



PHYSICS

BOOKS - PRADEEP PHYSICS (HINGLISH)

ELECTRICITY

Solved Problem

1. A conductor carries a current of 0.2*A*. Find the amount of charge that will pass through the cross-section of the conductor in 30*s*. How many electrons will flow in this time interval if the charge on one electron is $1.6 \times 10^{-19}C$? A. $1.5 imes 10^{19}$

B. $3.9 imes10^{19}$

 $\text{C.}~6.75\times10^{19}$

D. $3.75 imes10^{19}$

Answer: D

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2. The filament of an electric lamp draws a current of 0.4A which lights for 3 hours. Calculate the amount of charge that flows through the circuit.

A. 1320 C

B. 4320 C

C. 2000 C

D. None

Answer: B



3. An electric iron draws a current of 0.5 when voltage is

200V. Calculate the amount of charge flowing through it

in one hour.



4. Calculate the amount of work done to carry 4C of charge from a point at 100V to a point at 120V.

A. 80J

B. 100J

C. 5J

D. 120J

Answer: A

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5. What is the resistance of an electric arc lamb when hot,

if the lamp uses 20A when connected to a 200 volt line ?



6. Calculate the potential difference required across a conductor of resistance 5Ω resistance. It draws a current of 0.3A when glowing from a source of 3V. Calculate the resistance of the bulb when glowing and explain the reason for the difference in resistance.



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7. A torch bulb when cold has 1Ω resistance. It draws a current of 0.3A when glowing from a source of 3V. Calculate the resistance of the bulb when glowing and explain the reason for the difference in resistance.



8. How much current does an electric heater draw from a 220V line, If the resistance of the heater (when hot) is 50Ω ?



9. The resistance of a wire of length 80cm and of uniform

area of cross-section $0.025 cm^2$, is found to be 1.50 ohm.

Calculate the resistivity of the wire.



10. Calculate the resistance of 1km long copper wire of radius 1mm. Resistivity of copper is $1.72 imes 10^{-8} \Omega m$.



11. Two copper wires A and B of length 30 m and 10 m have

radii 2cm and 1cm respectively. Compare the resistances

of the two wires. Which will have less resistance?



12. Suppose a 6-volt battery is connected across lamp whose resistance is 20Ω through a variable resistor as shown in (Fig. 3.11). If the current in the circuit is 0.25A,

calculate the value of the resistance from the resistor

which must be used ?



13. In the circuit diagram given in (a), suppose the resistors R_1 , R_2 and R_3 have values 5Ω , 10Ω and 30Ω respectively, which have been connected to a battery of 12V. Calculate

(a) the current through each resistor,

(b) the total current in the circuit, and

(c) the total circuiot resistance.



calculate.

(a) the total resistance and

(b) the total current flowing in the circuit.



15. When two resistors of resistances R_1 and R_2 are connected in parallel, the net resistance is 3Ω . When connected in series, its value is 16Ω . Calculate the values of R_1 and R_2 .





17. Three resistors are connected as shown in the diagram.



Though the resistor 5 ohm, a current of 1 ampere is flowing.

(i) What is the current through the other two resistors?

(ii) What is the p.d. across AB and across AC?

(iii) What is the total resistance?



18. A 24 volt battery is connected to the arrangement of resistances shown in (Fig.) Calculate

(i) the total effective resistance of the circuit,

(ii) the total current flowing in the circuit.



19. Three resistors of 6Ω , 3Ω and 2Ω are connected together so that the total resistance is greater than 6Ω but less than 8Ω . Draw a diagram to show this arrangement and calculate its total resistance.



20. For the combination of resistors shown in (fig.)

(a) find the equivalent resistance between

(i) C and D and

(ii) A and B.



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21. An electric bulb is rated at 200V - 100W. What is its resistance ? Five such bulbs burn for four hours. What is the electrical energy consumed ? Calculate the cost if the rate is 50 paise per unit.

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22. A torch bulbs is rated at 2.5V and 750mA. Calculate

its

(i) power

(ii) its resistance and

(iii) the energy consumed if the bulb is lighted for 4hour.



23. A 6V - 12W lamp is connected in series with a source of 12V supply. Calculate the value of the resistance R for the proper working of the lamp. What is the current flowing through the circuit ?

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24. Two coils of resistances 3Ω and 6Ω are connected in series across a battery of emf12V. Find the electrical energy consumed in 1 minute in each resistance when these are connected in series.

A. 500 J, 500 J

B. 320 J, 640 J

C. 320 J, 320 J

D. None of these

Answer: B

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25. Two bulbs A and B are rated 100W - 120V and 10W - 120V respectively. They are connected across a 120V source in series. Which will consume more energy?

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1. What does an electric circuit mean ?

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2. Define the unit of current.

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3. Calculate the number of electrons constituting one coulomb of charge.



4. Name a device that helps to maintain a potiontial

difference across a conductor.



6. How much energy is given to each coulomb of charge passing through a 6V battery ?

B. 10 J

C. 12 J

D. 6 J

Answer: D

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7. On what factors does the resistance of a conductor

depend ?



8. Will current flow more easily through a thick wire or a thin wire of the same material when connected to the same source ? Why ?

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9. Let the resistance of an electrical component remain constant while the potential difference across the two ends of the component decreases to half its former value. What change will occur in the current through it ?



10. Why are coils of electric toasters and electric irons made of an alloy rather than a pure metal ?



11. Use the data in Table 3.1 to answer the following :

(a) Which among iron and mercury is a better conductor ?

(b) Which material is the best conductor ?

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12. Draw a schematic diagram of a circuit consisting of a battery of three cells of 2V each, a 5 ohm resistor, an 8

ohm resistor, and a 12 ohm resistor, and a plug key, all

connected it series.

