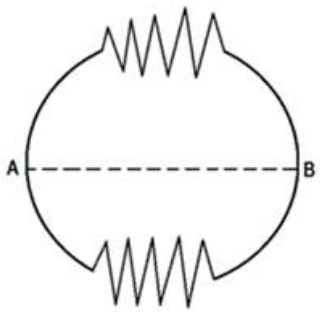
$$\frac{1}{Rt} = \frac{1}{4} + \frac{1}{4} = \frac{2}{4} = \frac{1}{2}$$

R_t = 2 ohm, is the resistance across A and B (the diameter).

18. Question

A wire is bent into a circle. The effective resistance across the diameter is 8 Ω. Find the resistance of the wire.

Answer



In this question we are given with the resistance across the diameter AB which 8 ohms is, and we have to calculate the resistance of the wire formed from the circle across its free ends.

The situation of resistors is same as of previous question, So,

We need to find the resistance of the two parallel wires and then we can find the resistance of the total full wire.

Let the resistance of the parallel wires be R ohm each.

So, $\frac{1}{Rt} = \frac{1}{R} + \frac{1}{R} = \frac{2}{R}$, $R_t = \frac{R}{2}$,

We are given that R_t = 8 ohm, so, R = 2 R_t = 2× 8 = 16 ohm.

So, the total resistance of the full straight wire across it's ends will be 16 + 16 = 2× 16 = 32 ohm, because R was the resistance of half wire.

19. Question

Two bulbs of 40 W and 60 W are connected in series to an external potential difference. Which bulb will glow brighter? Why?

Answer

Remember one thing whenever there is this type of question we will check the power dissipation in each bulb, the bulb dissipating more power will glow brighter than the bulb with dissipating less power. The dissipation of power depends upon the resistance of the bulb that is more the resistance of the bulb more is the dissipation of the power.

As the bulbs are connected in series that means there is same amount of current flowing through them, so,

Power(P) = potential difference(V)× current(I)

By Ohm's law, V = I× R

So, $P = I^2R = \frac{V^2}{R}$

Where V is the rating voltage of the bulbs which a very important concept in is these types of questions.

We will have to take input voltage less than or equal to the V volt or the rating voltage of the bulbs otherwise our bulb will fuse out.

$P_1 = \frac{V^2}{R_1}$ It is the power of 40 W bulb,

Now we have to calculate R_1 of bulb 1, so

$$R_1 = \frac{V^2}{P_1} = \frac{V^2}{40}$$

$P_2 = \frac{V^2}{R_2}$ It is the power of 60 W bulb,

Now we have to calculate R_2 of bulb 2, so

$$R_2 = \frac{V^2}{P_2} = \frac{V^2}{60}$$

Now as we have got the resistance of bulb 1 and 2, so we will find the current flowing in the circuit , which is

$$I = \frac{V}{R_1 + R_2} = \frac{V}{\frac{V^2}{40} + \frac{V^2}{60}} = \frac{24}{V}$$

Now let's calculate power dissipation which is ,

$P_1 = I^2 \times R_1 = \left(\frac{24}{V}\right)^2 \times \frac{V^2}{40} = 14.4\,W$

$P_2 = I^2 \times R_2 = \left(\frac{24}{V}\right)^2 \times \frac{V^2}{60} = 9.6\,W$

As we can see that power dissipated by P_1 is higher than that of P_2 ,

So, bulb 1 with 40 W power will glow brighter than bulb 2 with 60 W power.

20. Question

Two bulbs of 70 W and 50 W are connected in parallel to an external potential difference. Which bulb will glow brighter? Why?

Answer

Remember in these type of questions we will have to calculate the amount of power dissipated by the bulbs , the bulbs dissipating more power will glow more brightly.

Again we will first evaluate the resistance of each bulb and after that the current flowing in the circuit , then we will put both the values of current and resistance to evaluate the power dissipation by each bulb.

Let the rating voltage of both the bulbs be same as the input voltage which is V volts.

