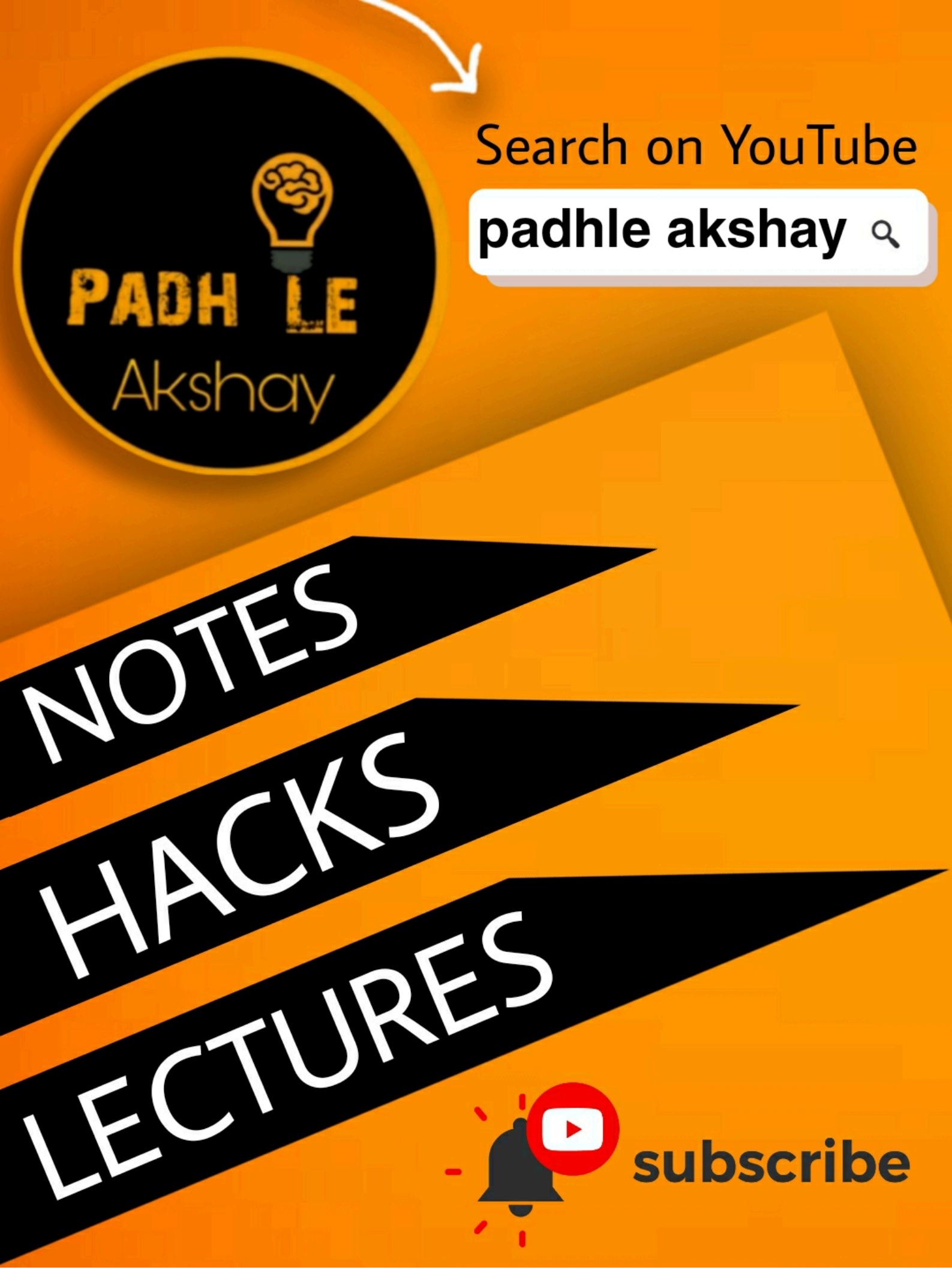
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NOTIFICATIONS

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Q.1. What is meant by resistance of a conductor? Name and define its SI unit. List the factors on which the resistance of a conductor depends. How is the resistance of a wire affected if

(i) its length is doubled,

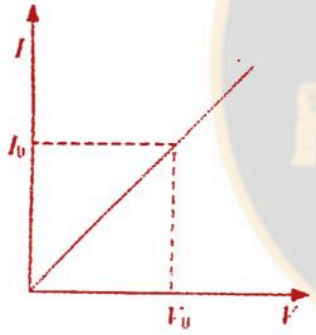
(ii) its radius is doubled? **[CBSE 2015]**

Ans. It is opposition offered to the flow of current by a conductor.
Ohm, it is the resistance of a conductor through which one ampere current flows under a potential difference of one volt.

