PHYSICS

BOOKS - DHANPAT RAI & CO PHYSICS (HINGLISH)

HEATING EFFECT OF CURRENT

Others

1. An electric current of 4.0A flows through a 12Ω resistor. What is the rate at which heat energy is produced in the resistor?

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2. How many electrons flow through the filament of a 120V and 60W electric lamp per second? Given $e = 1.6 \times 10^{-19} C$.

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3. Calculate the current flowing through a heater rated at $2kW$ when connected to a $300V$ d.c. supply.

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4. A current of 5.0A flows through an electric press of resistance 44Ω. Calulate the energy consumed by the press in 5minutes.

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5. A heating element is marked 210 V, 630 W. What is the current drawn by the element when connected to a 210 V dc mains ? What is the resistance of an element ?

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6. A 10 V storage battery of negilgible internal resistance is connected across a 200V battery and a resistance of 50Ω resistor made of alloy manganin. How much heat energy is produced in the resistor in 1 h? What is the source of this energy?

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7. An electric motor operates on a 50V supply and draws a current of 12A. If the motor yields a mechanical power of 150W. What is the percentage efficiency of the motor?

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8. An electric motor operating on a $50Vdc$ supply draws a current of $12A$. If the efficiency of the motor is $30\,\%$,estimate the resistance of the windings of the motor.

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9. Which of the two has greater resistance : a 1kW heater or a 100W tungsten bulb, bath marked for 230V?

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10. An electric power station (100 MW) transmits power to a distant load through long and thin cables. Which of the two modes of transmission would result in lessere power wastage : Power transmission of : (i) 20,000 V or (ii) 200 V?

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11. A generator is supplying power to a factory by cables of resistance 20Ω . If the generator is generating $50kW$ power as $5000V$, what is the power received by factory ?

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12. One kilowatt electric heater is to be used with 220V d.c. supply. (i) What is the current in the heater? (ii) What is Its resistance? (iii) what is the power dissipated in the heater? (iv) How much heat in calories is produced per second? (v) How many grams of water at $100^{\circ}C$ will be converted per minute into steam at $100^{\circ}C$, with the heater? Assume that the heat losses due to radiation are negligible. Latent heat of steam=540cal per gram.

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13. Two ribbons are gien with the following particulars:

Ribbon	Alloy	Length (m)	Width (mm)	Thickness (mm)	Temp. coeff. of resistivity	Resistivity
A	Constantan	8.456	1.0	0.03	Negligible	$4.9 \times 10^{-7}\ \Omega$ m
B	Nichrome	4.235	2.0	0.06	Negligible	$1.1 \times 10^{-6}\ \Omega$ m

For a fixed voltage supply. Which of the two ribbons corresponds to a greater rate of heat production?

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14. A $100W - 220V$ bulb is connected to 110 V source. Calculate the power consumed by the bulb.

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15. A heater coil is rated 100W,200V. It is cut into two identical parts. Both parts are connected together in parallel, to the same sources of 200V. Calculate the energy liberated per second in the new combination.

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16. An electric bulb is marked 100W, 230V. If the supply voltage drops to 115V, what is the heat and light energy produced by the bulb in 20min? Calculate the current flowing through it.

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17. By what percentage will the illimination of the lamp decrease if the current drops by 20% ?

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18. An electric bulb rated for $500W$ at $100V$ is used in a circuit having a $200V$ supply. The reistance R that must be put in series with bulb, so that the bulb delivers 500W is .....Ω.

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19. The maximum power rating of a 20Ω resistor is 2.0 kW. [That is, this is the maximum power the resistor can dissipate (as heat) without melting or changing in some other undersirable way]. Would you connect this resistor directly across a 300 V d.c. source of negligible internal resistance ? Explain your answer.

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20. A 25W and 100W bulbs are joined in series and connected to the mains. Which bulb will glow brighter?

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21. An electric bulb and electric heater are rated $100W, 220V$ and $500W, 220V$ respectively. Both are connected in series to a $220V$ d.c. mains. Calculate the power consumed by (i) electric bulb and (ii) heater

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22. Two heaters are marked 200V, 300W and 200 V, 600 W. If the heaters are combined in series and the combination connected to a 200 V dc supply, which heater will produce more heat ?

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23. Three identical resistors, each of resistance R, when connected in series with a d.c. source, dissipate power X. If the resistors are connected in parallel to the same d.c. source, how much power will be dissipated ?

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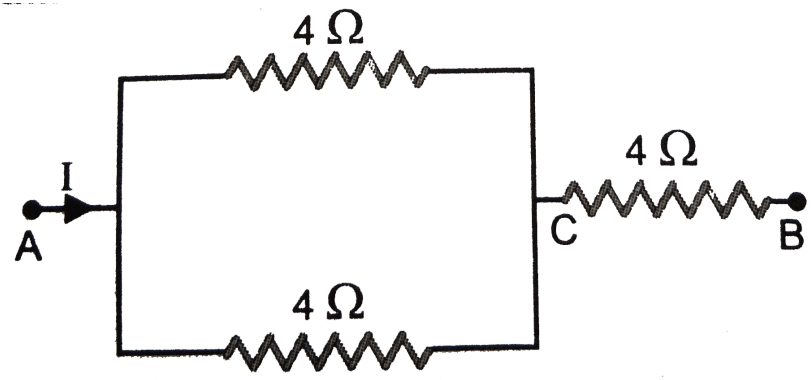
24. The resistance of each of the three wires joined as shown in figure is 4Ω and each one can have a maximum power of 20 watt (otherwise it will melt). What maximum power will the whole circuit dissipate ?



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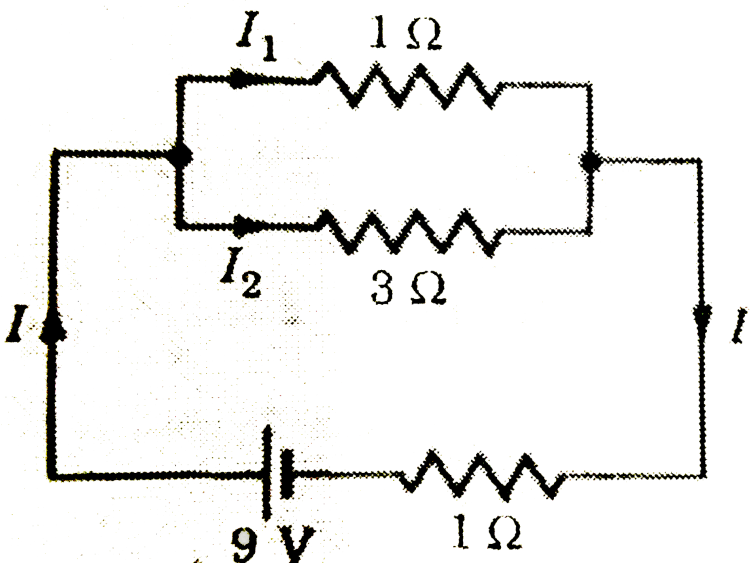
25. Find the heat produced per minute in each of the resistors shown in fig. 6.2.



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26. A 2H.P. electric motor working on 220V mains runs for 6hours a day. If electricity is rated at 50 paise per unit, find the cost of running for 30days. Also find the current through the motor when running on full capacity.