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13. Redraw the circuit of Q.12, putting in an ammeter to measure the current through the resistors and a voltmeter to measure the voltage across the 12ohm resistor. What would be the readings in the ammeter and the voltmeter ?



14. Judge the equivalent resistance when the following are

connected in parallel.

(a) 1Ω and $10^6\Omega$

(b) 1Ω and $10^8\Omega$ and $10^6\Omega$.



15. An electric lamb of 100Ω , a toaster of resistance 50Ω and a water filter of resistance 500Ω are connected in parallel to a 220V source. What is the resistance of an electric iron connected to the same source that takes as much current as all three appliances ans what is the current through it ?



16. What are the advantages of connecting electrical devices in parallel with the battery instead of connected them in series ?

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17. How can three resistors of resistances $2\Omega,\,3\Omega$, and 6Ω

be connected to give a total resistance of

(a) 4Ω

(b) 1Ω ?

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18. What is :

(a) the highest

(b) the lowest total resistances that can be secured by

of resistances

combinations of four coils

 $4\Omega, 8\Omega, 12\Omega, 24\Omega$?

A. 50ohm, 4ohm

B. 48 ohm, 2 ohm

C. 48 ohm, 8 ohm

D. None of the above

Answer: B



19. Why does the cord of an electric heater not glow while

the heating element does ?



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21. An electric iron of resistance 20Ω takes a current of 5A.

Calculate the heat developed in 30s.



22. What determines the rate at which energy is delivered

by a current ?

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23. An electric motor takes 5A from a 220V line.

Determine the power and energy consumed in 2h.

A. 7920348 J

B. 7120000 J

C. 7020000 J

D. 7920000 J

Answer: D



1. A piece of wire of resistance R is cut into five equal parts. These parts are then connected in parallel. If the equivalent resistance of this combination is R', then the ratio R/R' is :

A. 1/25

B. 1/5

 $\mathsf{C.}\,5$

 $\mathsf{D}.\,25$

Answer: D



2. Which of the following terms does not represent electrical power in a circuit :

A. $I^2 R$

 $\mathsf{B}.\,IR^2$

 $\mathsf{C}.\,VI$

 $\mathsf{D.}\, V^{\,2}\,/\,R$

Answer: D



3. An electric bulb is rated 220V and 100W. When it is operated on 110V, the power consumed will be :

A. 100 W

B. 75 W

C. 50 W

D. 25 W

Answer: D

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4. Two conducting wires of the same material and of equal length and equal diameters are first connected in series and then in parallel in an electric circuit. The ratio of the heat produced in series and parallel combinations would be :

A. 1:2

B. 2:1

C. 1:4

D.4:1

Answer:



5. How is voltmeter connected in the circuit to measure

potential difference between two points ?

- A. Parallel Connection
- **B. Series Connection**
- C. Both
- D. nONE

Answer: A



6. A copper wire has a diameter of 0.5mm and a resistivity of $1.6 imes 10^{-6}$ ohm cm. How much of this wire would be

required to make a 10 ohm coil ? How much does the resistance change if the diameter is doubled ?

A. 122.7 and 1/4

B. 130 and 1/2

C. 120 and 1/5

D. None of these

Answer: A

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7. The value of current, I, flowing in a given resistor for the corresponding values of potential difference, V, across the resistor are given below : I(ampere) 0.5 1.0 2.0 3.0 4.0 V(volt) 1.6 3.4 6.7 10.2 13.2 Plot a graph between V and I and calculate the resistance of the resistor



8. When a 12V battery is connected across an unknown

resistor, there is a current of 2.5mA in the circuit. Find

the value of the resistance of the resistor.

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9. A battery of 9v is connected in series with resistors of $0.2\Omega, 0.3\Omega, 0.4\Omega, 0.5\Omega$ and 12Ω . How much current would flow through the 12Ω resistor ?

A. 0.67 A

B. 2.3 A

C. 4.7 A

D. 0.5 A

Answer: A

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10. How many 176Ω resistors (in parallel) are required to

carry 5 A in 220 V line ?

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11. Show how you would connect thre resistors, each of resistance 6Ω , so that the combination has a resistance of (i) 9Ω

(ii) 2Ω.

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

?

A. 100

B. 200

C. 110

D. 120

Answer: C



13. A hot plate of an electric oven connected to a 220V lines has two resistance coils A and B, each of 24Ω resistance, which may be used separately, in series or in parallel. What are the currents in the three cases ?

A. 10.2 A, 20 A, 19 A

B. 9.2 A, 4.6 A, 18.3 A

C. 7.4 A, 50 A, 29 A

D. None of these

Answer: B



14. Compare the power used in the 2Ω resistor in each of the following circuits :

(i) a 6V battery in series with 1Ω and 2Ω resistors, and

(ii) a 4V battery in parallel with 12Ω and 2Ω resistors.

A. P1/P2 = 2

B. P1/P2 = 3

C. P1/P2 = 1

D. None

Answer: C



15. Two lamps, one rated 100W at 220V, and the other 60W at 220V, are connected in parallel to the electric mains supply. What current is drawn from the line if the supply voltage is 220V?



16. Which uses more energy, a250W TV set in 1h or a

1200W toaster in 10 minutes ?



17. An electric heater of resistance 8Ω draws 15A from the service mains for 2 hours. Calculate the rate at which heat is developed in the heater.

A.
$$1500 \frac{J}{s}$$

B. $2000 \frac{J}{s}$
C. $1000 \frac{J}{s}$
D. $1800 \frac{J}{s}$

Answer: D



18. Explain the following :

(a) Why is tungsten used almost axclusively for filament of incandescent lamp ?

(b) Why are the conductors of electric heating devices, such as toaster and electric irons, made of an alloy rather than a pure metal ?

(c) Why is the series arrangement not used for domestic circuits ?

(d) How does the resistance of a wire vary with its crosssectional area ?

(e) Why are copper and aluminimum wires usually employed for electricity transmission.