$P_1 = \frac{V^2}{R_1}$, $R_1 = \frac{V^2}{P_1} = \frac{V^2}{50}$, P_1 = 50 W

$P_2 = \frac{V^2}{R_2}$, $R_2 = \frac{V^2}{P_2} = \frac{V^2}{70}$, P_2 = 70 W

Now to calculate the current flowing in the circuit,

The net resistance is R,

$$\frac{1}{R} = \frac{1}{\frac{V^2}{50}} + \frac{1}{\frac{V^2}{70}} = \frac{50}{V^2} + \frac{70}{V^2} = \frac{120}{V^2}$$

$$R = \frac{V^2}{120}$$

Now let's calculate power dissipation which is ,

$$P_1 = \frac{V^2}{R_1} = \frac{V^2}{\frac{V^2}{50}} = 50\,W$$

$$P_2 = \frac{V^2}{R_2} = \frac{V^2}{\frac{V^2}{70}} = 70\,W$$

Hence power dissipated by the bulb 2 which has 70 W power will glow more brighter than the 50 W bulb 1.

Hence, we got the same answers when the bulbs are connected in parallel combination.

21. Question

Write about ocean thermal energy?

Answer

OCEAN THERMAL ENERGY :-

The water at the surface of the sea or ocean which, has considerable depth or deepness, is heated by the Sun while as we go deeper and deeper in the ocean or sea the upcoming sections become relatively colder than the previous one. This difference in temperature is used to obtain energy in ocean-thermal-energy conversion plants. These plants can operate if the temperature difference between the water at the surface and water at depths up to 2 km is 293 K (20°C) or more. The warm surface-water is used to boil a volatile liquid like ammonia. The vapours of the liquid are then used to run the turbine of generator. The cold water from the depth of the ocean is pumped up and condense vapour again to liquid.

22. Question

In a hydroelectric power plant, more electrical power can be generated if water falls from a greater height. Give reasons.

Answer

In hydroelectric power plants, the electric energy is produced by potential energy of the water at a certain height , and potential energy increases with the increase of height of the water.

When water is taken at some height it gains potential energy and when water from this height is thrown the potential energy of the water starts converting into kinetic energy and when the water hits the turbine the kinetic energy rotates the turbine and hence the electricity or electric energy is generated by conversion.

The more is the height of the water, the more is the potential energy, the more is the kinetic energy and , hence the more is the electric energy.

23. Question

What measures would you suggest to minimize environmental pollution caused by burning of fossil fuel?

Answer

The oxides of carbon, nitrogen and sulphur that are released on burning fossil fuels are acidic oxides. These lead to acid rain which affects our water and soil resources. To reduce these kind of hazardous incidents, the following measures will help you to reduce these incidents:-

1. The pollution caused by burning fossil fuels can be reduced by increasing the efficiency of the combustion process.

2. Using various techniques to reduce the escape of harmful gases and convert them into non-harmful gases.

3. Use that fuel which could create less ashes, so that the ashes do not get into surroundings and pollute it.

4. Use that fuel which produces high level of heat and less level of smoke and gases.

24. Question

What are the limitations in harnessing wind energy?

Answer

Wind energy is an environment-friendly and efficient source of

renewable energy. It requires no recurring expenses for the production of electricity. But there are many limitations in harnessing wind energy, that are:-

1. Wind energy farms can be established only at those places where wind blows for the greatest part of a year.

2. The wind speed should also be higher than 15 km/h to maintain the required speed of the turbine.

3. There should be some back-up facilities (like storage cells) to take care of the energy needs during a period when there is no wind.

4. Establishment of wind energy farms requires large area of land and also the initial cost of establishment of the farm is quite high.

25. Question

What is biomass? What can be done to obtain bioenergy using biomass?