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27. A house is fitted with 20 length of 60 watt each 10 fans consuming 0.5 ampere each an electric kettle of resistance 110Ω. If the energy is supplied at $120V$ and costs 150 paise kWh, calculate monthly bill for running these appliances for 6 hours a day (1 length = 30 days).

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28. There are two electric bulbs rated 60W. 110V and 100W, 110V. They are connected in series with a 220V d.c. supply. Will any bylb fuse? What will happen if they are connected in parallel with the same supply?

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29. Find the resistance of $240V - 200$ watt electric bulb when glowing. If this resistance is 10 times the resistance at $0^\circ C$ and the temperature of the glowing filament is $2000^\circ C$, then find the temperature coefficient of resistance of the filament.

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30. A thin metallic wire of resistance 100Ω is immersed in a calorimeter containing 250 g of water at $10^{\circ}C$ and a current of 0.5 ampere is passed through it for half an hour. If the water equivalent of the calorimeter is 10 kg, find the final temperature of water.

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31. A copper electric kettle weighing 1000 g contains 900g of water at $20^{\circ}C$ it takes 12 minutes to raise the temperature to $100^{\circ}C$. If electric energy is supplied at 210V, calculate the strength of the current, assuming that 10% heat is wasted. Specific heat of copper is 0.1.

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32. A coil of enamelled copper wire of resistance 50Ω is embedded in a block of ice and a potential difference of 210V applied across it. Calculate

the rate of which ice melts. Latent heat of ice is 80 cal per gram.

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33. The heater coil of an elecric kettle is rated at 2000W,200V, How much time will in take is rasing the temperature of 1 litres of water from $20^\circ C$ to $100^\circ C$. Assuming that only 80% of the total heat energy produced by the heater coil is used in raising the temperature of water. Density of water heater coil is used in raising the temperture of water. density of water =$1gcm^{-3}$ and specific heat of water $= 1\text{cal}g^{-1}.^\circ C^{-1}$.

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34. A heating coil is connected in series with a resistance r. the coil is dipped in a liquid of mass 2kg and specific heat 0.5cal $g^{-1}.^\circ C^{-1}$. A potential difference of 200V is applied and the temperature of the liquid is found to increase by $60^\circ C$ in 20 minutes. if R is removed, the same rise in temperature is reached in 15minutes if R is removed, the same rise in temperature is reached in 15 minutes. find the value of R.

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35. A 10V battery of negligible internal resistance is charged by a 200V d.c. supply. If the resitance in the charging circuit is 38Ω, what is the value of chargeing current?

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36. A dry cell of emf 1.6V and internal resistance 0.10 ohm is connected to a resistor of resistance R ohm. If the current drawn from the cell is 2A.

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37. A dry cell of emf $1.5V$ and internal resistance 0.10Ω is connected across a resistor in series with a very low resistance ammeter. When the circuit is switched on , the ammeter reading settles to a steady value of $2.0A$.

(i) What is the steady rate of chemical energy consumption of the cell ?

(ii) What is the steady rate of energy dissipation inside the cell ?

(iii) What is the steady rate of energy dissipation inside the resistor ?

(iv) What is the steady power out put of the source?

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38. A series battery of 10 lead accumulators each of emf 2V and internal resistance 0.25ohm is charged by a 220V d.c. mains. To limit the charging current a resistance of 47.5 ohm is used in series in the charging circuit. What is (a) the power supplied by the mains and (b) power dissipated as heat? Accout for the difference of power in (a) and (b).

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39. A series battery of six cells each of $emf 2V$ and internal resistance 0.5Ω is charged by a $100Vdc$ supply. What resistance should be used in the charging circuit in order to limit the charging current to $8A$. Using this relation , obtain (a) the powwer supplied by the dc source, (b) the

power dissipated as heat , and (c) the chemical energy stored in the battery in $15 \min$.

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40. A battery of emf ε and internal resistance r is connected across a pure resistance device (e.f. and electric heater or an electric bulb) of resistance R. Show that the power output of the device is maximum when there is a perfect 'mathcing' between the external resistance adn the source resistance (i.e., where R=r). Determine the maximum power outpur.

Or

State and prove the maximum power theorem. show that the effciency of a battery when delivering maximum power is only 50%

(b) What is power output of the source abvoe if the battery is hosrted? what is the power dissipation inside the battery in that case?

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41. A 24 V battery of internal resistance 4.0Ω is connected to a variable resistance. At what value of the current drawn from the battery is the rate of heat produced in the resistor maximum?

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42. (a) An electric motor runs on a d.c. source of emf e and internal resistance r. show that the power output of the source is maximum when the current drawns by the motor is $\varepsilon / 2r$.

(b) Show that power output of electric motor is maximum when the back emf is one-half the source emf provided the resistance of the windings of the motor is negligible.

(c) Compare and contrast carefully the situation in this excercise with that in Example 43 above.

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43. Two batteries each of emf ε and internal resistance r, are connected in parallel. If we take current from this combination in a external resistance R, then for what value of R maximum power will beobtained? What will be this power?

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44. Two wires made of tinned copper having identical cross section $\left(= 10^{-6} m^2 \right)$ and lengths $10 \text{ and } 15cm$ are to be used as fuses. Show that the fuses will melt at the same value of current in each case.

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45. A fuse with a circular cross - sectional radius of $0.15mm$ blows at $15A$. What should be the radius of the cross section of a fuse made of the same material that blows at $30A$?

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46. In the circuit shown in Fig.6.2, the heat produced in 5Ω resistor, due to the current flowing through it is 10 calorie per second. Find the heat produced in 4Ω resistor.

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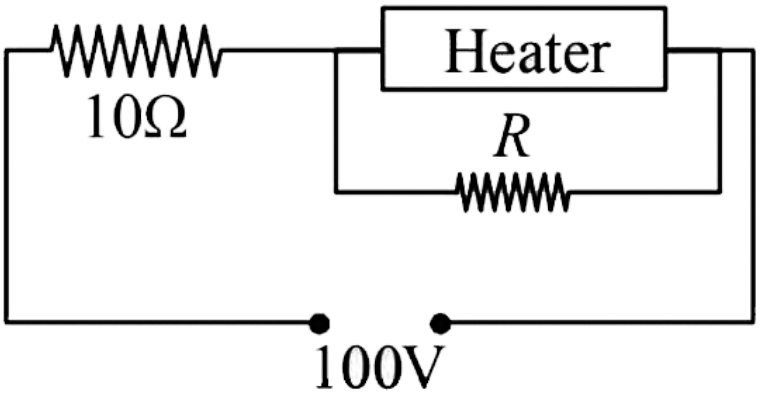
47. A heater is designed to operate with a power of 1000 walts in a 100 volt line. It is connected in a combinations with a resistance of 10 ohms and a resistance R to a 100 volts mains as shown in figure. What should be the value of R so that the heater operates with a power of 62.5 watts.



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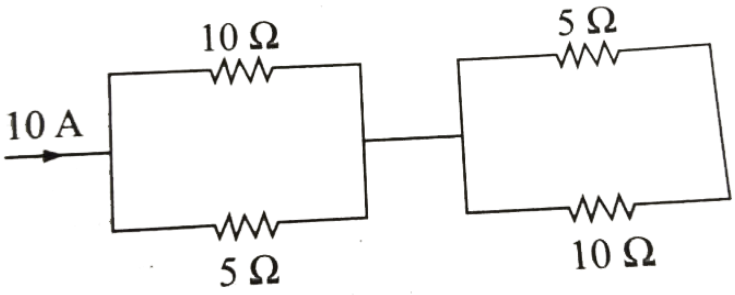
48. Four resistances carrying a current shown in Fig. 7.41 are immersed in a box containing ice at $0^{\circ}C$. How much ice must be put in the box every $10\ \min$ to keep the average quantity of ice in the box constant? Latent heat of ice is $80 cal g^{-1}$.