The factors are-length, area of cross-section, material temperature.
(i) Length is doubled, resistance is doubled.
(ii) Radius is doubled, area of cross-section becomes 4 times, so resistance becomes one-fourth.

Q.2. While studying the dependence of potenital difference (V) across a resistor on the current (I) passing through it, in order to determine the resistance of the resistor, a student took 5 readings for different values of current and plotted a graph between V and I. He got a straight line graph passing through the origin. What does the straight line signify? Write the method of determining resistance of the resister using this graph. **[CBSE 2019]**

Sol.



Straight line graph between potential difference(V) and current (I) shows that resistor is a linear element and follows Ohm's Law.
Calculation of Resistance :

At any point on the graph, resistance is given as,

$$R = \frac{V^0 \text{ (value of potential difference at that point)}}{I^0 \text{ (value of current at that point)}}$$

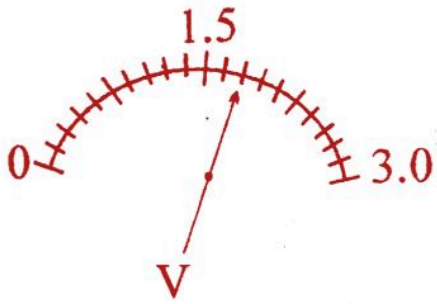
In other words, the Slope of the graph at any point gives the value 1/R

Hence, slope = $I^0 / V^0 = 1/R$

R = 1/Slope

$$= \frac{V^0 \text{ (value of potential difference at that point}}{I^0 \text{ (value of current at that point)}}$$

Q.3. Consider the sacle of voltmeter shown in the diagram and answer the following questions : **[CBSE 2019]**



(a) What is the least count of the voltmeter?

(b) What is the reading shown by the voltmeter ?

(c) If the voltmeter is connected across a resistor of 20fÇ, how much current is flowing through the resistor?

Sol. (a) Least count = 3/20 = 0.15 V

(b) (1.5 + 0.5 + 0.15) V = 1.8V

(c) R=20ohm V=1.8V, I = ?

By ohm's law

V=IR

1.8/20 = I

I = 0.09 A

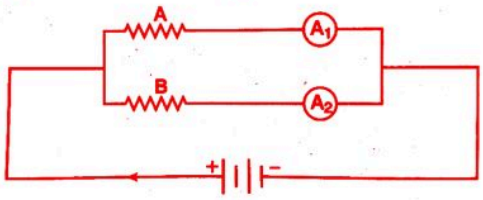
Q.4. An electric heater rated 800 W operates 6h/day. Find the cost of energy to operate it for ₹30 days at 3.00 per unit. **[CBSE 2011]**

Sol. Energy consumed = P x t = 800 × 6 × 30

= 144000 Wh = 144 kWh

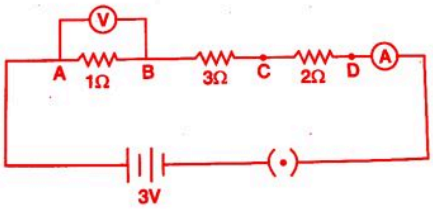
Cost of electricity = 144 x 3 = 432

Q.5. In the circuit diagram shown, the two resistance wires A and B are of same area of cross-section and same material, but A is longer than B. Which ammeter A_1 or A_2 will indicate higher reading for current? Give reason. **[CBSE 2011,17]**



Ans. Ammeter A2 shows higher reading. Because, since wire A is longer, it has greater resistance and so draws lesser current. So more current flows through B and A2 shows higher reading.

Q.6. How would the reading of voltmeter (V) change, if it is connected between B and C? Justify your answer. **[CBSE 2011,17]**



Sol. $R = R1 + R2 + R3 = 1 + 2 + 3 = 6ohm$

$V = IR, \quad V = V/R = 3/6 = 1/2\ A$

Voltage across 1ohm, $V = IR = 1/2 \times 1 = 0.5V$

Voltage across 3 ohm, $V = IR = 1/2 \times 3 = 1.5V$

Q.7. The resistance of a wire of 0.01 cm radius is 10ohm. If the resistivity of the material of the wire is 50×10^{-8} ohm meter, find the length of the wire [CBSE 2014]

Sol. Given, Radius = 0.01 cm = 0.01×10^{-2} m

Resistivity, $p = 50 \times 10^{-8}$ ohm m.

Resistance, R = 10ohm

$R = Pl/A = Pl/\pi r^2$

$l = R\pi r^2/p$

$$= \frac{10 \times 3.14 \times 0.01 \times 10^{-2} \times 0.01 \times 10^{-2}}{50 \times 10^{-8}}$$

$$= \frac{3.14 \times 10^{-4}}{50 \times 10^{-8} \times 10^{5}}$$

$$\text{Length} = \frac{6.28 \times 10^{-4}}{10^{-3}} = 0.628m$$

Q.8. (a) Write Joule's law of heating.