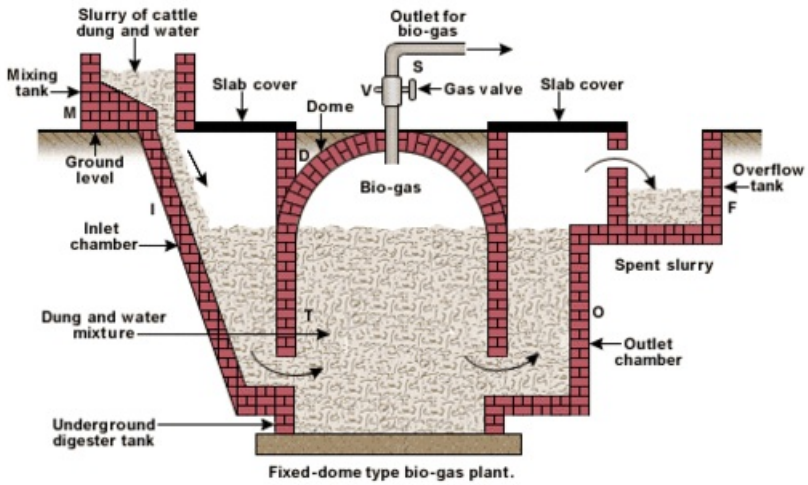
Answer

The fuels which are plants and animal's products, the source of these fuels is said to be bio-mass. Bio means living things and mass means the matter that is matter obtained from the living.

As the bio-mass when burned do not provide much heat and give out a lot of smoke or pollution through them, so there is a method called bio gas plant. The plant has a dome-like structure built with

bricks. Anaerobic micro-organisms that do not require oxygen decompose or break down complex compounds of the cow-dung or sewage or dead plants, slurry. It takes a few days for the decomposition process to be complete and generate gases like methane, carbon dioxide, hydrogen and hydrogen sulphide.

After the above process the formed biogas is stored in the plant in a tank and can be used through pipes.



Fixed-dome type bio-gas plant.

26. Question

Which form of energy leads to the least amount of environmental pollution in the process of harnessing and utilization? Justify your answer.

Answer

Solar energy is the energy which leads to the least amount of environmental pollution in the process of harnessing and utilizing it.

Because :-

1. The input of solar energy is the sun which is the ultimate source of energy and will never die and is nonpolluting.

2. There is no much activities or harming of nature when harnessing it like it is in wind energy, we have to consider large area of land and place windmills there that might include cutting of trees or digging of earth too deep.

3. There is no release of harmful gases as there is in geothermal energy when the melted rocks come to the surface of the earth from the core, then they release harmful gases when they form contact with water.

4. There is no burning of any fossil fuels like there is in thermal power plants and no radioactive waste as it is in nuclear power plants.

5. There is no disturbance caused to the wildlife, because we can place it on top of our home and use it while we are in our house , but there might be some disturbance caused to the aquatic life in energy from the sea methods and by hydroelectric power plant also.

Part-C

1. Question

Veena's car radio will run from a 12 V car battery that produces a current of 0.20 A even when the car engine is turned off. The car battery will no longer operate when it has lost 1.2 x 10^6 J of energy. If Veena gets out of the car, leaving the radio on by mistake, how long will it take for the car battery to go completely dead, i.e. lose all energy?

(1 day = 86400 second)

Answer

In this question we need to find the time taken (T) by the car to go dead when the radio is left on by Veena , We are given with the amount of energy car can supply (E) which is 1.2 X 10^6 .

We are also given with the car battery's potential difference (V) which it can give which is 12 V , and the amount of current produced (I) is 0.2 A .

By using the equation , E = V× I× T , $T = \frac{E}{V \times I}$

$$T = \frac{1.2 \times 10^6}{12 \times 0.2}$$

$$= \frac{10^6}{2}$$

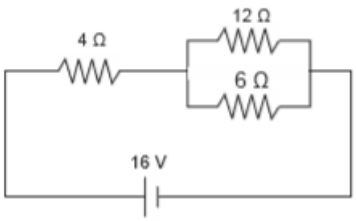
$$= 5 \times 10^5 \text{ seconds}$$

$$= 5.787035 \text{ days}$$

1 day = 86400 seconds, 5 X 10^5 seconds = $\frac{1}{86400} \times 5 \times 10^5$ days

2. Question

Find the total current that passes through the circuit. Find the heat generated across the each resistor.



Answer

First we need to find the total current (I) flowing in the circuit, that we can find by using Ohm's law, because we are given with the battery's potential difference (V) and we need to find the net resistance of the circuit (R).