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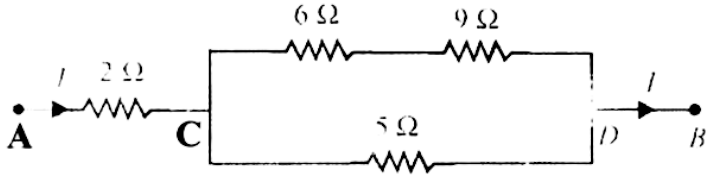
49. In the circuit shown in figure, the 5Ω resistance develops $20.00 cal/s$ due to the current flowing through it. The heat developed in 2Ω resistance (in cal $/ s$) is



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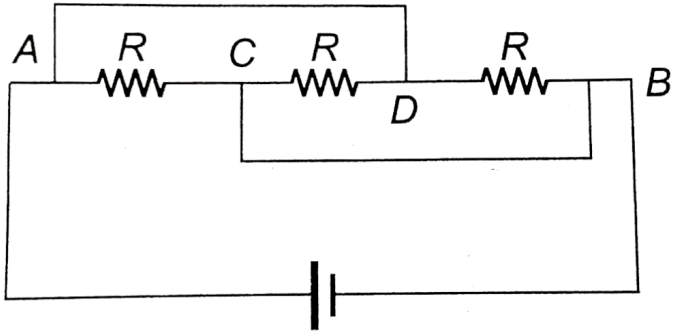
50. Three equal resistace, each of R ohm, are connectedd as shown in the figure. A battery of $2V$ and of internal resistance 0.1 ohm is connected across the circuit. The value of R for which the heat generated in the circuit maximum will be



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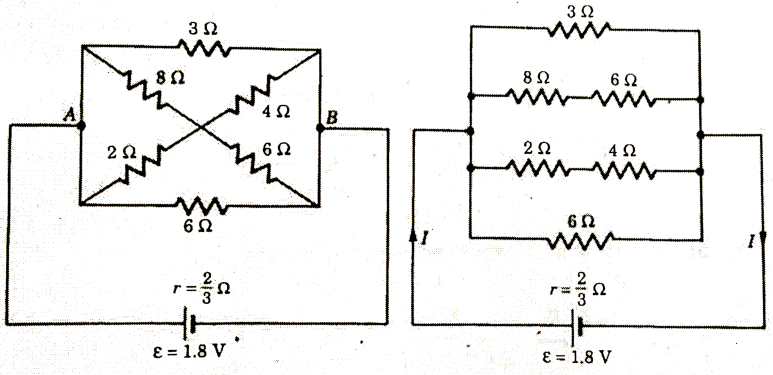
51. Calculate the current in the 3Ω resistor and the power dissipated in the entire circuit shown in Fig. 6.10.



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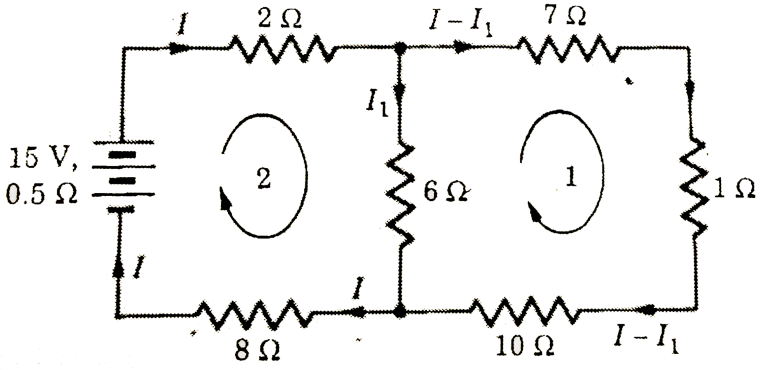
52. Calculate the current drawn from the battery of emf 15V and internal resistance 0.5Ω in the circuit shown in Fig. 6.12. Also find the power dissipated in thd 6Ω resistor.



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53. Two resistance R_1 and R_2 may be connected either in series or in parallel across a battery of zero internal resistance. It is required that the joule heating for the parallel combination be five times that for series combination. If R_1 is 10Ω find R_2.

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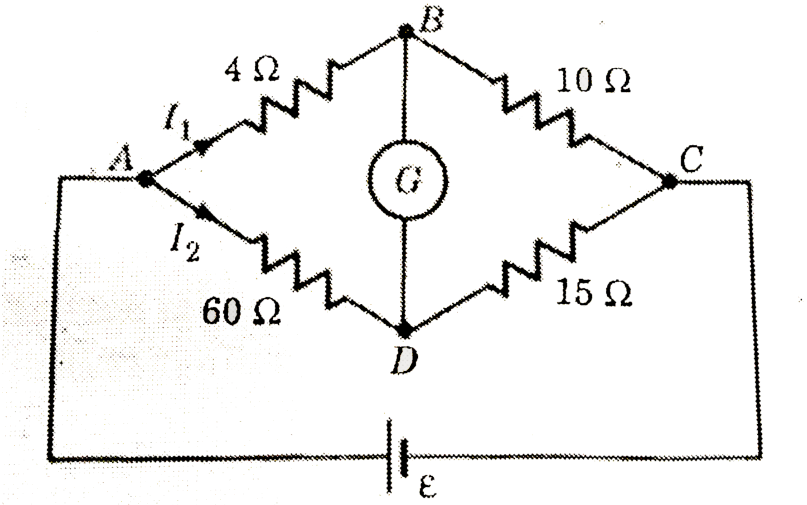
54. Calculate the ratio of the heat produced in the four arms of the Wheatstone bridge shown in Fig. 6.13



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55. A perosn decides to use his bath tub water to generate electric power to run a 40W bulb. The bath tub is located at a height of 10m from the ground and it holds 200 litres of water. He instals a water driven wheel generator on the ground. At what rate should the water drain from the bath tub to light the bulb? How long can he keep the bulb on , if bath tub was full initially ? Efficiency of generator is $90\ \%$. Take $g = 9.8m / s^2$

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56. The walls of a closed cubical box of edge 50cm are mdade of a material of thickness 1mm and thermal conductivity 4×10^{-4} cal $s^{-1}cm^{-1}.^{\circ} C^{-1}$ the interior of the box maintained at $100^{\circ} C$ above the outside temperature by a heater placed inside the box and connected acros a 400 V d.c. source. Calculate the resistance of the heater.

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57. A copper wire having cross-sectional area $0.5mm^2$ and a length 0.1 m is initially at $25^\circ C$ and is thennallyinsulated from the surrounding. If a current of 10 A is set up in this wire,

(a) Find the time in which the wire will start melting. The change ofresistancewith the temperature of the wire maybe neglected.

