PHYSICS

BOOKS - RESNICK AND HALLIDAY PHYSICS (HINGLISH)

CIRCUITS

Sample Problems

1. The emf and resistances in the circuit of Fig 27-8a have the following values:

$\varepsilon_1 = 4.4V . \varepsilon_2 = 2.1V,$

$r_1 = 2.3\Omega, r_2 = 1.8\Omega, R = 5.5\Omega$

(a) What is the current I in the circuit?

(b) What is the potential difference between the terminals of battery 1 in Fig. 27 8a?

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2. Figure 27-11a shows a multiloop circuit containing one ideal battery and four resistances with the following values:

$R_1 = 20\Omega, R_2 = 20\Omega, \varepsilon = 12V,$

$R_3 = 30\Omega, R_4 = 8.0\Omega$

(a) What is the current through the battery?

(b) What is the current i_2 through R_2?

(c) What is the current i_3 through R_3?

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3. Figure 27-12 shows a circuit whose elements have the following values: $\varepsilon_1 = 3.0V, \varepsilon_2 = 6.0V, R_1 = 2.0\Omega R_2 = 2.0\Omega.$ The three batteries are ideal batteries. Find the magnitude and direction of the current in each of the three branches

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4. Twelve wires, each having resistance r, are joined to form a cube as shown in Fig. 27-18. Find the equivalent resistance between the ends of a face diagonal such as a and c.

Figure 27.18 Twelve equal resistors arc arranged in the shape of a cube. The battery is connected between points a and c.

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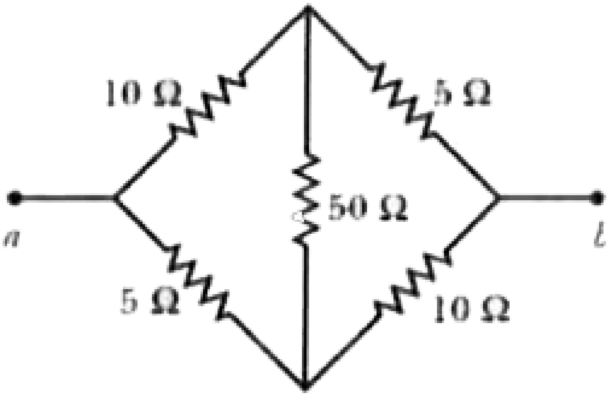
5. Find the equivalent resistance between points a and b of the circuit shown in Fig 27-20.



A network of five resistances.

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6. As a car rolls along pavement, electrons move from the pavement first onto the tires and then onto the car body. The car stores this excess charge and the associated electric potential energy as if the car body were onc plate of a capacitor and the pavement were the olher plate (Fig. 27-35a). When the car stops, it discharges its excess charge and energy through the tires, just as a capacitor can discharge through a resistor. If a conducting object comes within a few centimeters of the car before the car is discharged, the remaining energy can be suddenly transferred to a spark between the car and the object. Suppose the conducting object is a fuel dispenser. The spark will not ignite the fuel and cause a fire if the spark energy is less than the critical Value $U_{\text{fire}} = 50mJ$.

When the car of Fig. 27-35a stops at time t=0, the car ground potential difference is $V_0 = 30kV$. The car-ground capacitance is $C = 500pF$, and the resistance of each tire is $R_{\text{tire}} = 100G\Omega$. How much time does the car take to discharge through the tires to drop below the critical value U_{fire}?

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7. (a) Find the current I supplied by the battery in the network as shown in steady state. (b) Find the steady state charge on the capacitor. (c) Find the initial current through the battery.