As we can see there are 3 resistors 4 ohm, 6 ohm and 12 ohm, and there are two resistors in parallel the 6 and 12 ohm ones, sowe will first solve the parallel ones and get the parallel resistance R_p

$$\frac{1}{Rp} = \frac{1}{6} + \frac{1}{12} = \frac{3}{12} = \frac{1}{4}$$

R_p = 4 ohm

Now the net resistance will come by simply adding the R_p = 4 ohm and the other 4 ohm resistor because they both are now in series,

So,

$R = R_p + 4 = 4 + 4 = 8$ ohm

R = 8 ohm

By using Ohm's law, V = I× R, $I = \frac{V}{R}$

$$I = \frac{16}{8} = 2\,A$$

Now we need to find the heat generated across each resistor, which we will do by using Joule's law of heating,

Mathematically, $H = I^2 \times R \times T = I^2RT$

Where I is current passing through conductor; T is time; R is resistance of the conductor; and H is heat generated across the conductor.

As the 4 ohm resistor is alone and in series so current I_1 passing through it will be equal to the total current passing through the circuit ,

Which is 2 A and the potential difference across the 4 ohm resistor is

V = I× R = 2× 4 = 8 V

Now the two resistors 6 and 12 ohm are in parallel that is they have same potential difference across them which is 8 V because the battery has total potential difference of 16 V and 8 V is consumed by the 4 ohm resistor which is in series and alone so , 16-8 = 8 V the remaining potential difference is 8 V which is consumed by both 6 and 12 ohm resistors in parallel.

Let the current passing through 6-ohm resistor be I_2 and current passing through 12 ohm resistor be I_3 .

By Ohm's law,

$V = I_2 \times R_2$, $I_2 = \frac{V}{R_2}$

$$I_2 = \frac{8}{6} = \frac{4}{3}\,A$$

$V = I_3 \times R_3$, $I_3 = \frac{V}{R_3}$

$$I_3 = \frac{8}{12} = \frac{2}{3}\,A$$

Heat generated by 4-ohm resistor,

$$H_1 = {I_1}^2 R_1 T = 2^2 \times 4 \times 1 = 16\,\text{Joules}$$

Heat generated by 6-ohm resistor,

$$H_2 = {I_2}^2 R_2 T = \left(\frac{4}{3}\right)^2 \times 6 \times 1 = \frac{32}{3}\,J$$

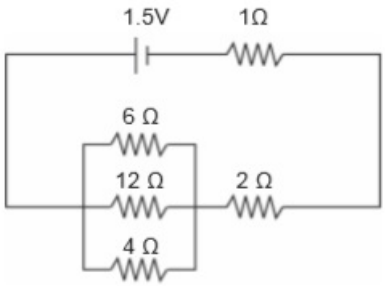
Heat generated by 12-ohm resistor,

$$H_3 = {I_3}^2 R_3 T = \left(\frac{2}{3}\right)^2 \times 12 \times 1 = \frac{16}{3}\ J$$

Time will be same for all the resistors always, in this case as no time is given so we will calculate for one second of heat generated or we can leave the answer in terms of T.

3. Question

Find the total current that passes through the circuit given in the diagram. Also find the potential difference across 1Ω resistor.



Answer

To find the total current(I) passing through the circuit, we must find the total resistance(R) and also we know the battery's potential difference(V) which is 1.5 V , so by Ohm's law we can find the net current flowing in the circuit.

As we can see by the figure that two resistors 1 ohm and 2 ohm are in series to each other, so we can directly add them , 1 + 2 = 3 ohm,

Also we can see that 3 resistors 4 ohm , 6 ohm , and 12 ohm are parallel to each other , so , let the net parallel resistance of these three resistors be R_p ,

$$\frac{1}{R_p} = \frac{1}{4} + \frac{1}{6} + \frac{1}{12} = \frac{6}{12} = \frac{1}{2}$$

Therefore, R_p = 2 ohm

Hence by Ohm's law, V = I× R

$$I = \frac{V}{R} = \frac{1.5}{2} = 0.75\ A$$

As the current passing through 1 ohm resistor is the net current flowing in the circuit, so

V = I× R = 0.75× 1 = 0.75 V. It is the potential difference(V) across the 1 ohm resistor.

4. Question

Raman's air-conditioner consumes 2160 W of power, when a current of 9.0 A passes through it.

i) What is the voltage drop when the air-conditioner is running?

ii) How does this compare to the usual household voltage?

iii) What would happen if Raman tried connecting his air-conditioner to a 120V line?

Answer

We are given the amount of power consumed by Raman's air-conditioner when a current of 9 A flows through it.