1. A child has drawn the electric circuit to study Ohm's law as shown in (Fig. 3.42). His teacher told him that the circuit diagram needs correction. Study the circuit diagram and redraw it after making all corrections.



2. Three 2Ω reistors , A, B and C, are connected as shown in (Fig. 3.44). Each of them dissipates energy and can withstand a maximum current that can flow through the three resistors ?





3. Should the resistance of an ammeter be low or high ?

Give reason.

4. Draw a circuit diagram of an electric circuit containing a cell, a key, an ammeter, a resistance of 2Ω in series with a combination of two resistors (4Ω each) in parallel and a voltmeter across the parallel combination. Will the potential difference across the 2Ω resistor be the same as that across the parallel combination of 4Ω resistors? Give reason.

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5. How does use of a fuse-wire protect electrical

appliances?

6. What is electrical resistivity ? In a series electrical circuit comprising a resistor made up of a matallic wire, the ammeter reads 5A. The reading of the ammeter decreases to half when the length of the wire is doubled. Why ?

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7. What is the commercial unit of electrical energy ?
Represent it in terms of joules.

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8. (a) A current of 1A flows in a series curcuit containing an electric lamp and a conductor of 5Ω when connected

to a 10V battery. Calculate the resistance of the electric lamp.

(b) Now if a resistance of 10Ω is connected in parallel with this series combination, what change (if any) in current flowing through 5Ω conductor and potential difference across the lamp will take place ? Give reason.

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9. Why is parallel arrangement used in domestic wiring ?



10. B_1, B_2 and B_3 are three identical bulbs connected as shown in (fig. 3.46). When all the three bulbs glow, a

current of 3A is recorded by the ammeter A.

(i) What happens to the glow of the other two bulbs when

the bulb B_1 gets fused ?

(ii) What happens to the readings of A_1, A_2, A_3 and A

when the bulb B_2 gets fused ?

(iii) How much power is dissipated in the circuit when all the three bulbs glow together ?



1. Three incandecent bulbs of 100W each are connected in series in an electric circuit. In another circuit another set of three bulbs of the same wattage are connected in parallel to the same source.

(a) Will the bulbs in the two circuits glow with the same brightness ? Justify your answer.

(b) Now let one bulb in both the circuits get fused. Will the rest of the bulbs continue to glow in each circuit ? Give reason.



2. State Ohm's law ? How can it be verified experimentally ?

Does it hold good under all conditions ? Comment.



3. How will you infer with the help of an experiment that the same current flows through every paet of the circuit containing three resistances in series connected to a battery ?

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4. How will you conclude that the same potential difference (voltage) exists across three resistors

connected in a parallel arrangement to a battery ?



5. What is Joule's heating effect ? How can it be demonstrated experimentally ? List its four applications in daily life.



- 6. Find out the following in the electric circuit given in (Fig.
- (a) Effective resistance of two 8Ω resistors in the combination
- (b) Current flowing through 4Ω resistor
- (c) Potential difference across 4Ω resistance

(d) Power dissipated in 4Ω resistor

(e) Difference in ammeter readings, if any.



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Additional Very Short Answer

1. What is meant by quantization of charge?

2. What is an electric current ? Give its SI unit.



3. What is represented by Joule/coulomb ?

A. Power

B. Electrical Energy

C. Electric Current

D. Electric Potential

Answer: D

4. A charge of 2C moves between two plates, maintained at a pd of 1V. What is the energy acquired by the charge ?

A. 5 J

B. 2 J

C. 12 J

D. None

Answer: B



5. Why are copper wires used as connected wires ?

6. A wire of resistivity ρ is stretched to double its length.

What is its new resistivity?

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7. How many times (roughly) is the resistivity of an

insulator greater than a metal?

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8. What is the resistance of a connecting wire ?

9. What is the resistance of an ammeter ?

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10. What is the resistance of a voltmeter ?
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11. Which has more resistance : 100 W bulb or 60 W bulb ?
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12. Which material is the best conductor of electricity at

room temperature ?



16. What sets the electrons into motion in an electric circuit ?



17. Why are filaments of incandescent lamps made of thin

tungsten wire ?



18. Which are the metals that are generally used :

(i) in electric circuits and

as transmission lines ?



19. Graphs between electric current and potential difference across two conductors A and B are as shown in (Fig. 3.49). Which of the two conductors has more resistance ?



20. Why is resistance more in series combination of resistors ?

O Watch Video Solution	

21. Why is resistance less in parallel combination of resistors ?

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22. How will you join three resistances, each of 2Ω so that

the effective resistance is 3Ω ?

23. On what factors does the resistivity of a material depend ?



25. What happens to the resistance of a circuit if the

current through it is doubled ?

26. What happens it the pd across a resistance is doubled



27. How does the resistance of a wire depend upon its

radius ?

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28. How does the resistance of a wire depend on its length

?

29. How does the resistance of a metallic wire depend on

its temperature ?



30. Two wires are of the same length, same radius, but one

of them is of them is of copper and the other is of iron.

Which will have more resistance ?

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31. Find the potential difference required to pass a current

of 0.2A in a wire of resistance 20Ω .

32. An electric bulbs draws 1.2A current at 6.0V. Find the

resistance of the bulb.

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33. Which will have a higher resistivity : a conductor or an

insulator ?

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34. Two wires of same material and same length have radii

 r_1 and r_2 respectively. Compare their resistances.

35. Name a substance whose resistance decrease with

temperature.

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36. Name a substance whose resistance almost remains

unchanged by increase of temperature.

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37. Distinguish between kilowatt and kilowatt hour.

38. Name two special characteristics of a heater coil.



40. Calculate the current through a lamp of 25W operating at 200V.

41. If r_1, r_2 and r_3 are three resistors connected in series in a circuit and I is the current through the circuit, what is the current flowing through each resistor ?