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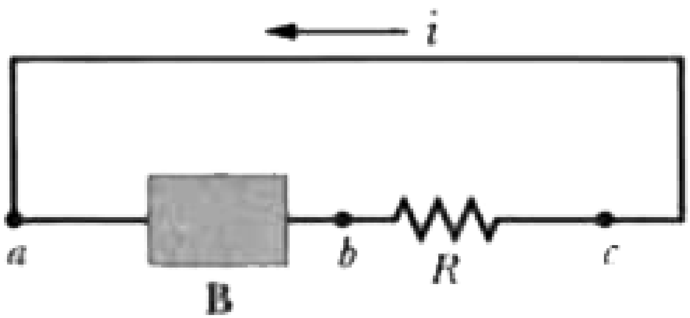
Checkpoints

1. The figure shows the current I in a single-loop circuit with a battery B and a resistance R (and wires of negligible resistance). (a) Should the emf arrow at B be a drawn pointing leftward or rightward? At points a,b and c rank (b) the magnitude of the current)c the electric potential, and (d) the electric potential energy of the charge carriers greatest first.



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2. If $R_1 > R_2 > R_y$ rank the three resistance according to (a) the current through them and (b) the potential across them, greatest first.

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3. A battery has an emf of 12 V and an internal resistance of 2Ω. Is the terminal-to-terminal potential difference greatest then less than, or equal to 12V if the current in the battery is (a) from the negative to the positive terminal, (b) from the positive to the negative terminal, and (c) zero?

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4. A batery, with potential V across it, is connected to a combination of two idential resistors and them has current I through it. What are the potential difference acros and the current through either resistor if the resistors are (a) in series and (b) in parallel?

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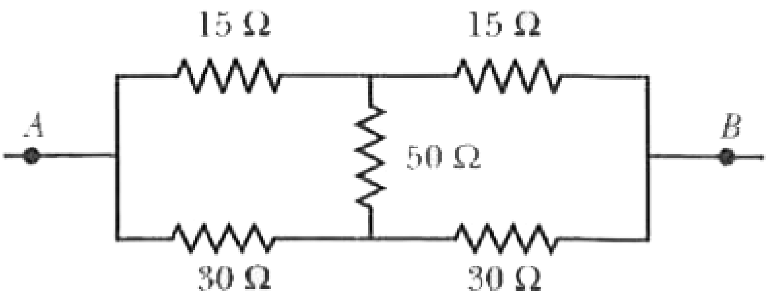
5. In the adjoing circuit, find the branches in which the current is the same. Hence, redraw the circuit so that we can find the equivalent resistance of the circuit by simple series parallel



analysis.

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6. A galvanometer has a coil of resistance 100Ω showing a full-scale deflection at $50\mu A$. What resistance should be a to use itas (a) a voltmeter of range 50V and (b)an ammeter of range 10mA?

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7. The table gives four sets of values for the circuit elements in Fig 27.33. Rank the sets according to (a) the initial current (as the switch is closed on a) and (b) the time required for the current to decrease to half its initial value, greatest first.

	1	2	3	4
$\mathscr{E}$(V)	12	12	10	10
$R(\Omega)$	2	3	10	5
$C(\mu F)$	3	2	0.5	2

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Problems

1. An isolated charged capacitor may gradually discharge as charge leaks from one plate to the other through the intermediate material, as if it were discharging through an external resistor. (a) What is the resistance of such an external resistor if a $2.00 \mu F$ capacitor's potential difference decreases to 60.0% of its initial value of 50.0 V in 2.40 d? (b) What is the corresponding loss of potential energy in that time interval? (c) At the end of that interval, at what rate is the capacitor losing potential energy?

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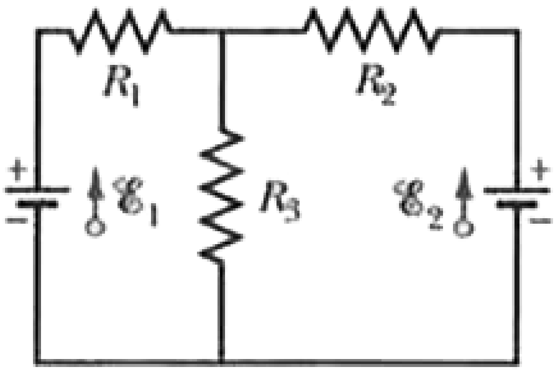
2. In Fig. 27-37, the ideal batteries have emfs $\varepsilon_1 = 12.0 V$ and $= \varepsilon_2 = 0.500 \varepsilon_1$ and the resistances are each

4.00Ω. What is the current in (a) resistance 2 and (b) resistance 3?