(b) Two lamps, one rated 100 W; 220 V, and the other 60 W; 220 V, are connected in parallel to electric mains supply. Find the current drawn by two bulbs from the line, if the supply voltage is 220 V. [CBSE 2018]

Sol. (a) Joule's law of heating $H = I^2Rt$

When electric current flows through resistance element, the flowing charges suffer resistance, the work done to overcome resistance is converted to heat energy.

(b) P1 =100W, V1=220W

$P_2 = 60$ W, $V_2 = 220$ W

$P = VI$

$I1 = P1/V1 = 100/220 = 10/22 = 0.45amp$

$I2 = P2/V2 = 60/220 = 3/11 = 0.27amp$

Q.9. Five resistors are connected in a circuit as shown. Find the ammeter reading when circuit is closed. [CBSE 2011]

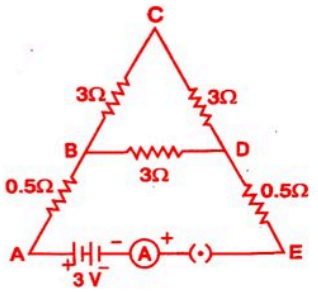
Sol. The resistance between the points B and D is x

$$x = \frac{3\Omega \times 6\Omega}{3\Omega + 6\Omega} = 2\Omega$$

Now the resistance of the whole combination is

$R = 0.5\Omega + x + 0.5\Omega = 0.5\Omega + 2.0\Omega + 0.5\Omega = 3.0\Omega$

Ammeter reading $= 3V/3\Omega = 1.0$ ampere



Q.1. (a)Name an instrument that measures electric current in a circuit. Define unit of electric current.

(b) What are the following symbols mean in an electric circuit?

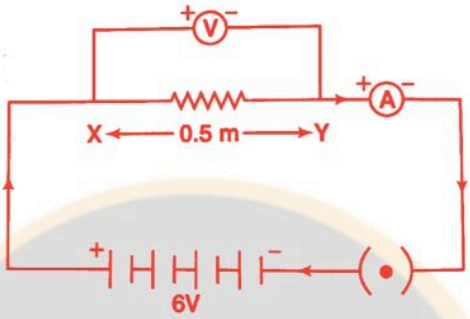
(i)  **(ii)** 

(c) Draw closed circuit diagram a consisting of 0.5 m long nichrome wire XY, an ammeter, a voltmeter, four cells of 1.5 V and a plug key. [CBSE 2015]

Ans. (a) An ammeter. The current is said to be one ampere if 1 coulomb of charge flows through a cross-section of conductor per second.

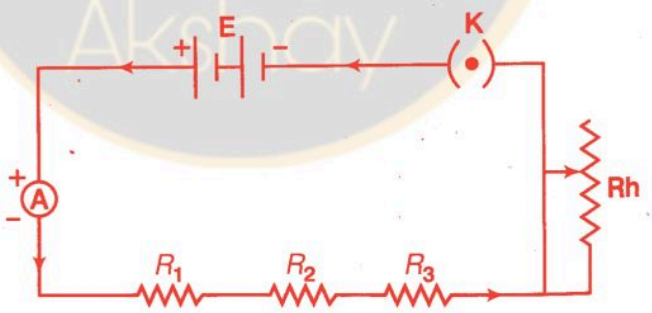
(b) (i) Rheostat (ii) Plug key (closed)

(c) The diagram is as shown.



Q.2. Draw a labelled circuit diagram showing three resistors R_1, R_2 and R3 connected in series with a battery (E), a rheostat (Rh), a plug key (K) and an ammeter (A) using standard circuit symbols. Use this circuit to show that the same current flows through every part of the circuit. List two precautions you would observe while performing the experiment. [CBSE 2015]

Ans. The circuit diagram is as shown.



Join three resistors of different values in series. Connect them with a battery, an ammeter, a rheostat and a plug key, as shown in figure. Plug the key.
Note the ammeter reading. Change the position of ammeter to anywhere in between the resistors. Note the ammeter reading each time. We observe that the value of the current in the ammeter is the same, independent of its position in the electric circuit. It means that in a series combination of resistors the current is the same in every part of the circuit or the same current through each resistor.

Precautions

(i) The current should not be passed for a long time.
(ii) All the connections should be tight.

Q.3. (a) Explain how does a cell maintain current in a circuit.