(b) What will be the time taken iflength of the wire is doubled? Given for copper wire, its density $9 \times 10^3 kg/^3$ specific heat $9 \times 10^{-2} kcal/kg.^\circ C$ melting point $1075^\circ C$ and specific resistance $1.6 \times 10^{-8} \Omega - m$

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58. A fuse made of lead wire has an area of cross-section $0.2mm^2$. On short circuiting. The current in the fuse wire reaches 30A. How long after the short circulting will the fuse begin to melt? For lead, specific heat $0.032 \text{cal} g^{-1}.^\circ C^{-1}$, melting point $= 327^\circ C$, density =$11.34 gcm^{-3}$ and the resistivity $= 22 \times 10^{-6} \Omega$cm. Initial temperature of the wire is $20^\circ C$. Neglect heat losses.

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59. An electric tea kettle has two heating coils. When one of the coils is switched on , boiling begins in $6\ \min$. When the other coil is switched on , boiling begins in $8\ \min$. In what time will the boiling begin if both coils are switched on simultaneously (i) in series and (ii) in parallel.

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60. How much is the current flowing through a heater rated at 2kW when connected to a 100 V d.c. supply?

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61. A small heating element, connected to 10V d.c. supply draws a current of 5 A. How much electric energy is supplied to heater?

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62. Two wires A and B of the same material and having same length, have their cross-sectional areas in the ratio $1:4$. what should be the ratio of heat produced in these wires when same voltage is applied across each ?

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63. There are two bulbs marked (a) 220V, 160W (b) 220V, 40W. Which has higher resistance?

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64. Two heater coils made of the same material are connected in parallel across the mains : the length and the diameter of one coil is double that of the other . Which of them will produce more heat?

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65. What voltage drop is there across 1kW electric heater, whose resistance when hot is 40Ω?

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66. An electric current of 2.0 A passes through a wire of resistance 25Ω. How much heat will be developed in 1 minute?

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67. An ammeter reads a current of 30A when it is connected across the terminals of a cell of emf 1.5V. Neglecting the meter resistance, find the amount of heat produced in the battery in 10seconds?

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68. A coil of resistance 100Ω is connected across a battery of $emf 6.0V$. Assume that the heat developed in the coil is used to raise its temperature. If the heat capacity of the coil is $4.0JK^{-1}$, how long will it take to raise the temperature of the coil by $15^{\circ}C$?

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69. A $100W$ and a $500W$ bulbs are joined in series and connected to the mains which bulb will glow brighter?

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70. Two bulbs are market 220V, 100W and 220V,50W respectively. They are connected in series to 220V mains. Find the ratio of heats generated in them.

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71. We have a $30W, 6V$ bulb , which we want to glow by a supply of $120V$. What can be done for this ?

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72. Two electric lamps are rated as 220V. 40 W and 220V,60W. Find the heat generated per second in lamp when they are connected in series across 220V mains. Given 1 cal=4.2J.

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73. In a house having $220V$ line , the following appliances are operating : (i) a $60W$ bulb, (ii) a $1000W$ heater , and (iii) a$40W$ radio.

Calculate (a) the current drawn by the heater and (b) the current passing through the fuse in the main line.

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74. How many 60W bulbs may be safely used on 220V line using a 5A fuse?

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75. An electric heater consists of 10m long nichrome wire of $2.5 \times 10^{-6} m^2$ corss-sectional area. Calculate the wattage of the heater, when the potential difference across the heater is 200V. Given that the resistivity of nichorme $= 1.1 \times 10^{-6} \Omega$m.

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76. The resistances of 20Ω are connected to a source of emf. Calculated the ratio of the heats produced in the two resistances when they are connected (i) In series and (ii) in parallel.

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77. A line having a total resistance of $0.2\ \omega$ delivers $10KW$ at $220V$ to a small factory . Calculate the efficiency of transmission .

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78. A motor operating on $120V$ draws a current of $2A$. If the heat is developed in the motor at the rate of $9cals^{-1}$, what is the efficiency?

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79. A small electric motor is rated 1/8H.P. and is running at 230V supply. How much current it will draw working at fully capacity ? What will be the cost of running it for 6 hours if electric energy is supplied at the 1.00per unit?

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80. A 500W electric heater is designed to work with a 200 V line. If the voltage of the line drops to 160V, then what will be the percentage loss of the heat developed?

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81. A 50 W bulb is connected in a 200V line. Determine the current flowing in it and its resistance. If 10% of the total power is converted into light, then what will be the rate of production of heat? Take $J = 4.2 J \text{cal}^{-1}$.

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82. Three equal resistor connected in series across a source of enf together dissipate $10 W a$. If the same resistors aer connected in parallel across the same emf, then the power dissipated will be

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83. A room is lighted by $200W, 124V$ incandescent lamps fed by a generator whose output voltage is $130V$. The conducting wires from the generator to the user are made of aluminimum wire of total length 150 m and cross-sectional area $15mm^2$. How many such length can be installed ? What is the total power consumed by the user ? sp. resistance of aluminium is $2.9 \times 10^{-4}\Omega m$

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84. An electric heater consists of 20m length of manganin wire of 0.23 m^2 cross-sectional area. Calculate the wattage of the heater when a potential difference of 200V is applied across it. Resistivity of magnanin = $4.6 \times 10^{-7}\Omega$m.

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85. Two electric bulbs rated as 100W. 220V and 25W,220V are connected in series across 220V line. Calculate (i) current through(ii) Potential

difference across and (iii) actual powers consumed in filament of each bulb.

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86. Find the cost of electricity for running an electric motor of 1 hp the 5 hrs a day at the rate of Rs 1.50 per unit of electricity for the month of November

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87. The heater coil of an electric kettle is rated as 2000W at 200V. How much time will it take to heat one litre of water from $20^{\circ}C$ to $100^{\circ}C$ assming that entire electric energy liberated form the heater coil is utilised for heating water? Also calculate the resistance of the coil. Density of water is $1gcm^{-3}$.

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88. A copper kettle weighing 1000g holds 1900g of water at $19^{\circ}C. ittakes12\ \min utes \rightarrow raisethetemperature \rightarrow$ 100^(@)C $. Ife \neq rgyis \supset pliedis \supset pliedat210V, calcatethestren > hofcurrentas$ $10\%ofheatisw * ed.\ \sec \quad \text{if} \quad icheatofcopper$=0.1"cal" g^(-1)C^(-1)`.

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89. A 30V storage battery is being charged by 120V d.c. supply. A resistor has been connected in series with the battery to limit the charging current to 10A. Find the rate at which energy is dissipated in the resistor. If the total heat produced could be made available for heating water, how long would it take to bring 1 kg of water from $10^{\circ}C$ to the boiling point? Specific heat of water $= 1\text{cal}g^{-1}.^{\circ}\ C^{-1}$ and from $15^{\circ}C$ to the boiling point ? Specific heat of water =1 cal $g^{-1}.^{\circ}\ C^{-1}$ and 1 cal=4.2J

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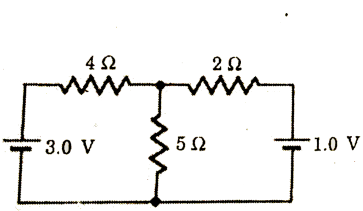
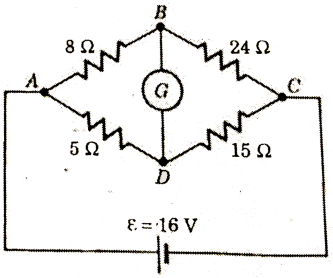
90. Calculate the power dissipated in the various resistances and the power given by the cells in the circuit shown in Fig: 6.14.





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91. Calculate the rate of productive of heat in the four arms of the Wheatstone's bridge shown in Fig. 6.15.

