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Class: 10
Subject:
Topic: Electricity
No. of Questions: 20

Q1. A wire of resistivity ρ is stretched to double its length. How does it affect the (a) resistance (b) resistivity?

Sol. (a) wire is stretched to double its length

So, New length of wire l'= 2l

New Area of cross section or thickness of wire A'= A/2

New resistance = r =(ρ x 2l) /(A/ 2) = 4ρl/ A = 4 R

Hence, new resistance =4 times of the initial

(b) The resistivity is a property of a material and thus is a constant.

So, in this case, by increasing the length of the wire we are not altering its resistivity. It will remain the same, ρ

Q2. A wire of resistance 10 ohm is bent in the form of a closed circle. What is the effective resistance between the two points at the end of any diameter of the circle?

Sol. A wire of resistance 10 ohm is bent in the form of a closed circle

So, R1 = R2 = 5 Ohm form a parallel loop

R' = (R1.R2)/(R1+ R2) = (5x5)/(5+5) = 2.5 Ohm

Q3. List two safety measures commonly used in electric circuits. Explain the main function of each.

Sol. Two safety measures commonly used in electric circuits and appliances are

(i) Electric Fuse: An electric fuse is connected in series it protects the circuit from overloading and prevents it from short circuiting.

(ii) Proper earthling of all electric circuit in which any leakage of current in an electric appliance is transferred to the ground and people using the appliance do not get the shock.

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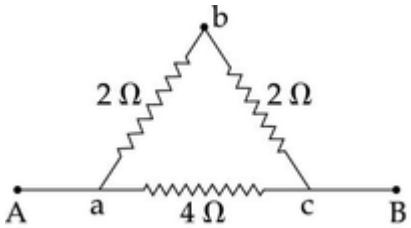
Q4. With the help of a circuit diagram prove that when a number of resistors are connected in parallel the reciprocal of the equivalent resistance of the combination is equal to the sum of the reciprocals of the individual resistances of the resistors.

Find the resistance between A and B in the following network



Sol. The resistance between a to b and b to c = R1= 2 + 2 = 4 ohm

R2 = 4 Ohm

The resistance between A and B =R' = (R1xR2)/(R1+ R2) = 4x4/(4+4) = 2 Ohm

Q5. (a) How does the resistance of a wire change when?

(i) Its length is tripled?

(ii) Its radius is tripled?

(iii) Its material is changed to one whose resistivity is three times?

(b) List two reasons why nichrome is used for making heating element of electrical appliances.

Sol. (a)

(i) We know that resistance of wire is directly proportional to length of wire

So, if its length is tripled the resistance increases 3 times

(ii) We know that resistance of wire is inversely proportional to area of cross section of wire

New radius = 3r so, New area increases 9 times

Thus the resistance of a wire decreases 9 times

(ii) $R = \rho l/A$

New resistivity $\rho' = 3\rho$

New Resistance $R' = 3\rho l/A = 3R$

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Thus, the resistance of wire increases 3 times

(b) Nichrome is used for making heating element of electrical appliances because:

(i) Nichrome does not oxidize i. e. burn easily at high temperatures as it has higher melting and boiling point than metals.

(ii) Nichrome has higher resisistivity and consequently a higher resistance. Therefore, it will resist the flow of charges more, and lead to development of heat faster

Q6. Mention one reason why tungsten is used for making filament of electric lamp.

Sol. tungsten does not oxidize, i. e. burn easily at high temperatures as it has higher melting and boiling point than metals

Q7. List two characteristics of the material to be used in fuse wire. Name the material it is made of. A fuse is always connected in series in an electric circuit? Justify this statement giving reason

Sol. two characteristics of the material to be used in fuse wire

(a) Low melting and boiling point (b) high electric resistance

Fuse is generally made up of an alloy of tin and lead

In series connection the current for the entire house pass through the fuse. So, when fuse melts , it breaks down the entire home circuit and no current flows to the household circuitry. Thus, a fuse is always connected in series

Q8. A circuit has a line of 5 A. How many lamps of rating 40 W; 220 V can simultaneously run on this line safely?

Sol. P = VI so, I = P/V = 40/220

No of lamp can simultaneously run on this line safely = 5A/(40/220)A = 27

Q9. Several electric bulbs designed to be used on a 220 V electric supply line, are rated 10 W. How many lamps can be connected in parallel with each other across the two wires of 220 V line if the maximum allowable current is 5 A?