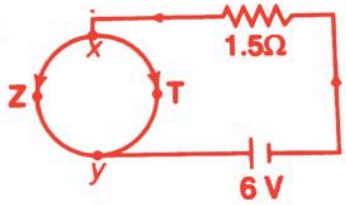
(b) In the circuit given below the resistance of the path xTy = 2Ω and that of xZy = 6Ω

(i) Find the equivalent resistance between x and y.

(ii) Find the current in the main circuit.

(iii) Calculate the current that flows through the path xTy and xZy.

[CBSE 2014]



Ans. (a) The chemical action within a cell generates the potential difference (P.D.) across the terminals of the cell. This potential difference sets and maintains current in the circuit.

(b) (i) Equivalent resistance, = 1/Re= 1/2 + 1/6

=3+1= 4/6 =2/3

6

Re = 1.5Ω

or

(ii) Total resistance of the circuit = Re +1.5Ω

=1.5Ω + 1.5Ω = 3Ω

Current (I) = 6V/3Ω = 2A

(iii) P.D. across the parallel combination of 2Ω and 6Ω = 1.5 x 2 = 3 V

Q.4 (i) A wire of resistivity p is stretched to double it's length. What is it's new resistivity. Give reason for your answer.

(ii) Draw a schematic diagram of a circuit consisting of a battery of three cells of 2V each, a 5Ω resistor, 8Ω resistor and 12Ω resistor and a plug key all connected in series.

(iii) Two wires, one of copper and other of manganese have equal lengths and equal resistances which is thicker. (Given that resistivity of manganese is lower than that of copper.)

[CBSE 2013,14,17]

Ans. (i) Given that resistivity of manganese is lower than that of copper, it remains unchanged because resistivity depends on nature of material.

(iii) Rcopper = Pc.lc/Ac

Rm = Pm lm/Am

Now, Rc = Rm (given)

Lc=Lm (given)

Pc/Ac =Pm/Am

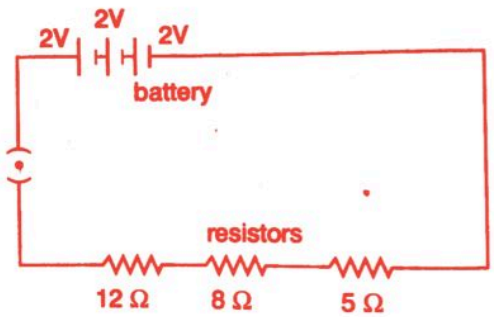
or

Pc/Pm = Ac/Am

Since, Pm <Pc Am < Ac

Copper wire will be thicker.

(ii)



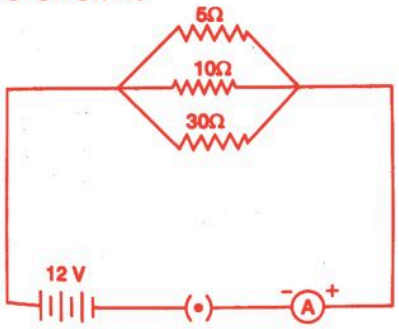
Q.5.(i) How will you convert a given set of resistors so that the equivalent resistance is increased? Give reason for your answer. [CBSE 2012]

(ii) In the given circuit diagram, calculate

(a) the value of current through each resistor

(b) the total current in the circuit

(c) the total effective resistance of the circuit.



Sol. (i) In series because R = R1 + R2 + R3

(ii) (a) I1=V/R1 =12/5 =2.4A

I2= V/R2 =12/10 = 1.2 A

I3=V/R3=12/30 = 0.4 A

(b) Total current I = I1 + I2 + I3 = 2.4A + 1.2A + 0.4A = 4A

(c) Total effective resistance

1/R=1/R1+1/R2+1/R3

=1/5+1/10+1/30

R = 3Ω

Q.6.Define power. State the difference between 1 watt and 1 watt hour. Establish the relationship between unit of electric energy and SI unit of energy. An electrical heater rated W/220 V operates 2 hours daily. Calculate the cost of energy to operate for 30 days at the rate of 5.00 per kWh. [CBSE 2012]

Sol. Power is defined as the rate at which electric energy is dissipated or consumed in an electric current.

1 watt is the power consumed by a device that carries a current of 1 A when operated at a potential difference of 1 V while 1 watt hour is the energy consumed when 1 watt of power used for 1 hour.

Commercial unit of electric energy is kWh.