42. Which combination of resistors is used to decrease

current in a circuit ?

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43. What is the pd across each resistor in a series circuit ?

44. The power rating of an appliance is 100W - 250V.
What does it signify?
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45. Why is much less heat generated in long electric

cables than in the filament of an electric bulb ?

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46. Is Joule heating always desirable ?

47. Why are the coils of electric toasters made of an alloy

than a pure metal?



2. Two wires are of the same material but of different lengths and areas of cross-section. Will their resistivities be same or different ?



6. Why are constantan and manganin used for making

standard resistances ?

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7. Why is lead-tin alloy used for making fuse ?



8. What are superconductors ?

9. (a) What is common between charge and mass?

(b) We know that mass varies with velocity. Does charge

also vary with velocity?



10. (a) What are two physical quantities to which electric

potential is analogous to ?

(b) To which process is the flow of current in a conductor

analogous to?


11. (a) What do you mean by the term load in an electric circuit ?

(b) Which of the two loads in an electric circuit bigger

than the other :

(i) fluorescent tube

(ii) a 100W incandescent lamp ?

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12. (a) Which is more conducting : silver or gold ?

(b) Which is a better insulator : glass or ebonite ?

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13. (a) Of which material is a fuse-wire made of ?

(b) Of which material is the element of an electric heater made of ?

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14. (a) Whose resistivity increases more with temperature :

of an alloy or of its constituent metals ?

(b) Name a material whose resistivity becomes zero at a

particular temperature ?



15. A wire having a resistance of 18Ω is cut into three equal parts. What is the equivalent resistance if these three parts are joined in parallel ?

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16. What is the ratio of equivalent resistance of series combination of n equal resistance to the equivalent resistance in parallel combination of these n resistances ?



17. A given wire is stretched to double its length. How will

its resistance change ?



18. A wire of 3Ω resistance and 10cm length is stretched to 30cm length. Assuming that it has uniform cross-section, what will be its new resistance ?



19. (a) When is the pd for all the resistors in a circuit the same and is equal to applied pd ?(b) When is the current through all the resistors in a circuit the same and is equal to the total current in the circuit ?

20. (a) How does the current divide itself in a parallel combination of resistors ?

(b) How does the pd divide itself in a series combination

of resistors ?



21. (a) How is heat produced in a conductor by an electric

current?

(b) What are the factors on which heat produced due to a

current flowing through a conductor depend ?



22. (a) Are electrons consumed in a electric circuit when a

current flows through it ?

(b) What actually is consumed in an electric circuit when

current flows through it ?

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23. (a) How does an incandescent bulb work?

(b) Why is the resistance of bulb much less when it is not

glowing?



24. (a) Why does resistance increase in a series combination of resistors ?

(b) Why does resistance decrease in a parallel combination of resistors ?

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25. (a) If a number of bulbs of different wattages are joined in parallel, which bulb will glow with maximum brigthness ?

(b) Which bulb will glow with maximum brightness in case

bulbs of different wattages are joined in series ?



26. What do you mean by electric potential difference ?

How is it measured ? Define its SI unit.



27. State Ohm's law ? How can it be verified experimentally

? Does it hold good under all conditions ? Comment.

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28. What do you mean by electrical resistance ? How does

it arise ? Give its SI unit.

Watch Video Solution

29. What is electrical resistivity ? How does it depend om

temperature. Give its SI unit.



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32. Find an expression for equivalent resistance of three resistors joined in parallel.



33. Derive an expression for electric energy in terms of potential difference, current and the time for which current flows through a conductor.

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34. What is electric power ? Derive an expression for the

same. Give its SI unit.



35. What do you understand by the rating of an electric appliance ?

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36. Discuss briefly three applications of heating effect of

current.

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Additional Long Answer

1. What is Ohm's law ? How is it represented graphically ? Derive an expression for the resultant resistance of a series combination of resistors.

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2. State Ohm's law. Derive an expression for the equivalent

resistance of a number of resistances in parallel.

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3. Discuss series and parallel combinations of resistors with their salient features.

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4. What is electric energy and electric power. Derive their

expressions and define their units

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Based On Practical

1. The current flowing through a conductor and the potential difference across its two ends are as per reading of the ammeter and the voltmeter shown in (Fig. 3.50).

Find the resistance of the conductor.





2. In a given ammeter, a student sees that needle indicates 17 divisions in ammeter while performing an experiment to verify Ohm's law. If ammeter has 10 divisions between 0 and 0.5A, then what is the value of 17 divisions ?



3. The value of current, *I*, flowing in a given resistor for the corresponding values of potential difference, *V*, across the resistor are given below : $I(\text{ampere}) \ 0.5 \ 1.0 \ 2.0 \ 3.0 \ 4.0$ $V(\text{volt}) \ 1.6 \ 3.4 \ 6.7 \ 10.2 \ 13.2$ Polt a graph between V and I and calculate the resistance

of the resistor.

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4. In the circuit shown in (fig. 3.51), find the current recorded by ammeter (A).



5. Four resistances, each of 10Ω , are connected to form a square as shown in (Fig. 3.52), find the equivalent

resistance between the opposite corners A and C.



6. Four resistances, each of 10Ω , are connected to form a square as shown in (Fig. 3.52), find the equivalent resistance between two points on any one side (AB).





7. A wire of resistance (1 Ω) is divided into two halves and both halves are connected in parallel. Find the new resistance.

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8. The V-I graphs of parallel and series combinations

of two metallic resistors are shown in (Fig. 3.53). Which

graph represents the parallel combinations ?





9. The following apparatus is available in a laboratory :

Battery : adjustable from 0 to 4.5V

Resistors : 3Ω and 6Ω

Ammeters : A_1 of range 0 to 3 A , least count 0.1A

 A_2 of range 0 to 1 A , least count 0.05A

Voltmeters : V_1 of range 0 to 10 V , least count 0.5V

 V_2 of range 0 to 5 V , least count 0.1V

Which is the best combination of votmeter and ammeter

for finding the equivalent resistance of the resistors in

series ?