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92. A house is fitted with 10 lamps rated 100W each, four fans each containing 0.5A. An electric kettle of resistance 100Ω and an electric iron of 12Ω. If the energy is supplied at 200V and costs 50paise per kWh,

calculate the bill for running the appliances four hours in a day for the month of February.

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93. Following items are used in a house:

Item	Numbers	Power	Time
T.V.	1	60 W	2 hrs a day
Fridge	1	60 W	24 hrs a day
Tubes	3	40 W each	4 hrs a day (each)
Bulbs	2	60 W each	2 hrs a day (each)
Press	1	600 W each	$\frac{1}{2}$ hr a day

What will be the electric bill of the house for two months (each month of 30 days.) if the rate of power is Rs. 1.35 per unit?

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94. A house if fitted with a motor of 1 H.P., 5 lamps consuming 0.2 A each and two fans of 80W each. If all the appliances work for 5 hours per day, calculate the montly bill. Energy is supplied at 220V and costs 20 paise per kWh. Take one month=30 days.

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95. A 40 V battery of internal resistance 6Ω is connected to a variable resistor.At what value of the current drawn from the battery is the rate of heat produced in the resistor is maximum?

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96. An accumulator of emf ε and internal resistance r is first connected to an external resistance R_1 and then to an external resistance R_2 for the same time. For what value of r the beats dissipated in R_1 and R_2 will be same?

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97. A series battery of 6 lead accumulators, each of emf 2.0V and internal resistance 0.25Ω is charged by a 230V d.c. mains to limit the charging current, a series resistance of 53Ω is used in the charging circuit. What is

(i) power supplied by the mains (ii) power dissipated as heat? Account for the difference in the two cases.

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98. A fuse wire of circular cross-section has a radius of 1mm. This wire blows at a current of 8A. Find the radius of the fuse wire which will blow off when a current of 1A passes through it.

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99. A current of 2A is passed through a wire immersed in 80 g of water initially at $15.7^{\circ}C$ in 40 minutes, the temperature of water rises to $30^{\circ}C$ if the resistance of the wire is 0.5Ω. Calculate the value of J.

Watch Video Solution

100. (i) A storage battery of emf $8V$, internal resistance 1Ω is being charged by a $120V$ d.c. source using a 15Ω resistor in series in the circuit. Calculate the current in the circuit (ii) terminal voltage across the battery during charging and (ii) chemical energy stored in the battery in 5 minutes.

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101. An electric current of 4.0A flows through a 12Ω resistor. What is the rate at which heat energy is produced in the resistor?

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102. How many electrons flow through the filament of a 120V and 60W electric lamp per second? Given $e = 1.6 \times 10^{-19}C$.

Watch Video Solution

103. Calculate the current flowing through a heater rated at 2kW when connected to a 300V d.c. supply.

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104. A current of 5.0A flows through an electric press of resistance 44Ω. Calulate the energy consumed by the press in 5minutes.

Watch Video Solution

105. A heating element is marked 210V, 630W. What is the current drawn by the element when connected to a 210V d.e. mains? What is the resistance of the element?

Watch Video Solution

106. A 10V stroage battery of negligible internal resistance is connected across a 50Ω resistor made of alloy manganin. How much heat energy is

produced in the resistor in 1h? What is the source of this energy?

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107. An electric motor operates on a 50V supply and draws a current of 12A. If the motor yields a mechanical power of 150W. What is the percentage efficiency of the motor?

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108. An electric motor operating on a $50Vdc$ supply draws a current of $12A$. If the efficiency of the motor is $30\,\%$,estimate the resistance of the windings of the motor.

Watch Video Solution

109. Which of the two has greater resistance : a 1kW heater or a 100W tungsten bulb, bath marked for 230V?

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110. An electric power station (100MW) transmits power to a distant load through long and thin cables. Which of the two modes of transmission would result in lesser power wastage: transmission of: (i) 20,000 V or (ii) 200V?

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111. A generator is supplying power to a factory by cables of resistance 20Ω. If the generator is generating 50kW power at 5000V. What is the power received by the factory?

Watch Video Solution

112. Two ribbons are gien with the following particulars:

Ribbon	Alloy	Length (m)	Width (mm)	Thickness (mm)	Temp. coeff. of resistivity	Resistivity
A	Constantan	8.456	1.0	0.03	Negligible	$4.9 \times 10^{-7}\ \Omega$ m
B	Nichrome	4.235	2.0	0.06	Negligible	$1.1 \times 10^{-6}\ \Omega$ m

For a fixed voltage supply. Which of the two ribbons corresponds to a greater rate of heat production?

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113. An electric heating element to dissipate 480 watts on 240V mains is to be made from nichrome ribbon 1 mmwide and thickness 0.05mm. Calculate the length of the ribbon required if the resistivity of nichrome is $1.1 \times 10^{-6}\Omega m$.

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114. 100 W,220V V bulb is connected to 110V source. Calculate the power consumed by the bulb.

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115. A heater coil is rated 100W,200V. It is cut into two identical parts. Both parts are connected together in parallel, to the same sources of 200V. Calculate the energy liberated per second in the new combination.

Watch Video Solution

116. An electric bulb is marked 100W, 230V. If the supply voltage drops to 115V, what is the heat and light energy produced by the bulb in 20min? Calculate the current flowing through it.

Watch Video Solution

117. Determine the percentage by which the illumination of a lamp will decrease if the current drops by 20%.

Watch Video Solution

118. An electric bulb rated for 500W at 100V is used in circuit having 200V supply. Calculate the resistance R that must be put in seires with the bulb, so that the bulb delivers 500 W.

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119. The maximum power rating of a 20Ω resistor is 2.0kW. (that is this is the maximum power the resistor can dissipate (as heat) without melting or changing in some other undesirable way). Would you connect his resistor directly across a 300V d.c. source of negligible internal resistance?

Watch Video Solution

120. A 25W and 100W bulbs are joined in series and connected to the mains. Which bulb will glow brighter?

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121. An electric heater and an electric bulb are rated 500W. 220V and 100W, 220V respectively. Both are connected in series to a 220V d.c. mains. Calculate the power consumed by (i) the heater ana (ii) electric bulb.

Watch Video Solution

122. Two heatere are marked 200V, 300W and 200V, 600W. If the heaters are combined in series and the combination connected to a 200V d.c. supply. Which heater will produce more heat?

Watch Video Solution

123. Three identical resistors, each of resistance R, when connected in series with a d.c. source, dissipata power X. if the resistors are connected in parallel to the same d.c. source, how much power will be dissipated?

Watch Video Solution

124. In the circuit shown in Fig.6.1, each of the three resistors of 4Ω can have a maximum power of 20W (otherwise it will melt). What maximum power can the whole circuit take?