1 kWh = 1000 watt x 3600 s

1 kWh = 3.6×10^6 watt second

= 3.6×10^6 J

Total energy consumed by heater

= 1000 W x 2h × 30

= 60000 Wh

= 60 kWh

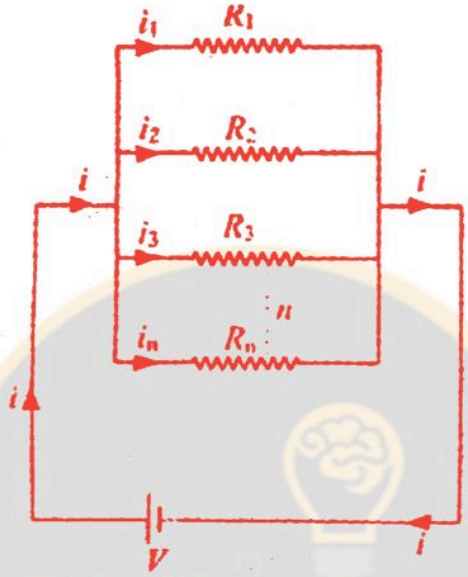
Therefore, cost of energy to operate for 30 days

= ₹5 × 60 = ₹300

Q.7. (a) With the help of a suitable circuit diagram prove that the reciproal of the equivalent resistance of a group of resistances joined in parallel is equal to the sum of the reciprocals of the individual resistances.

(b) In an electric circuit two resistors of 12Ω each are joined in paralle to a 6 V battery. Find the current drawn from the battery. **[CBSE 2019]**

Sol. Let there are n resistances, each of value R_1, R_2 .....Rn, respectively, are connected in parallel to a battery of voltage V. If the equivalent resistance of the circuit is Req, then current drawn from the battery is i = V/Req.



The total current i then divides into i1, i2, i3.... ...in, respectively in the given resistors. As all the resistances are connected in parallel, hence the voltage across each resistor is V volt. Now we can write.

i=i1+i2+i3+.....+ieq

V/Req =V/R1+V/R2+V/R3.....V/Rn .....(1)

From eq. 1.

1/Req=1/R1+1/R2+1/R3.....+1/Rn

Hence, reciprocal of the equivalent resistance is equal to the sum of reciprocal of each resistor jointed in parallel.

(b) Let net resistance of the given parallel combination be Rnet.

Then,

1/Rnet= 1/12+1/12

1/Rnet=2/12=1/6

Rnet=6Ω

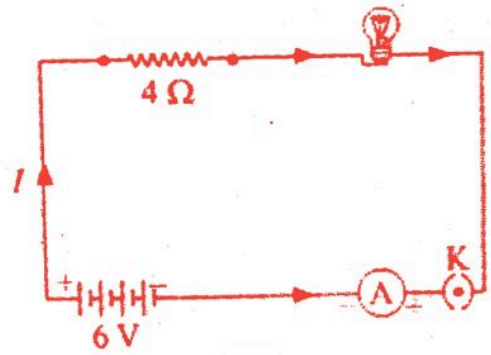
Hence,

current, i =V/Rnet

=6 V/6Ω = 1 A

Q.8. An electric lamp of resistance 20Ω and a conductor of resistance 4Ω are connected to a 6 V battery as shown in the circuit. Calculate:
(a) the total resistance of the circuit.
(b) the current through the circuit.
(c) the potential difference across the (i) electric lamp and (ii) conductor, and
(d) power of the lamp.
[CBSE 2019]

Sol.

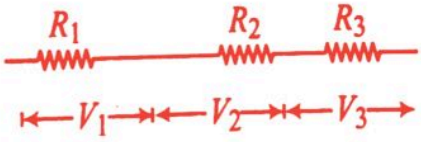


Resistance of electric lamp = 20Ω
Resistance of Condctor = 4Ω
Voltage of battery = 6 V

(a) Total resistance of the circuit
= 20 Ω + 4 Ω = 24 Ω
(c) Current in the circuit = I
Applying Ohm's law in the circuit,
V = IR
6 V=I x 24Ω
I = 6 V/24 Ω = 0.25 A
Hence current in the circuit is 0.25 Ampere.
(c) Potential difference across lamp.
Vlamp = IR
Vlamp = 0.25 A × 20Ω = 5 V
Vlamp = 5V
Potential difference across conductor.
VConductor = IR
VConductor = 0.25 A x 4Ω = 1V
VConductor = 1V
(d) Power of Lamp=I^2R = $(0.25)^2$ × 20 = 1.25 W

Q.9. (a) Three resistors of resistances R1, R2 and R3 are connected (i) in series, and (ii) in parallel. Write expressions for the equivalent resistance of the combination in each case.
(b) Two identical resistros of 12Ω each are connected to a battery of 3V. Calculate the ratio of the power consumed by the resulting combinations with minimum resistance and maximum resistance. R_1 =12Ω R_2 = 12Ω
[CBSE 2019]

Ans. (i) Resistance are connected in series:



V= V1+V2+V3

Same current will pass through all resistors

Using ohm's law

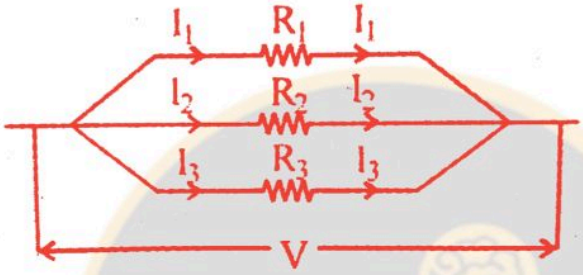
IRs=IR1 + IR2 + IR3

IRs= I(R1 + R2 + R3)

Rs = R1+ R2 + R3

Where, Rs ---> Equivalent resistance in series.