(i). The meaning of voltage drop simply means the potential difference across Raman's air conditioner when it is running which we have to find ,

Now to find the potential difference by knowing power and amount of electric current passing through passing through it we can use this relation ,

P = V× I , $V = \frac{P}{I}$

$$V = \frac{2160}{9} = 240 \text{ V}$$

(ii). In India, we have a household voltage of 220 V current supply,

which changes time to time and in very short time intervals.

As there is no major difference in 220 V and 240 V A.C. supply , which we will study in higher classes not in this class in detail , So yes these are comparable voltages and this air conditioner can be used in houses.

(iii). If raman tries to connect his air conditioner to a 120 V supply line , then his air conditioner would do less amount of work and deliver less power(rate of doing work) , also as it's potential difference is reduced to half and of course it's resistance is constant , so the current passing through it would also become less and will be reduced to half itself , so basically the power would become $1/4^{th}$ of the original power , also this situation might destroy your appliance or the air conditioner in Raman's case.

5. Question

The effective resistance of three resistors connected in parallel is 60/47 Ω. When one wire breaks, the effective resistance becomes 15/8 ohms. Find the resistance of the wire that is broken.

Answer

As the three resistors are in parallel combination to each other , so , let the total resistance of the 3 resistors be R_3 and the total resistance of the two resistors be R_2 ,

Let the three resistors be R_a , R_b , R_c .

First we will calculate the total resistance of 3 resistors,

$$\frac{1}{R_3} = \frac{1}{R_a} + \frac{1}{R_b} + \frac{1}{R_c} = \frac{47}{60}$$

We are given with the values of R_3 = 60/47 ohm and R_2 = 15/8 ohms ,

When one wire is broken down , let the wire be of resistance R_a , so

$$\frac{1}{R_2} = \frac{1}{R_b} + \frac{1}{R_c} = \frac{8}{15}$$

Put the value of two resistor equation in three resistor equation ,

We get ,

$$\frac{1}{R_a} + \frac{8}{15} = \frac{47}{60}$$

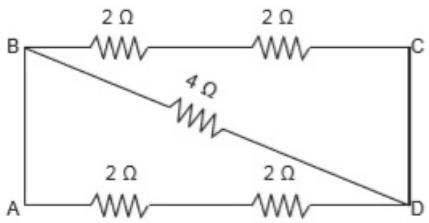
$$R_a = 4 \text{ ohm}$$

Hence this is the required resistance.

6 A. Question

Find the resistance across

A and D



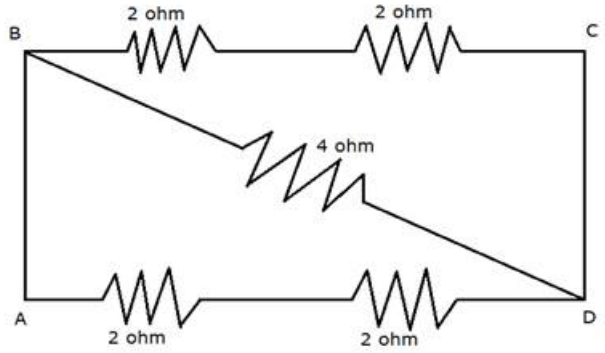
Answer

In order to find the total resistance, first we need to memorize the rule which we have learned which is , THE POINTS WHO'S ACROSS WE HAVE TO EVALUATE THE TOTAL RESISTANCE ARE THE GIVEN POINTS AND WE

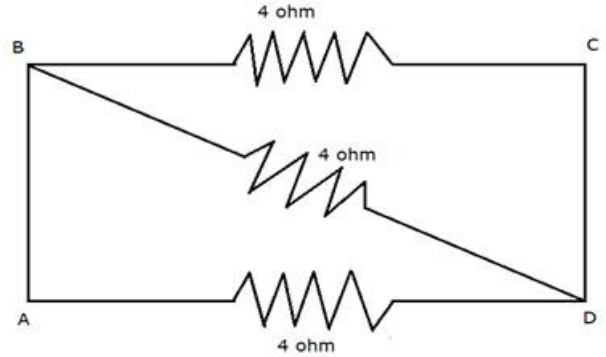
CONSIDER OR IMAGINE THAT A BATTERY IS CONNECTED TO THE CIRCUIT THROUGH THESE TWO POINTS ONLY .