10. The following pieces of apparatus are available in a laboratory :

Battery : adjustable from 0 to 6 V

Resistors : 3Ω and 6Ω

Ammeters : A_1 of range 0 to 5 A , least count 0.25A

 A_2 of range 0 to 3 A , least count 0.1A

Voltmeters : V_1 of range 0 to 10 V , least count 0.5V

 v_2 of range 0 to 5 V , least count 0.1 V

For the experiment to find the equivalent resistance of

the parallel combination of the two given resistors, which

is the best choice ?

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Higher Order Thinking

1. Drift speed is the term used to describe the flow of

current through a conductor. Does it represent the speed

of the current or its strength ?

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2. Tap water conducts electricity whereas distilled water does not. Why ?
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3. The electrical resistivities of a few materials are given in ohm.metre. Which of these materials can be used for making an element of a heating device ?

- (A) $6.84 imes10^{-8}$
- (B) $1.60 imes 10^{-8}$
- (C) $1.00 imes10^{-4}$
- (D) $2.50 imes10^{12}$
- (E) $4.40 imes10^{-5}$
- (F) $2.30 imes10^{17}$.



4. Two wires A and B are of equal lengths, different cross-sectional areas and made of the same metal.

(a) (i) Name the property which is same for both the wires.

(ii) Name the property which is the different for both the wires

(b) I fthe resistance of wire A is four times the resistance

of wire B, calculate

(i) the ratio of the cross-sectional area of the wires.

(ii) the ratio of the radii of the wires.



5. Two students perform experiments on series and parallel combinations of two given resistors R_1 and R_2 and plot the following V - I graphs [Fig. 5.24.]. Which of the graphs is/are correctly labeled in terms of the words 'series' and 'parallel'? Justify your answer.



6. Two electric circuits I and II are shown in (Fig. 3.55). In circuit I, the key K is closed whereas in circuit II, the key

is open. Compare the currents *I* and circuit *II*.





7. The electric power consumed by a device may be calculated by using either of the two expressions : $P = I^2 R$ or $P = V^2 / R$. The first expression indicates that it is directly proportional to R whereas the second expression indicates inverse proportionality. How can the seemingly different dependence of P on R in these expressions be explained ?



Value Based Question

1. In ancient times when lightning was the privilege of 'devine beings', a question - 'how much does lightning cost ?' would have been regarded as a sin. Today, electricity is a commodity that can be measured and priced like any other. The potential of a lightning discharge is 25 million volts and the maximum intensity of the current rating is 200, 000 amperes.

(a) What is the power of the discharge?

(b) What is the energy spent in the lightning if it lasts for 0.001s ?

(c) What is the approximate cost of a lightning discharge

(d) What message did nature convey to the man through

lightning?



2. If you were asked to think of electricity, many favourable

and unfavourable images come to your mind.

(i) Name the favourable images.

(ii) What are the unfavourable images ?

(iii) What is common to all these images ?



3. Our nervous system is electrical in nature and is highly sensitive to external current. Electrical shock occours due to flow of current through the body when a voltage is imerssed on it.

(i) To prevent injury, the important quantity to control is current and not voltage. Comment.

(ii) What are the approximate values of electric current that :

(a) stop breaking.

(b) cause ventricular fibrillations and.

(c) cause series burns?

(iii) A bird can roost on a high-voltage wire without being

eletrocuted, How is a bird different from a man in this

respect?

4. Tranditional methods for estimating body-fat percentage involve the use of buoyancy tanks or calipers to pinch the flesh. We now adopt a different technique, called *BIA*.

(i) What is BIA ?

(ii) What promise does it hold in medical science ?

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Problem For Practice

1. n electrons flow through a cross-section of a conductor

in time t. If the charge on an electron is e, write an

expression for the current in the conductor.



3. A polythene piece rubbed with wool is found to have negative charge of $3 \times 10^{-7}C$. Estimate the number of electrons transferred.



4. Calculate the current in a wire if 1500C charge is

passed through it in 5 minutes.



5. A current of 0.5A is drawn by a filament of an electric bulb for 10 minutes. Find the amount of electric charge that flows through the electric circuit.



6. How much work is done in moving a charge of 2C across two points having a potential difference of 12V?



7. An incandescent lamp of resistance 80Ω draws a current

of 0.75A. Find the line voltage.



8. A current of 0.2A flows through a conductor of resistance 4.5Ω . Calculate the potential difference at the ends of the conductor.

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9. A bulb of resistance 400Ω is connected to 220V mains.

Calculate the magnitude of current.



10. An electric heater draws a current of 5A when connected to 220V mains. Calculate the resistance of its filament.



11. (a) How much current will an electric bulb draw from a 220V source, if the resistance of the bulb filament is 1200Ω ?

(b) How much current will an electric heater draw from a 220V source, if the resistance of the heater coil is 100Ω ?



12. The potential difference between the terminals of an electric heater is 60V when it draws a current of 4A from the source. What current will the heater draw if the potential difference is increased to 120V?

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13. A 4Ω wire is doubled on it. Calculate the new resistance

of the wire.



14. When a potential difference of 2V is applied across the ends of a wire of 5m length, a current of 1A is found to flow through it. Calculate

(i) the resistance per unit length of the wire,

(ii) the resistance of 2m length of the wire.

(iii) the resistance across the ends of the wire if it doubled

on itself.

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15. What should be the length of a nichrome wire of resistance 4.5Ω , if the length of a similar wire is 60cm and resistance 2.5Ω ?

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16. A negligibly small current is passes through a wire of length 15m and of uniform cross-section $6.0 \times 10 \% - 7m^2$ and its resistance is measured to be 5.0Ω . What is the resistivity of the material at the temperature of the experiment ?