(ii) Resistors connected in parallel :



Potential difference across the resistors will be same I = I1 + 12 + 13

Using Ohm's law

V/Rp= V/R1 + V/R2 + V/R3

1/Rp=1/R1 + 1/R1 + 1/R2 + 1/R3

(b) V = 3V

Minimum resistance → Parallel combination.

1/R=1/R1 + 1/R2 = 12.12/(12+12)= 6Ω

6Ω=minimum resistance

P = V^2/R = (3) $^2/6$ = 9/6 = 3/2 = 1.5 watt

for maximum resistance

R = $R_1 + R_2$ = 12 + 12 = 24Ω

Pmin = V^2/R = $(3)^2/24$ = 9/24 = 3/8 Watt

Pmin/Pmin = 3/8 = 1/4

Q.10 (a) Write the relation between resistance and electrical resistivity of the material of a conductor in the shape of a cylinder of length 'l ' and area of cross-section 'A'. Hence derive the S.I. unit of electrical resistivity.

(b) Resistance of a metal wire of length 5 m is 100Ω. If the area of cross section of the wire is 3 x 10^{-7} m^2, calculate the resistivity of the metal. [CBSE 2019]

Sol. (a) $R = pl/A$

δ= Electrical resistivity

A = cross sectional area.

l = length of cylindrical wire.

unit of $p = RA/l = \Omega m^2/m = \Omega\text{-}m$

(b) $R = 100\Omega$

$l = 5\ m$

$A = 3 \times 10^{-7}\ m^2$

$k = pl/A$

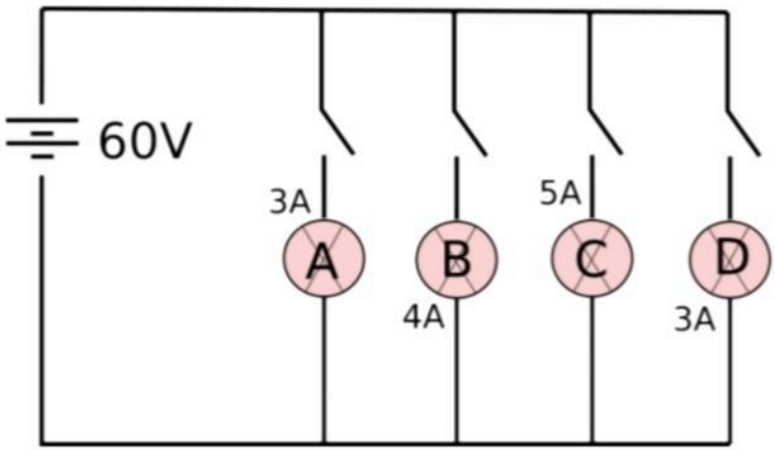
$p = RA/l$

$\delta = (100 \times 3 \times 10^{-7})/5$

$= 60 \times 10^{-7}$

$= 6 \times 10^{-6}\ \Omega\text{-}m$

In the given circuit, A, B, C and D are four lamps connected with a battery of 60V.



Analyse the circuit to answer the following questions.

(i) What kind of combination are the lamps arranged in (series or parallel)?
(ii) Explain with reference to your above answer, what are the advantages (any two) of this combination of lamps?
(iii) Explain with proper calculations which lamp glows the brightest?
(iv) Find out the total resistance of the circuit.

ANSWERS

(i) The lamps are in parallel.

(ii) Advantages:
(a)If one lamp is faulty, it will not affect the working of the other lamps.
(b)They will also be using the full potential of the battery as they are connected in parallel.

(iii)The lamp with the highest power will glow the brightest.
P=VI
In this case, all the bulbs have the same voltage. But lamp C has the highest current.
Hence, for Lamp C P=5 x 60 Watt = 300 W. (the maximum).