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3. In Fig 27.37,

$\varepsilon_1 = 1.00V, \varepsilon_2 = 3.00V, R_1 = 4.00\Omega, R_2 = 2.00\Omega, R_3 = 5.00\Omega,$

both batteries are deal. What is the latest which energy is dissipated in (a) $R_1, (b) R_2$ and $(c) R_3$? What is the power of (d) battery 1 and (e) ballery 2? Is energy being absorbed or provided in (f) battery and (g) battery 2?

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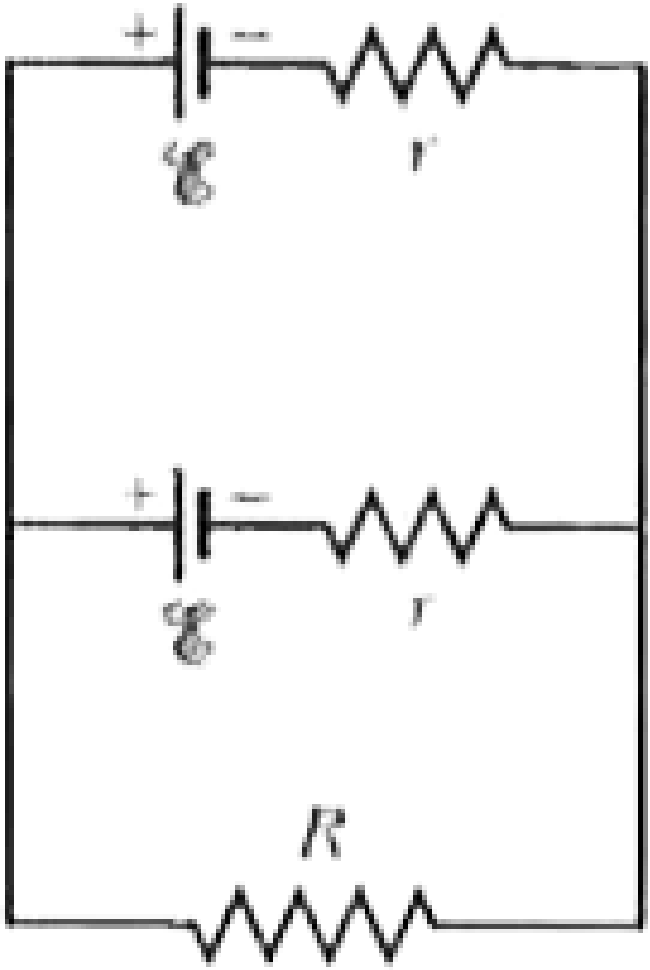
4. In Fig. 27-38, two batteries with an emf $\varepsilon = 12.0V$ and an internal resistance r=0.500 Ω are connected in parallel across a resistance R. (a) For what value of R is the dissipation rate in the resistor a maximum? (b) What is that maximum? and (c) what is the total dissipation rate in the batteries? In terms of r, what are (d) the effective R (internal) resistance of the two-battery system and (e) the resistance R that is required to maximize the dissipation rate? This is a general result.