And the rest are the normal points of the circuit.

A and D are the given points in this part of the question and the rest of the points are the simple points (that is B and C).

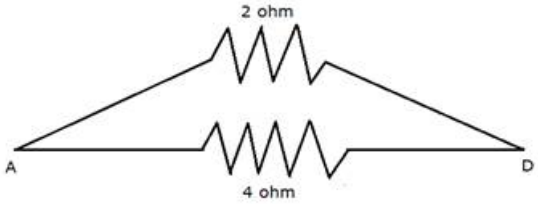


As the resistors in the line BC are in series and the resistors in the line AD are also in series with each other , so they will get added like integers or they will be simply added.

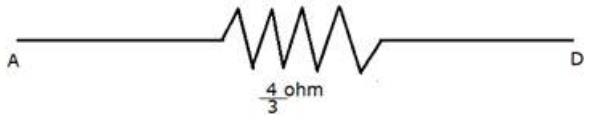


Now merge the points B into A and C into D , because they have same potential , all the three resistors are parallel to each other ,

By solving we will get ,



These two resistors are in parallel combination , so when we solve these two we will get ,

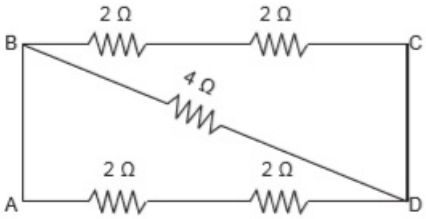


This is the resultant resistance.

6 B. Question

Find the resistance across

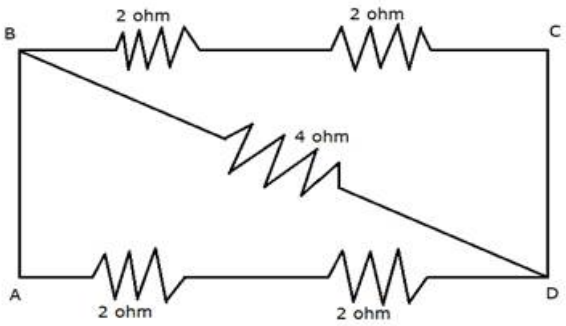
B and D.



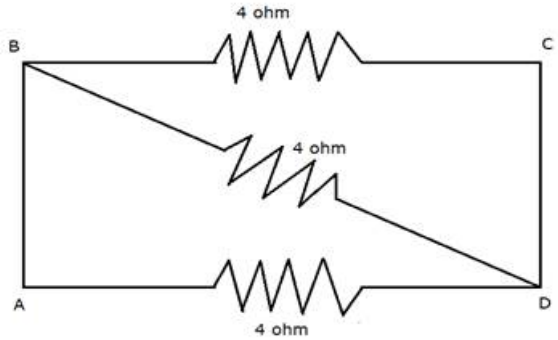
Answer

In order to find the total resistance, first we need to memorize the rule which we have learned which is , THE POINTS WHOSE ACROSS WE HAVE TO EVALUATE THE TOTAL RESISTANCE ARE THE GIVEN POINTS AND WE CONSIDER OR IMAGINE THAT A BATTERY IS CONNECTED TO THE CIRCUIT THROUGH THESE TWO POINTS ONLY .

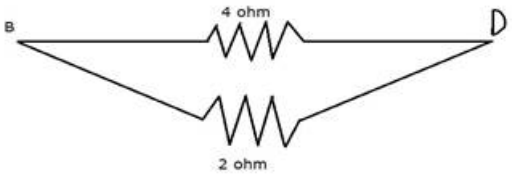
B and D are the given points in this part and the remaining are the simple points to deal with (that is A and C).



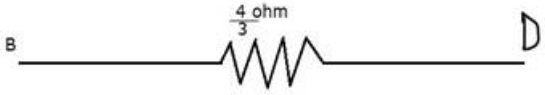
The resistors in the line BC are in series as well as the resistors in the line AD are also in series with each other, so by solving we get



Merge the point A into point B and also merge the point C into point D, all three resistors are parallel to each other, so,



These two resistors are parallel to each other, so by solving them we get,



Thus, it is the resultant or total resistance.

7. Question

Explain the two different ways of harnessing energy from the ocean.