17. A metal wire of resistivity $64 imes 10^{-6}$ ohm cm and

length 198cm has a resistance of 7Ω . Calculate its radius.


18. Calculate the resistivity of the material of a wire 1.0m

long, 0.4mm in diameter and having a resistance of 2.0Ω .



19. The resistivity os copper is 1.76×10^{-8} ohm m. The radius of the wire is 1mm. Calculate the length of a telegraph wire needed for having a resistance of 10.5Ω .

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20. A resistance wire made from German silver has a resistance of 4.25Ω . Calculate the resistance of another wire, made from the same material, such that its length

increases by 4 times and area of cross-section decrease by

 $3 \operatorname{times}$.



21. Resistance of a metal wire of length 1 m is 26Ω at $20^{\circ}C$. If the diameter of the wire is 0.3mm, what will be the resistivity of the metal at that temperature ? Using Table 1.1, predict the material of the wire.

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22. Calculate the amount of charge that would flow in 2 hours through the element of an electric bulb drawing a current of 0.25A.



23. A cylinder of a material is 10cm long and has a crosssection of $2cm^2$. If its resistance along the length be 20Ω , what will be its resistivity in numbers and units ?



24. A piece of wire of resistance 20Ω is drawn so that its

length is increased to twice is original length. Calculate

resistance of the wire in the new situation.



25. Calculate the area of cross-section of a wire if its length is .0m, its resistance is 23Ω and the resistivity of the material is $1.84 \times 10^{-6}\Omega m$.

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26. An electric lamp, whose resistance is 20Ω and a conductor of 4Ω resistance are connected to a 6V battery as shown in (Fig. 3.18) Calculate.

- (a) the total resistance of the circuit,
- (b) the current through the circuit, and
- (c) the potential difference across the electric lamp and





27. Three resistors of $2\Omega, \, 3\Omega \, {\rm ~and} \, \, 4\Omega$ are connected in

(a) series

(b) parallel.

Find the equivalent resistance in each case.

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28. Calculate the equivalent resistance between the points

A and B in the circuits shown in (Fig. 3.19)

(a) and (Fig. 3.19) (b).





29. Three resistors, each of 2Ω , are connected together so

that their total resistance is 3Ω . Draw a diagram to show

this arrangement and check it by calculation.



30. A combination consists of three resistors in series. Four similar sets are connected in parallel. If the resistance of each resistor is 2Ω , find the resistance of this combination.

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31. A circuit consists of 1Ω wire in series with a parallel arrangement of 6Ω and 3Ω wires. Calculate total resistance of the circuit.



32. Calculate the effective resistances between the points
A and B in the networks shown in (Fig. 3.20)
(a) and (Fig. 3.20)(b).





33. Two resistors 4Ω and 6Ω connected in parallel. The combination is connected across a 6V battery of negligible resistance. Calculate

(a) the current through the battery

(b) current through each resistor.

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34. Carefully study the circuit diagram shown and calculate the value of x.



A. 14.3 ohm

B. 11.3 ohm

C. 12 ohm

D. 23.4 ohm

Answer: B



35. Three resistors of 6Ω , 2Ω and x are connected in series to a cell of emf 1.5V. The current registered is (1/6)A. Calculate the value of x.

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36. Calculate the equivalent resistances between the points A and B of the circuits shown in (fig. 2.33)(b).



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37. A parallel combination of three resistors takes a current of 7.5A from a 30V supply. If the two resistors are 10Ω and 12Ω , find third one.



38. A wire whose resistance is 80Ω is cut into three pieces of equal lengths which are then arranged in parallel. Calculate the resistance of the combination.

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39. Five resistors, each 3Ω , are connected as shown in (fig.

3.23). Calculate the resistance between the points

(a) A and b

between the point C and D.



40. A electric iron consumes energy at the rate of

- (a) 840W when heating is at the maximum rate and
- (b) 360W when the heating is at the minimum. The

voltage is 220V What are the current and the resistance

in each case ?



41. A torch bulb of 3V draws a current of 0.4A. If the bulb is switched on for 5 minutes, calculate the energy released by the bulb.



42. An electric heater a current of 5A and its element has a resistance of 50Ω . If the heater is switched on for 5 minutes, calculate the energy released in kilojoules. **43.** An electric room heater has a resistance of 25Ω and operates at 220V for 12 minutes. Calculate heat energy dissipated by it in kilojoules.

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44. Calculate the total power of 5 fans if each of them draws a current of 0.8A at a potential difference of 220V.



45. An electric bulb of resistance 400Ω , draws a current of

0.5A. Calculate the power of the bulb and the potential





46. A soldering rod iron draws an energy of 45000J in 4 minutes when the current flowing through its element is 6A. Calculate the resistance of its heating element.



47. An electric bulb is marked 250W - 200V. What information does it convey ? How many Joules of energy is consumed by this bulb in one hour ? How long will it take for the bulb to consume 1kWh ?



48. 100J of heat are produced each second in a 4Ω resistance. Find the potential difference across the resistor.



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49. An electric bulb is connected to a 220V generator. The

current is 0.50A. What is the power of the bulb?



50. An electric refrigerator rated 400W operates 8 hour//day. What is the cost of the energy to operate it for





51. Two bulbs of 100W each and two coolers of 250W each, work on an average 6 hours a day. If the energy costs Rs. 1.75 perkWh, calculate the monthly bill and the minimum fuse rating when power is supplied at 250V.



52. An electric kettle is rated at 230V, 1000W. What is the resistance of its element ? What maximum current can pass through its element ?

53. Two bulbs A and B are rated 100W - 120V and 10W - 120V respectively. They are connected across a 120V source in series. Which will consume more energy?