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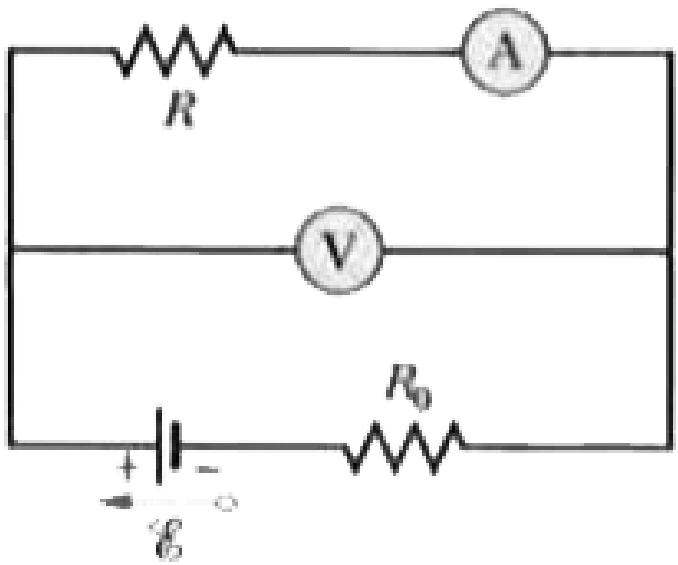
5. In Fig. 27-39, a voltmeter of resistance $R_v = 300\Omega$ and ammeter of resistance $R_A = 3.00\Omega$ are being used to measure a resistance R in a circuit that also contains a resistance $R_0 = 100\Omega$ and an ideal battery with an emf of $\varepsilon = 18.0V$. Resistance R is given by R =V/i, where V is the potential across R and i is the ammeter reading. The voltmeter reading is V', which is V plus the potential dilference across the ammeter. Thus, the ratio of the two meter readings is not R but only an apparent resistance R' -V/i. If R $= 85.0\Omega$ what are (a) the ammeter reading.



(b) the voltmeter reading, and (c) R'? (a) If R_A is decreased, does the difference between R' and R increase, decrease, or remain the same?

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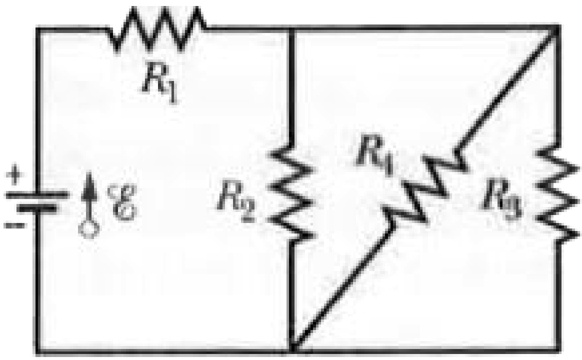
6. In Fig. 27-40, $R_1 = 100\Omega, R_2 = R_3 = 50.00\Omega, R_4 = 75.0\Omega,$ and the ideal battery has emf $\varepsilon = 12.0V$. (a) What is the equivalent resistance? What is i in (b) resistance 1, (c) resistance 2, (d) resistance 3, and (e) resistance 4?



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7. In Fig. 27-40, the resistors have the values $R_1 = 700\Omega$, $R_2 = 12.0\Omega$, and $R_3 = 4.00\Omega$ and the ideal battery's emf is 22.0 V. For what value of R_4 Will the rate at which the battery transfers energy to the resistors equal (a) 60.0 W, (b) the maximum possible rate $P_{\max}$ and and (c) the minimum possible rate $P_{\min}$? What are (d) $P_{\max}$ and $(e)P_{\min}$?

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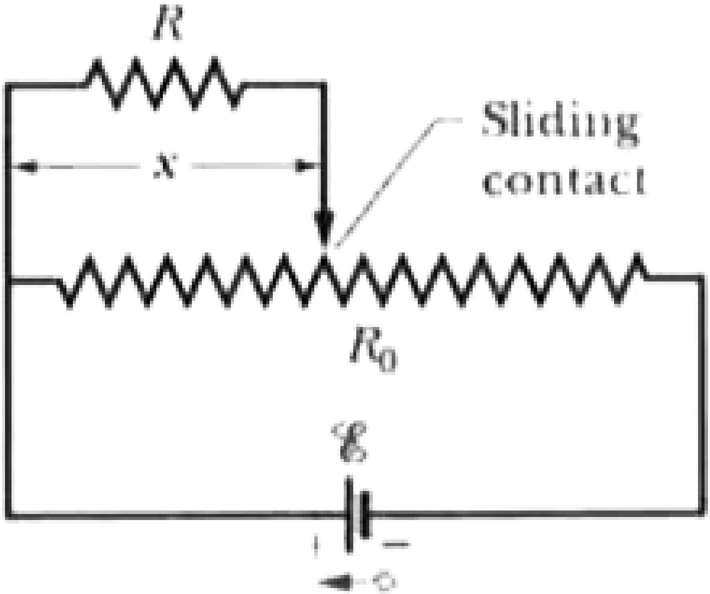
8. Figure 27-41 shows a battery connected across a uniform resistor R_0. A sliding contact can move across the resistor from x=0 at the left x= 10 cm at the right. Moving the contact changes how much resistance is to the left of the contact and how much is to the right. Find the rate at which energy is dissipated resistor R as a function of x. Plot the function for