(iv)The total current in the circuit = (3+4+5+3) A = 15A
The Voltage 60V
V=IR and hence R = V/I
= 60/15 A = 4A

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Multiple Choice Questions

& SCAN DONATE

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1. The unit of specific resistance is

(a) Ohm
(b) Ohm per second
(c) Ohm meter
(d) Ohm per meter

2. If a wire of resists R is melted and recast into half of its length, the new resistance of wire will be

(a) R/4
(b) R/2
(c) R
(d) 2R

3. If R1 and R2 are the resistance of statements of a 400 W and 200 W lamp designed to operate at same voltage then

(a) R2 = 2R2
(b) R2 = 2R1
(c) R2 = 4R1
(d) R1 = R2

4. Electric potential is

(a) Scalar quantity
(b) Vector quantity
(c)Neither scalar nor vector
(d) Sometimes scala sometimes vector

5. A current of 2A passes through a conductor and produces 80 joules of heat in 10 seconds. The resistance of the conductor is

(a) 0.5 Ω
(b) 2 Ω
(c) 4 Ω
(d) 20 Ω

6. Ohm's law is valid only when

(a) Temperature increases
(b) Temperature decreases
(c) Grave between V and I is straight arm
(d) Temperature remains constant

7. I is the current through a wire and 1 is the charge of electron, then no. of electrons jnt seconds will be

(a) I1/t
(c) It1
(b) 1/It
(d) It/1

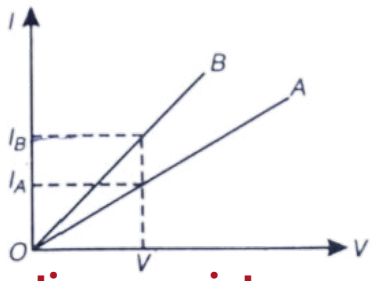
8. A man has five resistors each of 1/5Ω.What is the maximum resistance he can obtain by connecting them?

(a)1Ω
(b) 5Ω
(c)1/2Ω
(d)2/5Ω

9. Conventionally the direction of the current is taken as

(a) Direction of flow of -ve change
(b) The direction of flow of atomic
(c) The direction of flow of molecules
(d) The direction of flow of +ve charge

10. Graphs between electric current and potential difference across two Conductions A and B are shown in the figure. Which of the following conduction has more resistance?



(a) B
(b) A
(c) Both have equal resistance
(d) None of these

11. If the resistance of wire A is four times resistance of wire B then the ratio of Cross sectional areas of wires is

(a) 1:2
(b) 1:4
(c) 1: 8
(d) 1: 6

12. It the resistance of wire A is four times resistance of wire B then ratio of radii of two wires is

(a) 1:2
(b) 1:4
(c) 1:6
(d) 1:8

13. The resistance of germanium with rise in temperature

(a) increase
(b) decreases
(c) remains same
(d) first increases then decreases

14. An electric bulb is rated 220 V-100 W. If it is operated at 110 V then power consumed by it will be

(a) 100 W
(b) 50 W
(c) 25 W
(d) 400 W

15. A house is fitted with 10 tubes each of 40 W. If all tubes are lighted for 10 hours and in if the cast of one unit of electricity energy is Rs. 250 the total cost of electricity consumption is

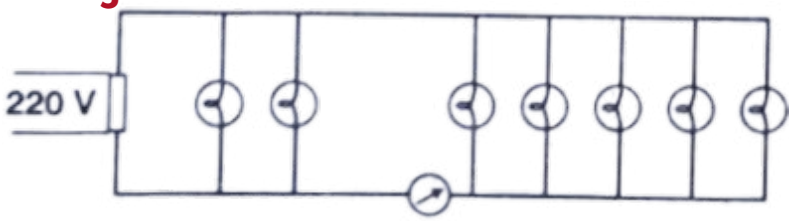
(a)₹100
(b)₹20
(c)₹25
(d)₹10

16. The commonly used safety fuse wire is made of

(a) Copper
(b) Lead
(c) Nickel
(d) An alloy of timand lead

17. Seven identical lamps of resistance 220Ω each are connected to a 220 V line as ^ show in figure. Then reading of ammeter well be

(a)1/10A
(b)2/5A
(c)3/10A
(d) none of these



18. Number of kilowatt hours=volt x ampere x..... /1000

(a) Time in seconds
(b) Time in minutes 1000
(c) Time in hours
(d) Time in days

19. Kilowatt hour (kWh) is equal to

(a) 3.6×10^6 MJ
(b) 3.6×10^5 MJ
(c) 3.6×10^2 MJ
(d) 3.6 MJ

20. Kilowatt hour is unit of

(a) Energy
(b) Power
(c) Impulse
(d) Force

21. The resistance of a conductor is reduced to Fit half its initial value. In doing so the heating vit effects in the conductor will become

(a) half
(b) double
(c) one fourth
(d) four times

22. The coil of heater is cut into two equal halves and only one of them is used in the ter. The ratio of heat produced by half of the coil to produced in original coil

(a) 2:1
(b) 4:1
(c) 1:2
(d) 1:4

23. Materials which allow larger current to flow through them are called

(a) Insulators
(b) Conductors
(c) Semiconductors
(d) Alloy

24. The resistivity of a wire

(a) varies with its length
(b) varies with its Mass
(c) varies with its cross section
(d) is independent of length, cross section Q mass of wire

25. What sete electron into motion in an electric circuit?

(a) Battery/cell
(b) Resistor
(c) Rheostat
(d) Ammeter

26. An electric geyser has Rating 2000 W, 220 V on it. What is the minimum setting of fuse wire that may be required for use with this geyser?