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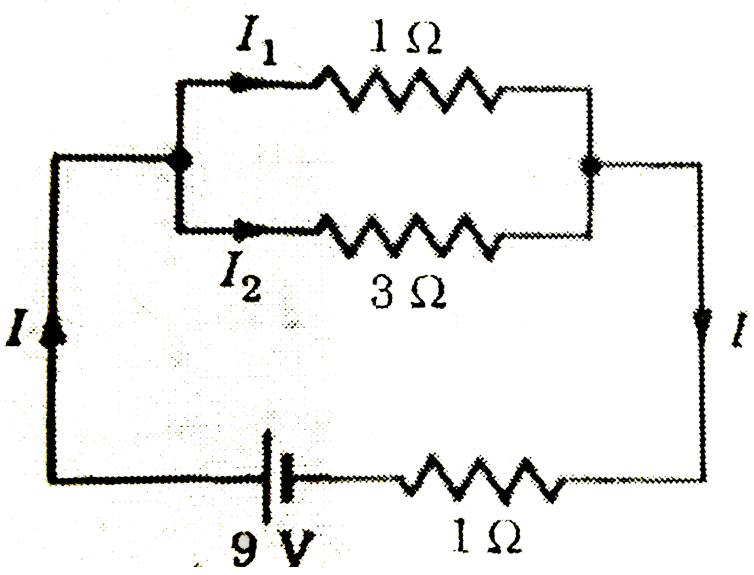
125. Find the heat produced per minute in each of the resistors shown in fig. 6.2.



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126. A 2H.P. electric motor working on 220V mains runs for 6hours a day. If electricity is rated at 50 paise per unit, find the cost of running for 30days. Also find the current through the motor when running on full capacity.

Watch Video Solution

127. A house is fitted with 20lamps of 60W each, 10fans consuming 0.5A each and an electric kettie of resistance 110Ω. If the energy is supplieda at 220V and costs 75 paise per unit, calculate the monthly bill for running appliances for 6 hours a day. take 1 mont =30days.

Watch Video Solution

128. There are two electric bulbs rated 60W. 110V and 100W, 110V. They are connected in series with a 220V d.c. supply. Will any bylb fuse? What will happen if they are connected in parallel with the same supply?

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129. Twenty one electric bulbs are connected in series with the mains of a 220V supply. After one bulb is fused, the remaining 20bulbs are again connected in series across the same mains. By what percentage will the illuminaton of (i) a bulb change and (ii) all the bulbs change?

Watch Video Solution

130. Find the resistance of $240V - 200$ watt electric bulb when glowing. If this resistance is 10 times the resistance at $0^\circ C$ and the temperature of the glowing filament is $2000^\circ C$, then find the temperature coefficient of resistance of the filament.

Watch Video Solution

131. A thin metallic wire of resistance 100Ω is immersed in a calorimeter containing 250g of water at $10^\circ C$ and a current of 0.5 ampere is passed

through it for half an hour. If the water equivalent of the calorimeter is 10g, find the rise of temperature.

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132. A copper electric kettle weighing 1000 g contains 900g of water at $20^\circ C$ it takes 12 minutes to raise the temperature to $100^\circ C$. If electric energy is supplied at 210V, calculate the strength of the current, assuming that 10% heat is wasted. Specific heat of copper is 0.1.

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133. A coil of enamelled copper wire of resistance 50Ω is embedded in a block of ice and a potential difference of 210V applied across it. Calculate the rate of which ice melts. Latent heat of ice is 80 cal per gram.

Watch Video Solution

134. The heater coil of an elecric kettle is rated at 2000W,200V, How much time will in take is rasing the temperature of 1 litres of water from $20^\circ C$ to $100^\circ C$. Assuming that only 80% of the total heat energy produced by the heater coil is used in raising the temperature of water. Density of water heater coil is used in raising the temperture of water. density of water =$1gcm^{-3}$ and specific heat of water $= 1\text{cal}g^{-1}.^\circ C^{-1}$.

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135. A heating coil is connected in series with a resistance r. the coil is dipped in a liquid of mass 2kg and specific heat 0.5cal $g^{-1}.^\circ C^{-1}$. A potential difference of 200V is applied and the temperature of the liquid is found to increase by $60^\circ C$ in 20 minutes. if R is removed, the same rise in temperature is reached in 15minutes if R is removed, the same rise in temperature is reached in 15 minutes. find the value of R.

Watch Video Solution

136. A 10V battery of negligible internal resistance is charged by a 200V d.c. supply. If the resitance in the charging circuit is 38Ω, what is the value of chargeing current?

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137. A dry cell of emf 1.6V and internal resistance 0.10 ohm is connected to a resistor of resistance R ohm. If the current drawn from the cell is 2A.

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138. A dry cell of emf 1.5V and internal resistance 0.10 Ω is connected across a resistor in series with a very low resistance ammeter: When the circuit is switched on, the ammter reading settles to a steady value of 2.0A. What is the steady

(a) rate of chemical energy consumption of the cell,

(b) rate of energy dissipation inside the cell,

(c) rate of energy dissipation inside the resistor,

(d) power output of the source?

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139. A series battery of 10 lead accumulators each of emf 2V and internal resistance 0.25ohm is charged by a 220V d.c. mains. To limit the charging current a resistance of 47.5 ohm is used in series in the charging circuit. What is (a) the power supplied by the mains and (b) power dissipated as heat? Accout for the difference of power in (a) and (b).

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140. A series battery of 6 lead accumulators each of emf 2.0V and internal resistance 0.50Ω is charged by a 10V d.c. supply. What series resistance should the used in the charging circuits in order to limit the current to 8.0A? Using the required resistor, obtain (a) the power supplied by the d.c. source (b) the power supplied by the d.c. energy stored in the battery in 15min.

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141. Power from a 64 V d.c. supply goes to charge a battery of 8lead accumulators each of emf 2.0V and internal resistance $1/8\Omega$. The charging current also runs an electric motor placed in series with the battery. If the resistance of the windings of the motor is 7.0Ω and the steady supply current is 3.5A. obtain.

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142. A battery of emf ε and internal resistance r is connected across a pure resistance device (e.f. and electric heater or an electric bulb) of resistance R. Show that the power output of the device is maximum when there is a perfect 'mathcing' between the external resistance adn the source resistance (i.e., where R=r). Determine the maximum power outpur.

Or

State and prove the maximum power theorem. show that the effciency of a battery when delivering maximum power is only 50%

(b) What is power output of the source abvoe if the battery is hosrted? what is the power dissipation inside the battery in that case?

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143. A 24 V battery of internal resistance 4.0Ω is connected to a variable resistance. At what value of the current drawn from the battery is the rate of heat produced in the resistor maximum?

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144. (a) An electric motor runs on a d.c. source of emf e and internal resistance r. show that the power output of the source is maximum when the current drawns by the motor is $\varepsilon / 2r$.

(b) Show that power output of electric motor is maximum when the back emf is one-half the source emf provided the resistance of the windings of the motor is negligible.

(c) Compare and contrast carefully the situation in this excercise with that in Example 43 above.

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145. Two batteries each of emf ε and internal resistance r, are connected in parallel. If we take current from this combination in a external resistance R, then for what value of R maximum power will beobtained? What will be this power?

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146. Two wires made of tinned copper having identical cross-section $\left(=10^{-6}m^2\right)$ and lengths 10cm and 15cm are to be used as fuses. Sow that the fuses will melt at the same value of current in each case.

Watch Video Solution

147. A fuse with a circular cross-sectional radius of 0.15mm blows at 15A. What should be the radius of cross-section of a fuse made of the same material which will blow at 30A?

Watch Video Solution

148. In the circuit shown in Fig.6.2, the heat produced in 5Ω resistor, due to the current flowing through it is 10 calorie per second. Find the heat produced in 4Ω resistor.

Watch Video Solution

149. A heater is designed to operate with a power of 1000W in a 100V line. It is connected in combination with a resistace of 10Ω and a resitance. R, to a 100V mains, as shown in Fig. 6.6 What should be the value of R so that the heat operates with a power of 62.5 W ?