$\varepsilon_0 = 50V$, $R = 2000\Omega$ and $R_0 = 100\Omega$



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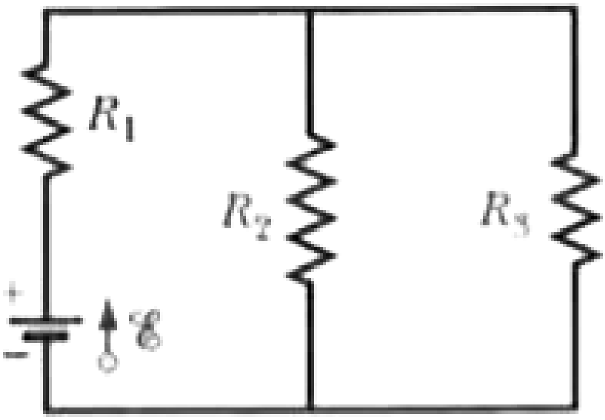
9. In Fig. 27-42, the resistances are $R_1 = 3.00\Omega$, $R_2 = 700\Omega$. and the battery is ideal. What value of R_3 maximizes the dissipation rate in resistance 3?



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10. A capacitor with an initial potential difference of 80.0 V is discharged through a resistor when a switch between them is closed at t=0. At t= 10.0s, the potential difference across the capacitor is 1.00V (a) What is time constant of the circuit? (b) What is the potential difference across the capacilor

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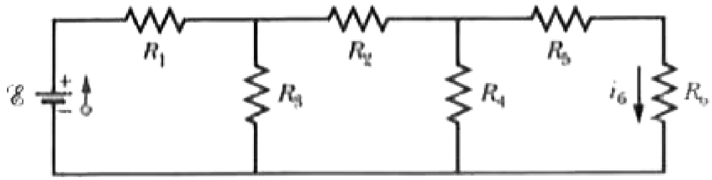
11. In Fig. 27-43, the current in resistance 6 is $i_6 = 2.80A$ the resistances are $R_1 = R_2 = R_3 = 2.00\Omega$, $R_4 = 16.0\Omega$, $R_5 = 8.00\Omega$ and $R_6 = 4.00\Omega$. Wat is the emf of the ideal battery?



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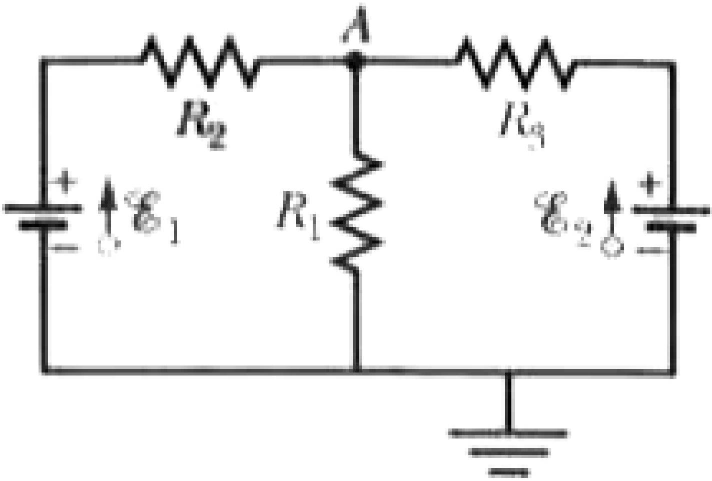
12. In Fig. 27-44, $\varepsilon_1 = 8.00V$, $\varepsilon_2 = 12.0V$, $R_1 = 100\Omega$, $R_2 = 200\Omega$, $R_3 = 300\Omega$. One point of the circuit is grounded (V =0). What are the (a) size and (b) direction (up or down) of the current through resistance 1, the (c) size and (d) direction (left or right) of the current through resistance 2, and the (e) size and (f) direction of the current through resistance 3? (g) What is the electric potential at point A?