Answer

Basically there are three ways of harnessing energy from the oceans and seas, but we are today going to discuss only two,

Which are :-

1. OCEAN THERMAL ENERGY :-

The water at the surface of the sea or ocean which, has considerable depth or deepness, is heated by the Sun while as we go deeper and deeper in the ocean or sea the upcoming sections become relatively colder than the previous one. This difference in temperature is used to obtain energy in ocean-thermal-energy conversion plants. These plants can operate if the temperature difference between the water at the surface and water at depths up to 2 km is 293 K (20°C) or more. The warm surface-water is used to boil a volatile liquid like ammonia. The vapours of the liquid are then used to run the turbine of generator. The cold water from the depth of the ocean is pumped up and condense vapour again to liquid.

2. OCEAN TIDAL ENERGY :-

Due to the gravitational pull of mainly the moon on the spinning earth, the level of water in the sea rises and falls. This phenomenon is called high and low tides and the difference in sea-levels gives us tidal energy by the same method as we saw in hydroelectric power plant , but in this method the gravitational energy by moon gives potential energy as well as kinetic energy to the water thereby there is formation of tides or waves. Tidal energy is harnessed by constructing a dam across a narrow opening to the sea. A turbine fixed at the opening of the dam converts tidal energy to electricity.

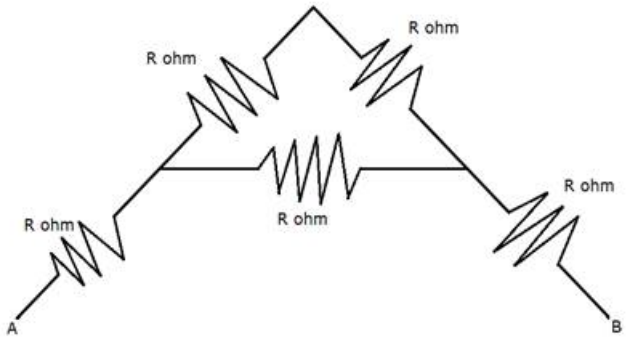
There is also Ocean wave energy.

8. Question

Five resistors of resistance ‘R’ are connected such that they form a letter ‘A’. Find the effective resistance across the free ends.

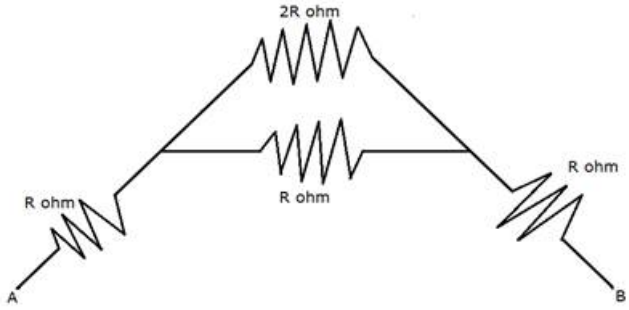
Answer

The simple resistors must be identified and after that they must be first solved and when they are solved look for again the simple resistors pattern solve till you end up with only one resistor.



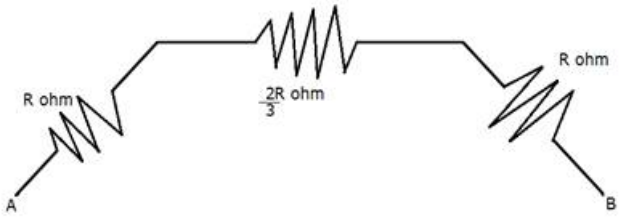
We will solve diagram by diagram,

First we will add the two top most resistors because they are in series, we get ,

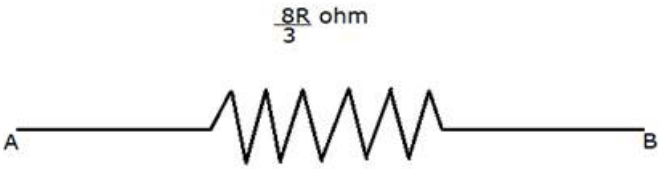


Now the two topmost resistors are parallel to each other because their free ends are attached to same points if we look it as wire.

We get,



Now these three are in series with each other, so we will add them simply like we are adding integers.



We will get,

Therefore, the total or the resultant resistance is = 8R/3 ohm.