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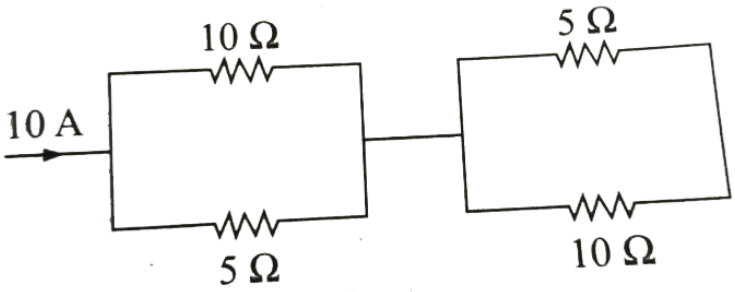
150. Four resistances carrying a current shown in Fig. 7.41 are immersed in a box containing ice at $0^{\circ}C$. How much ice must be put in the box every $10\ \min$ to keep the average quantity of ice in the box constant?

Latent heat of ice is $80 cal g^{-1}$.



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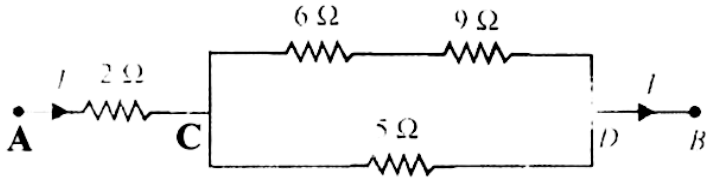
151. In the circuit shown in figure, the 5Ω resistance develops $20.00 cal/s$ due to the current flowing through it. The heat developed in 2Ω resistance (in cal $/ s$) is



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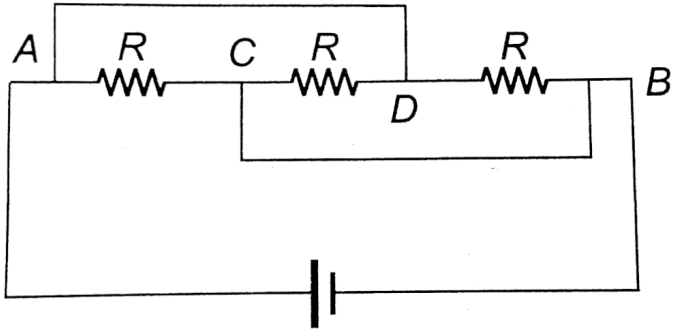
152. Three equal resistace, each of R ohm, are connectedd as shown in the figure. A battery of $2V$ and of internal resistance 0.1 ohm is

connected across the circuit. The value of R for which the heat generated in the circuit maximum will be



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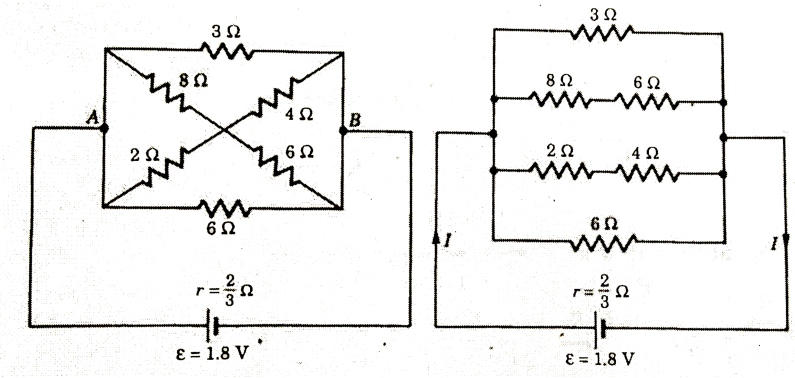
153. Calculate the current in the 3Ω resistor and the power dissipated in the entire circuit shown in Fig. 6.10.



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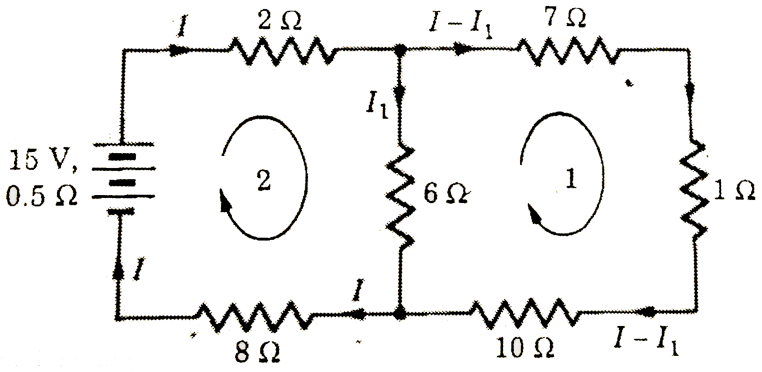
154. Calculate the current drawn from the battery of emf 15V and internal resistance 0.5Ω in the circuit shown in Fig. 6.12. Also find the power dissipated in thd 6Ω resistor.



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155. Two resistance R_1 and R_2 may be connected either in series or in parallel across a battery of zero internal resistance. It is required that the joule heating for the parallel combination be five times that for series combination. If R_1 is 10Ω find R_2.

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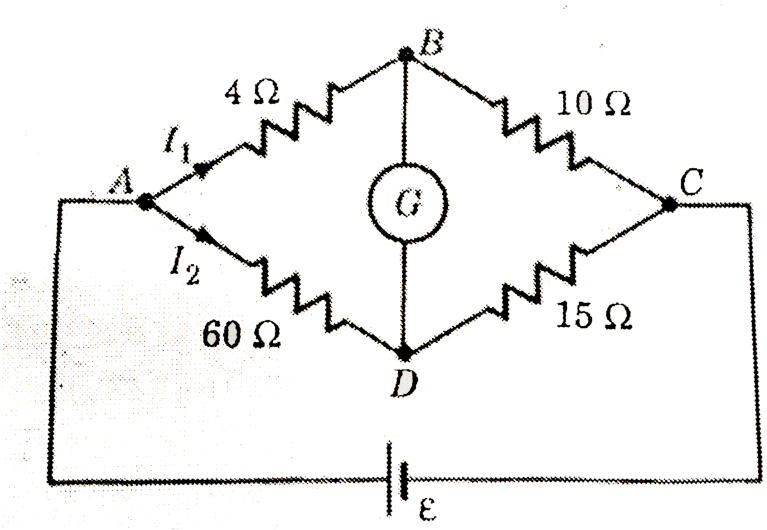
156. Calculate the ratio of the heat produced in the four arms of the Wheatstone bridge shown in Fig. 6.13



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157. A person decides to use bath tub water to generate electric power to run a 40 W bulb. The bath tub is located at a height of 10 m from the ground and it holds 200 liters of water. He installs a water driven wheel generator on the ground. At what rate should the water drain from the bath tub to light the bulb? The density of water is $1000(kg)/(m^3)$ and efficiency of generator is 80%. How long can he keep the bulb on if the bath tub was full initially.

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158. The walls of a closed cubical box of edge 50cm are mdade of a material of thickness 1mm and thermal conductivity 4×10^{-4} cal $s^{-1}cm^{-1}.^{\circ} C^{-1}$ the interior of the box maintained at $100^{\circ} C$ above the outside temperature by a heater placed inside the box and connected acros a 400 V d.c. source. Calculate the resistance of the heater.