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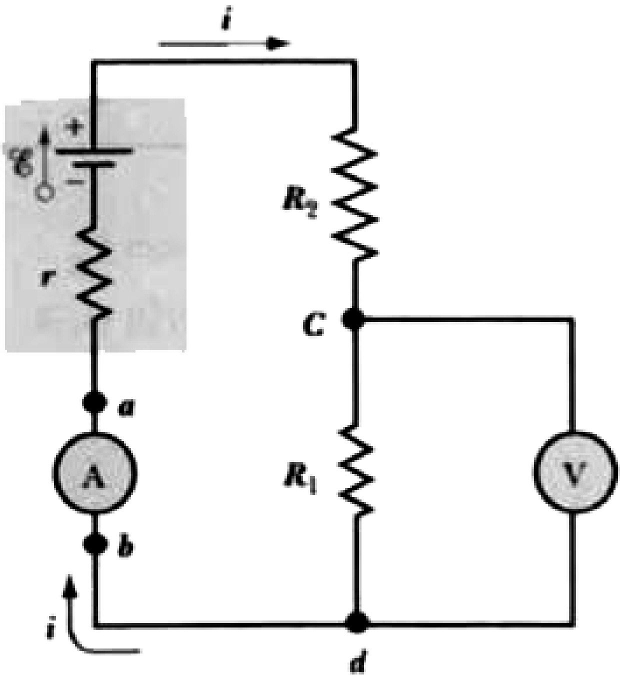
13. In Fig. 27-45, assume that $\varepsilon = 3.0V, r = 100\Omega, R_1 = 25022$ and $R_2 = 300\Omega.$ If the voltmeter resistance RV is $5.0k\Omega.$ what percent error does it introduce into the measurement of the potential difference across

R_1?. Ignore the presence of the ammeter.



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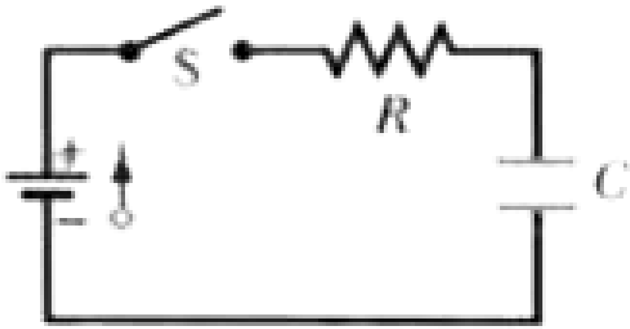
14. Switch S in Fig. 27-46 is closed at time t= 0, to begin charging an initially uncharged capacitor of capacitance $C = 49.0 \mu F$ through a resistor of resistance $R = 32.0 \Omega$. At what time is the potential across the capacitor equal to that across the resistor?