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54. Draw a circuit diagram of an electric circuit containing a cell, a key, an ammeter, a resistance of 4Ω in series with a combination of two resistors (8Ω) in parallel and a voltmeter across the parallel combination. Each of them dissipate maximum energy and can withstand a maximum power of 16W without melting. Find the maximum current that can flow through the three resistors.

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55. A resistance of 10Ω is bent in the from of a closes circle. What is the effective resistance between the two at the ends of any diameter of this circle ?



56. State which has a higher resistance : a50W or a25W

lamp and how many times ?



57. An electric geyser has the rating 2000W - 220V marked on it. What should be the minimum current rating (in whole number) of the fuse-wire to be used ?

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58. Two resistors with resistances 10Ω and 15Ω are to be connected to a battery of emf12V so as to obtain : (i) minimum current (ii) maximum current. How will you connect the resistances in each case ? Calculate the strength of the total current in the circuit in the two cases.



59. What is the safest voltage you can put across a

 $98\Omega-0.5W$ resistor ?



Exemplar Multiple Choice

1. A cell, a resistor, a key and an ammeter are arranged as shown in the circuit diagrams of (Fig. 3.37). The current

recorded in the ammeter will be :



(i)







A. maximum in (i)

B. maximum in (ii)

C. maximum in (iii)

D. the same in all the cases

Answer: D

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2. In the following circuits, (Fig. 3.38), heat produced in the resistor or combination of resistors connected to a 12V battery will be :







B. minimum in case (i)

C. maximum in case (ii)

D. maximum in case (iii)

Answer: D



3. Electrical resistivity of a given metallic wire depends

upon:

A. its length

B. its thickness

C. its shape

D. nature of the material

Answer: D



4. A current of 1A is drawn by a filament of an electric bulb. Number of electrons passing through a cross-section of the filament in 16 seconds would be roughly :

A. 10^{20}

 $B.\,10^{10}$

 $C. 10^{18}$

D. 10^{23}

Answer: A



5. Identify the circuit, (Fig.) in which the electrical

components have been properly connected.



A. (i)

B. (ii)

C. (iii)

D. (iv)



D. 1Ω

Answer: D



7. What is the minimum resistance which can be made using five resistors each of $(1/5)\Omega$?

A. $(1/5)\Omega$

B. $(1/25)\Omega$

C. $(1/10)\Omega$

D. 25Ω

Answer: B

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8. The proper representation of series combination of cells, (Fig. 3.40) for obtaining maximum potential is :



A. (i)

B. (ii)

C. (iii)

D. (iv)

Answer: A



9. Which of the following represents voltage ?

A. $\frac{\text{Work done}}{\text{Current} \times \text{Time}}$

B. Work done \times Charge

 $C. \quad \frac{\text{Work done \times Time}}{\text{Current}}$

D. Work done $\, imes \,$ Charge $\, imes \,$ Time

Answer: A

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10. A cylindrical conductor of length l and uniform area of cross-section A has resistance R. Another conductor of length 2l and resistance R of the same material has area of cross-section :

A. A/2

 $\mathsf{B.}\,3A\,/\,2$

 $\mathsf{C.}\,2A$

 $\mathsf{D}.\,3A$

Answer: C



11. A student carries out an experiment and plots the V - I graphs of three samples of nichrome wire with resistances R_1 , R_2 and R_3 respectively, (Fig. 3.41). Which

of the following is true ?



A. $R_1 = R_2 = R_3$ B. $R_1 > R_2 > R_3$ C. $R_3 > R_2 > R_1$ D. $R_2 > R_3 > R_1$

Answer: C

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12. If the current I through a resistor is increased by 100% (assume that temperature remains unchanged), the increase in power dissipated will be :

A. 100~%

B. 200~%

C. 300~%

D. 400~%

Answer: C

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13. The resistivity does not change if :

A. the material is changed

B. the temperature is changed

C. the shape of the resistor is changed

D. both material and temperature are changed

Answer: C



14. In an electrical circuit three incandescent bulbs A, B and C of rating 40W, 60W and 100W respectively are connected in parallel to an electric source. Which of

the following is likely to happen regarding their brightness ?

A. Brightness if all the bulbs will be the same.

B. Brightness of bulb A will be the maximum.

C. Brightness of bulb B will be more than that of A.

D. Brightness of bulb C will be less than that of B.

Answer: C



15. In an electrical circuit, two resistors of 2Ω and 4Ω respectively are connected in series to a 6V battery. The heat dissipated by the 4Ω resistor in 5s will be :

A. 5 J

B. 10 J

C. 20 J

D. 30 J

Answer: C

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16. An electric kettle consumes 1kW of electric power when operated at 220V. A fuse-wire of what rating must be used for it ?

 $\mathsf{B.}\,2A$

 $\mathsf{C.}\,4A$

D. 5A

Answer: D

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17. Two resistors of resistances 2Ω and 4Ω when connected to a battery will have :

A. same current flowing through them when connected in parallel

B. same current flowing through them when

connected in series

C. same potential difference across them when

connected in series

D. different potential differences across them when

connected in parallel.

Answer: B

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18. Unit of electric power may also be expressed as :

A. volt ampere

B. kilowatt hour

C. watt second

D. Joule second

Answer: A

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- 1. There are two electric bulb :
- (i) marked 60W, 220V and
- (ii) marked 100W, 220V

Which one of them has higher resistance ?





2. Out of the two, a toaster of 1kW and an electric heater

of 2kW, which has a greater resistance ?

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3. An electric iron has a rating of 750W, 220V. Calculate :

(i) current passing through it and

(ii) its resistance, when in use.



4. A wire 1.0 m long, 0.2 mm in diameter, has a resistance

of 10Ω . Calculate the resistivity of its material.



6. Describe two conducting materials which are meant for

specific uses.

Describe briefly the phenomenon of heat production by

an electric current ?



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8. What do you mean by rating of an electric appliance ?

Illustrate with an example.