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159. A copper wire having cross-sectional area $0.5mm^2$ and a length 0.1 m is initially at $25^{\circ} C$ and is thennallyinsulated from the surrounding. If a current of 10 A is set up in this wire,

(a) Find the time in which the wire will start melting. The change ofresistancewith the temperature of the wire maybe neglected.

(b) What will be the time taken iflength of the wire is doubled? Given for copper wire, its density $9 \times 10^3 kg/^3$ specific heat $9 \times 10^{-2} kcal/kg.^{\circ} C$ melting point $1075^{\circ} C$ and specific resistance $1.6 \times 10^{-8} \Omega - m$

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160. A fuse made of lead wire has an area of cross-section $0.2mm^2$. On short circuiting. The current in the fuse wire reaches 30A. How long after the short circulting will the fuse begin to melt? For lead, specific heat $0.032\text{cal}g^{-1}.^{\circ}C^{-1}$, melting point $=327^{\circ}C$, density $=11.34gcm^{-3}$ and the resistivity $=22\times10^{-6}\Omega$cm. Initial temperature of the wire is $20^{\circ}C$. Neglect heat losses.

Watch Video Solution

161. An electric tea kettle has two heating coils. When one of the coils is switched on , boiling begins in $6\ \text{min}$. When the other coil is switched on , boiling begins in $8\ \text{min}$. In what time will the boiling begin if both coils are switched on simultaneously (i) in series and (ii) in parallel.

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162. How much is the current flowing through a heater rated at 2kW when connected to a 100 V d.c. supply?

Watch Video Solution

163. A small heating element, connected to 10V d.c. supply draws a current of 5 A. How much electric energy is supplied to heater?

Watch Video Solution

164. Two wires A and B of the same material and having same length, have their cross-sectional areas in the ratio $1:4$. what should be the ratio of heat produced in these wires when same voltage is applied across each ?

Watch Video Solution

165. There are two bulbs marked (a) 220V, 160W (b) 220V, 40W. Which has higher resistance?

Watch Video Solution

166. How many electrone flow per second through as electric bulb rated 220V,100W?

Watch Video Solution

167. What voltage drop is there across 1kW electric heater, whose resistance when hot is 40Ω?

Watch Video Solution

168. An electric current of 2.0A passes through a wire of resistance 25Ω How much heat will be developed in 1 minute?

Watch Video Solution

169. An ammeter reads a current of 30A when it is connected across the terminals of a cell of emf 1.5V. Neglecting the meter resistance, find the amount of heat produced in the battery in 10seconds?

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170. A coil of resistance 100Ω is connected across a battery of emf 6.0V. Assume that. The heat developed in the coil is used to raise its temperature. If the thermal capacity of coil is 4.0 JK^{-1}. How long would to take it raise the temperature of the coil by $15^{\circ}C$?

Watch Video Solution

171. A 100W and a 500W bulbs are joined in series and connected to the main which bulb will glow brighter?

Watch Video Solution

172. Two bulbs are market 220V, 100W and 220V,50W respectively. They are connected in series to 220V mains. Find the ratio of heats generated in them.

Watch Video Solution

173. Two electric lamps are rated as 220V. 40 W and 220V,60W. Find the heat generated per second in lamp when they are connected in series across 220V mains. Given 1 cal=4.2J.

Watch Video Solution

174. In a house having 220V line, the following appliances are working : (i) a 60W bulb and (ii) a 1000 W heater(iii) a 40W raido. Calculate (a) the current drawn by heater and (b) the current passing through the fuse line.

Watch Video Solution

175. How many 60W bulbs may be safely used on 220V line using a 5A fuse?

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176. An electric heater consists of 10m long nichrome wire of $2.5 \times 10^{-6} m^2$ corss-sectional area. Calculate the wattage of the heater, when the potential difference across the heater is 200V. Given that the resistivity of nichorme $= 1.1 \times 10^{-6} \Omega$m.

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177. The resistances of 20Ω are connected to a source of emf. Calculated the ratio of the heats produced in the two resistances when they are connected (i) In series and (ii) in parallel.

Watch Video Solution

178. An electric motor operating on a 30V supply draws a current of 10A and yields mechanical power of 120W. What is the efficiency of the motor? How much energy is lost as heat in 2h?

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179. A line having a total resistance of 0.2Ω delivers 10kW at 220V to a small factory. Calculate the efficiency of the transmission.

Watch Video Solution

180. A motor operating on 120V V draws a current of 2 A. if the heat is developed in the motor at the rate of 9 $\text{cal}s^{-1}$, what is its effciency?

Watch Video Solution

181. A small electric motor is rated 1/8H.P. and is running at 230V supply. How much current it will draw working at fully capacity ? What will be the cost of running it for 6 hours if electric energy is supplied at the 1.00per unit?

Watch Video Solution

182. A 500W electric heater is designed to work with a 200 V line. If the voltage of the line drops to 160V, then what will be the percentage loss of the heat developed?

Watch Video Solution

183. Three equal resistors connected in series across a source of emf together dissipate 10W of power. What would be the power dissipated if te same resistors are connected in parallel across the same source of emf?

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184. A room is lighted by 200W, 124V incandescent lamps fed by a genrator whose output voltage is 130V. The connecting wires from the generator to the user are made of aluminium wire of total length 130V and cross-sectional area $15mm^2$. How many such lamps can be installed? What is the total power consumed by the user?Specific resistance of aluminium $= 2.9 \times 10^{-8}\Omega$m.

Watch Video Solution

185. An electric heater consists of 20m length of manganin wire of 0.23 m^2 cross-sectional area. Calculate the wattage of the heater when a potential difference of 200V is applied across it. Resistivity of magnanin = $4.6 \times 10^{-7}\Omega$m.

Watch Video Solution

186. Two wires A and B of same material and mass, have their lengths in the ratio 1:2. On connecting them, one at a time to the same source of emf, the rate of heat dissipation in B is found to be 50W. What is the rate of heat dissipation in A?

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187. Find the cost of electricity for running an electric motor of 1H.P. for 5hrs day at the rate of Rs. 1.50 per unit of electricity in the month of November.

Watch Video Solution

188. The heater coil of an electric kettle is rated as 2000W at 200V. How much time will it take to heat one litre of water from $20^{\circ}C$ to $100^{\circ}C$ assming that entire electric energy liberated form the heater coil is utilised for heating water? Also calculate the resistance of the coil. Density of water is $1gcm^{-3}$.

Watch Video Solution

189. A 40 V battery of internal resistance 6Ω is connected to a variable resistor.At what value of the current drawn from the battery is the rate of heat produced in the resistor is maximum?

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190. An accumulator of emf ε and internal resistance r is first connected to an external resistance R_1 and then to an external resistance R_2 for the same time. For what value of r the beats dissipated in R_1 and R_2 will be same?

Watch Video Solution

191. A current of 2A is passed through a wire immersed in 80 g of water initially at $15.7^\circ C$ in 40 minutes, the temperature of water rises to $30^\circ C$ if the resistance of the wire is 0.5Ω. Calculate the value of J.

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192. A storage battery of emf 8V, internal resistance 1Ω, is being charged by a 120V d.c. source, using a 15Ω resistor in series in the circuit. Calculate (i) the current in the circuit. (ii) terminal voltage across the battery during charging, and (iii) chemical energy stored in the battery in 5 minutes?

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