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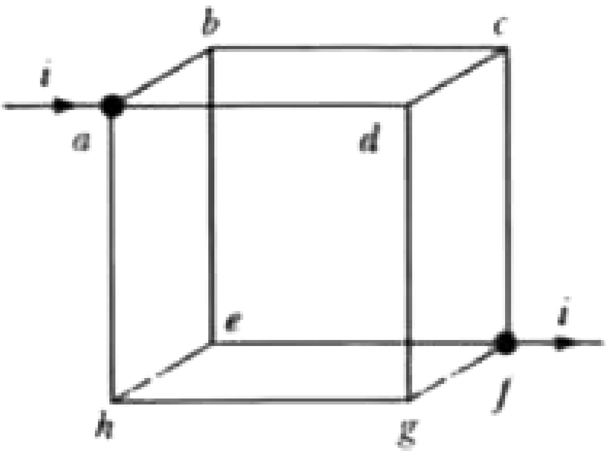
15. In the circuit shown in Fig. 27-47, there is a cube of resistances which are all having the same resistance of R. Find the equivalent resistance of the network between diagonally opposite points as shown in the figure.



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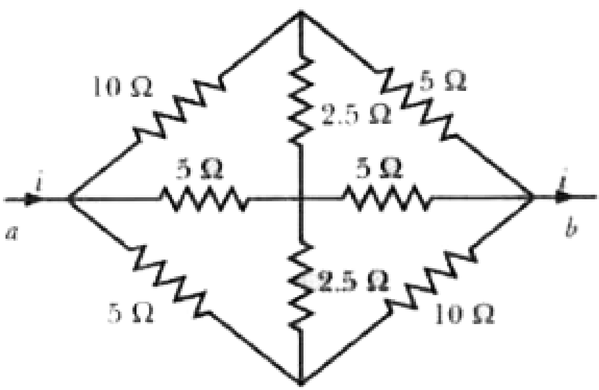
16. Find the equivalent resistance of the network as shown in Fig 27.48 between points a and b



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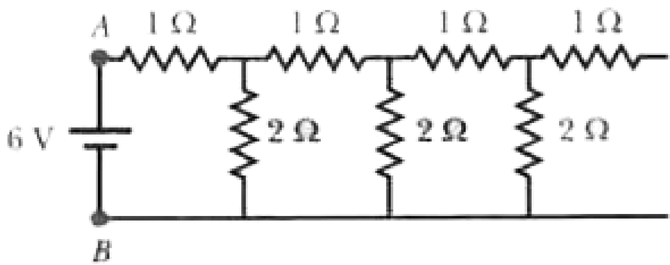
17. An infinite ladder is constructed with 1Ω and 2Ω resistors as shown in Fig 27-49. Find the effective resistance between the points A and B.



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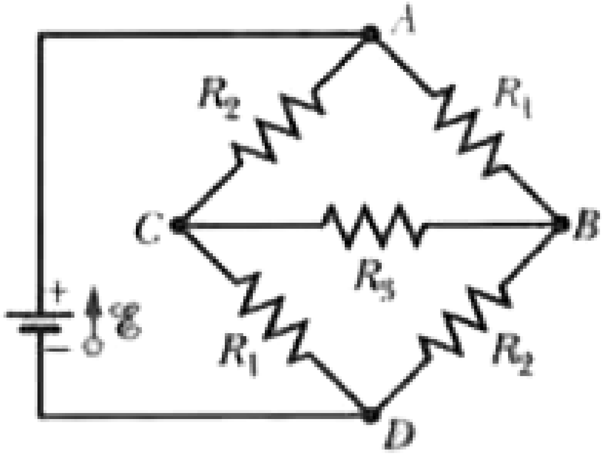
18. In Fig 27-50, $\varepsilon = 24.0V$, $R_1 = 2000\Omega$, $R_2 = 3000\Omega$ and $R_3 = 4000\Omega$. What are the potential differences (a) $V_A - V_B$ (b) $V_B - V_C$ (c)

$V_C - V_D$ and $(d) V_A - V_C$?