(a) 5 A
(b) 10 A
(c) 15 A
(d) 20 A

27. Two metallic,wires A and B are connected in parallel. Wire A has length T and radius Y and wire B has a length '2V and radius '2r' Then the ratio of total resistance of parallel combination and the resistance of wire A is

(a) 1:2
(b) 1:3
(c) 1:4
(d) 1:5

28. Correct formula for Joules law of heating is

(a) $H = I^2RT$
(b) H=I.V.T
(c) $H=V^2T/R$
(d) All of these

ANSWERS

1.-- c
2.-- a
3.-- b
4.-- a
5.-- b
6.-- d
7.-- d
8.-- a
9.-- d
10.- a
11.-- b
12.-- a
13.-- b
14.-- c
15.-- d
16.-- d
17.-- d
18.-- c
19.-- d
20.-- b
21.-- a
22.-- a
23.-- b
24.-- d
25.-- a
26.-- b
27.-- b
28.-- d

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Case-Based Questions

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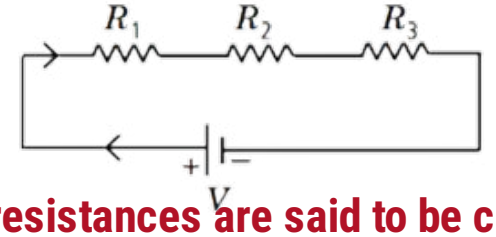
Read the following passage carefully and answer following questions:

QUESTION 1:

Two or more resistances are connected in series or in parallel or both, depending upon whether we want to increase or decrease the circuit resistance.



The two or more resistances are said to be connected in series if the current flowing through each resistor is same. The equivalent resistance in the series combination is given by $Rs=R^1+R^2+R^3$

i. When three resistors are connected in series with a battery of voltage V and voltage drop across resistors is V_1, V_2 and V_3, which of the relation is correct?

(a) $V=V_1=V_2=V_3$
(b) $V=V_1+V_2+V_3$
(c) $V_1+V_2+V_3=3V$
(d) $V > V_1+V_2+V_3$

ii. When the three resistors each of resistance RΩ ,connected in series, the equivalent resistance is

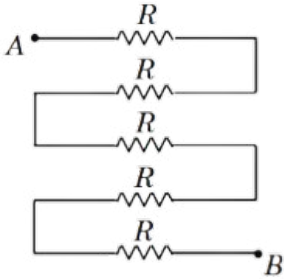
(a) R/2
(b) >R
(c) <R/2
(d) < R

iii. There is a wire of length 20 cm and having resistance 20Ωcut into 4 equal pieces and then joined in series. The equivalent resistance is

(a) 20Ω
(b) 4Ω
(c) 5Ω
(d) 10Ω

iv. In the following circuit, find the equivalent resistance between A and B is (R = 2Ω)

(a) 10Ω
(b) 5Ω
(c) 2Ω
(d) 4Ω



ANSWERS

i. b
ii. b
iii. a
iv. a

QUESTION 2:

The heating effect of current is obtained by transformation of electrical energy in heat energy. Just as mechanical energy used to overcome friction is converted into heat, in the same way, electrical energy is converted into heat energy when an electric current flows through a resistance wire. The heat produced in a conductor, when a current flows through it is found to depend directly on

(a) strength of current
(b) resistance of the conductor
(c) time for which the current flows.

The mathematical expression is given by $H = I^2RT$. The electrical fuse, electrical heater, electric iron, electric geyser etc. all are based on the heating effect of current.

i. What are the properties of heating element?

(a) High resistance, high melting point
(b) Low resistance, high melting point
(c) High resistance, low melting point
(d) Low resistance, low melting point.

ii. What are the properties of electric fuse?

(a) Low resistance, low melting point
(b) High resistance, high melting point.
(c) High resistance, low melting point
(d) Low resistance, high melting point

iii. When the current is doubled in a heating device and time is halved, the heat energy produced is

(a) doubled
(b) halved
(c) four times
(d) one fourth times

iv. A fuse wire melts at 5 A. It is is desired that the fuse wire of same material melt at 10 A. The new radius of the wire is

(a) 4 times
(b) 2 times
(c)1/2times
(d)1/4times

ANSWERS

i. a
ii. c
iii. a
iv. b