Sol. P = V × I so, I = P/v = $\frac{10}{220}$

No. of lamp can simultaneously run on this line safely = $\frac{5A}{(10/220)A} = 110$

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Q10. Express work done in an electric field in terms of charge and potential difference. Calculate the amount of work done in carrying a charge of 5 mC against a potential difference of 100 V

Sol. Work dome = charge x potential difference

the amount of work done in carrying a charge of 5 mC against a potential difference of 100 V = $5 \times 10^{-3} \times 100 = 0.5$ J

Q11. Distinguish between kilowatt and kilowatt hour. For a heater rated at 4.4 kW; 220 V. Calculate the -

(i) Current drawn by the heater (ii) resistance of the heater element

(iii) Energy consumed by the heater in 4 hours (iv) cost of running the heater if 1 kWh costs Rs. 6.50

Sol. Kilowatt is the unit of Power whereas Kilowatt hour is the commercial unit of energy.

Given, P = 4.4 kW = 4400 W and V = 220 volts

(i) As P = V xI So, I = P/V = 4400/220 = 20 A

(ii) As $P = I^2 \times R$ So, $R = P/I^2 = 4400/(20)^2 = 11$ ohms

(iii) Since, electric energy = electric power X time = 4.4 kW X 4 hours = 17.6 kWh

(iv) Since, 1KwH costs Rs. 6.50, hence, costs of 17.6 kWh = 17.6 X 6.50 = Rs. 114.4

Q12. Distinguish between resistance and resistivity of a conductor.

Sol. Resistivity

1. It is the measure of a material's ability to oppose the flow of current.

2. It depends on the property of the material. Its value is constant for a particular range of temperature.

3. Unit of resistivity is Ohm meter

Resistance

1. It is a measure of the opposition that a circuit (or an electrical element) offers to the flow of electric current.

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2. Resistance of a conductor is directly proportional to its length and inversely proportional to its area of cross¬ section.

3. Unit of resistance is Ohm

Q13. Which has more resistance: 100W bulb or 60W bulb?

Sol. We know that: $R = V^2/P$

As R is inversely proportional to P for constant V. Thus, the resistance of 60W bulb is more.

Q14. Ammeter burns out when connected in parallel. Give reasons.

Sol. Ammeter consists of a wire of low resistance when connected in parallel; a large amount of

Current passes through it hence gets burnt i.e. short circuited.

Q15. Two fuse wire A and B of the same length are rated 15A and 5A. Which amongst the A and B will be thicker and why?

Sol. The wire A with 15 A rating is thicker. It is because, thicker the wireless is the resistance and hence it can carry more current.

Q16. Two bulbs marked 200 Watts – 250 V, and 100 Watts – 250 V are joined in series to 250 V supply. Find the power consumed by the circuit

Sol. The resistance of first and second bulb are $R1 = (250)^2 /200$ and $R2 = (250)^2/100$

The total resistance when the bulbs are connected in series will be

$R = R1+R2 = (250)^2 /200 + (250)^2 /100 = 312.5 + 625 = 937.5$ Ohm

The total power consumption when they joined in series to 250 V supply. The power consumed in the circuit will be,

$P = V^2 /R = (250)^2 /937.5 = 66.66$ W

Q17. What is conductance?

Sol. The measure of how efficiently electricity travels along a particular pathway via an electrical component is known as conductance.

When a current of one ampere (1 A) passes through a component across which a voltage of one volt (1 V) exists, then the conductance of that component is 1 S. The siemens is, in fact, equivalent to one ampere per volt.

$G = I/V$

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Since, V =IR

G= 1/R

Conductance is actually the inverse or reciprocal of resistance. With this, the higher the resistance, the lesser the degree of conductance. With this idea, a symbol was derived for conductance, "G," and is measured in Siemens (S) , formerly known as the mho.

Q18. A household uses the following electric appliances:

(i) Refrigerator of rating 400W for ten hours each day.
(ii) Two electric fans of rating 80W each for twelve hours each day.
(iii) Six electric tubes of rating 18W each for 6 hours each day.
Calculate the electricity bill of the household for the month of June if the cost per unit of electric energy is Rs. 3.00

Sol. Electrical energy consumed per day = 400x10+2x80x12+6x18 = 4000+1920+108

= 6028 watt hour

= 6.028 k watt hour

Electric bill for the month of June = 6.028 ×3 ×30

= 542.52 Rs.

Q19. Two wires of same material and same length have radii r_1 and r_2. Compare their resistances.

Sol. If R_1 and R_2 are resistances, then $R_1 / R_2 = r_2^2 / r_1^2$ because ρ and I are same.

Q20. The resistors are generally made of thin wires of Eureka or Manganin while the wires used in connections are made comparatively thicker and are of copper or aluminium. Why? Give reason.

Sol. The resistors are generally made of thin wires of Eureka or Manganin while the wires used in connections are made comparatively thicker and are of copper or aluminium. This is because thicker wire has less resistance than thinner wire