9. Two metallic wires A and B (of the same material) are

connected in parallel. Wire A has length l and radius r ,

wire B has a length 3l and radius 3r. Compute the ratio of the total resistance of parallel combination and the resistance of wire A.



10. Calculate the equivalent resistance between the points

A and B in the combination of resistors shown in (Fig. 3.56).



11. If three resistors having resistances 2Ω , 3Ω and 5Ω are connected in parallel, then will the value of the total resistance be less than 2Ω , or greater than 2Ω or lie between 2Ω and 5Ω ? Explain.

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12. A piece of wire having resistance R is cut into four equal parts.

(i) How will the resistance of each part combination

compare with the original wire ?

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13. A piece of wire of resistance R is redrawn by pulling it until its length is doubled. Compare the new resistance with the original value.

Two lamps , one rated 100 W at 220 V, and the other 60 W

at 220 V, are connected in parallel to a 220 V supply. What

is the current drawn from the supply line ?

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14. In the circuit diagram given in (Fig. 3.57), calculate :

(a) the current through each resistor

(b) the total current in the circuit

(c) the total effective resistance of the circuit.



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15. If you were asked to think of electricity, many favourable and unfavourable images come to your mind.

(i) Name the favourable images.

(ii) What are the unfavourable images ?

(iii) What is common to all these images ?



16. (a) Why a bird perched on a high voltage wire is not

killed by the current ?

(b) How many 176Ω resistors (in parallel) are required to

carry a current of 5 A in 220 V line?



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17. (a) Water boils in an electric kettle in 15 minutes after being swiched on. Using the same mains supply, should the length of the heating element be increased or decreased if the water is to boiled in 10 minutes ? Why ? Does Ohm's law hold good under all conditions ?



18. (a) What is meant by saying that the potential difference two points is 1 volt ? Name a device that helps to measure the potential difference across a conductor. (b) Why does the connecting cord of an electric heater not glow hot while the heating element does ? (c) Electrical resistivities of some substances at $20^{\circ}C$ are given below :

Silver $1.60 imes 10^{-8} \Omega m$

Copper $1.62 imes 10^{-8} \Omega m$

Tungsten $5.20 imes 10^{-8}\Omega m$

Iron $10.0 imes 10^{-8}\Omega m$

Mercury $94.0 imes10^{-8}\Omega m$

Nichrome $100 \times 10^{-6} \Omega m$.

Answer the following question in relation to them :

(i) Among silver and copper, which one is a better

conductor ? Why ?

(ii) Which material would you advise to be used in electrical heating devices ? Why ?



19. (a) Name an instrument that measures electric current
in a curcuit. Define the unit of eletric current.
(b) What do the following cumbols (Fig. 2.58) mean in a

(b) What do the following symbols, (Fig. 3.58) mean in a circuit diagram ?

(c) An electric circuit consisting of a 0.5m long nichrome wire XY, an ammeter, a voltmeter, four cells of 1.5V each and a plug key was set up.

(i) Draw a diagram of this electric circuit to study the relation between the potential difference maintained

between the points 'X' and 'Y' and the electric current flowing through XY.

(ii) Graph shown in (Fig. 3.59) was plotted V and I values. What would be the values of v/I ratios when the potential differences are 0.8V, 1.2V and 1.6Vrespectively ? What conclusion do you draw from these values ?



20. You are making a snack for you some friends to helpO you get ready for a full night of studing. You decide that coffee, toast and popcorn would be a good start. You turn on the toaster (900 W), place some popcorn in the microwave (1200 W), and turn it on. Because your apartment is an older building, the fuse (10 A rating) may blow when you turn on too many appliances at 220*V*. (i) Should you suggest the coffeemaker (600 W)?

(ii) Check the answer to part (i).

(iii) If not, suggest an alternative to start the coffeemaker.(iv) Which human quality corresponds to blowing of the fuse ?



21. Three incandescent bulbs of 100W each are connected in series in an electric circuit. In another circuit, another set of three bulbs of the same wattage are connected in parallel to the same source.

(a) Will the bulbs in the two circuits glow with the same brightness ? Justify your answer.

(b) Now let one bulb in both circuits get fused. Will the rest of the bulbs continue to glow in each circuit ? Give reason.

(a) In a household electric circuits, different appliances are connected in parallel to one another. Give two reasons for the same.

(b) An electrican puts a fuse of rating 5A in that part of domestic electrical circuit in which electrical heater of

rating 1.5kW, 220V is operating. What iis likely to happen in this case and why ? What change, if any, needs to be made ?



Mock Test Sec B

1. Which one of the given four milliammeters shown in (Fig. 3.60) would you use for measurement of current

flowing in a circuit ?



2. The rest positions of the needles in a miliammeter and voltmeter not in use are as shown in (Fig. 3.61)(a). When a

student uses these in his experiment, the readings of the needles are in the positions shown in (Fig. 3.61)(b). Find the corrected values of current and voltage in the experiment.





3. To the terminals marked as X and Y in the given circuit, three students connect 4 cells of voltage 1.5V each in three different manners (A),(B), (C) shown in (Fig. 3.62). Find the readings (V_A, V_B, V_C) of the voltmeter, for

the three students.



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4. To determine the equivalent resistance of two resistors when connected in series, a student arrnaged the circuit components as shown in (Fig. 3.63) But he did not succeed to achieve the objective. Which mistake has been committed by him in setting up the circuit ?



5. The following instruments are available in a laboratory :

(i) Milliammeter A_1 of range 0.300mA and least count

10mA

Milliammeter A_2 of range 0.200mA and least count 20mA

Voltmeter V_1 of range 0.3V and least count 0.3V

Which pair of instruments would be the best choice for

carrying out the experiment to determine the equivalent

resistance of two resistors connected in series ?

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6. For the circuits A and B shown in (Fig. 3.64), what would be the voltmeter readings ?



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