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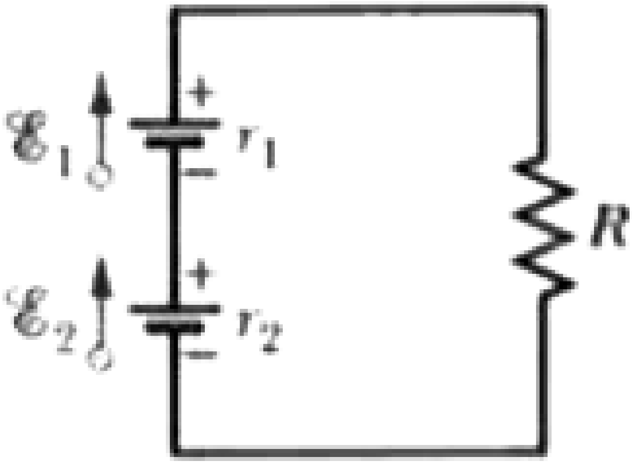
19. In Fig. 27-51. battery 1 has emf $\varepsilon_1 = 12.0V$ and internal resistance $r_1 = 0.025\Omega$ and battery 2 has $emf_2 = 12.0V$ and internal resistance $r_2 = 0.012\Omega$. The batteries are connected in series with an external resistance R. (a) What R value makes the terminal-to-terminal potential difference of one of the batteries zero? (b) Which battery is that?



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20. A capacitor with initial charge q_0, is discharged through a resistor. What multiple of the time constant τ gives the time the capacitor takes to lose (a) the first 25% of its charge and (b) 50% of its charge?

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21. In Fig 27-52, circuit section AB absorbs energy at a rate of 50W when current i=2.0A through it is in the indicated direction. Resistance $R = 2.0\Omega$, (a) What is the potential difference between A and B? Emf device X lacks internal resistance. (b) What is its emf? (c) is pont B connected the positive terminal of X or to the negative terminat?

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22. Sixteen copper wires of length l and diameter d are connected in parallel to form a single composite conductor of resistance R. What must the diameter D of a single copper wire of length l be if it is to have the same resistance?

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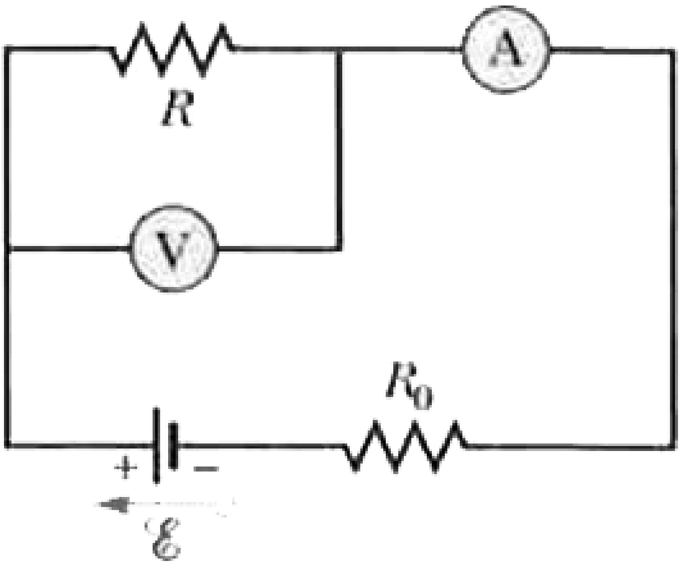
23. In Fig 27-53, a voltmeter of resistance $R_v = 300\Omega$ and an ammeter of resistance $R_A = 3.00\Omega$ are being used to measure a resistance R in. a circuit that also contains a resistance $R_0 = 100\Omega$ and an ideal battery of emf $\varepsilon = 28.5V$. Resistance R is given by R=V//i where V is the voltmeter reading and i is the current in resistance R. However, the ammeter reading is not i but rather i', which is i plus the current through the voltmeter. Thus, the ratio of the two meter readings is not R but only an apparent resistance R'=V/I'. If $R = 85.0\Omega$ what are (a) the ammeter reading. (b) the voltmeter reading, and (c) R' (d) If R_v is increased does the difference between R' and R increase, decrease or on the same?



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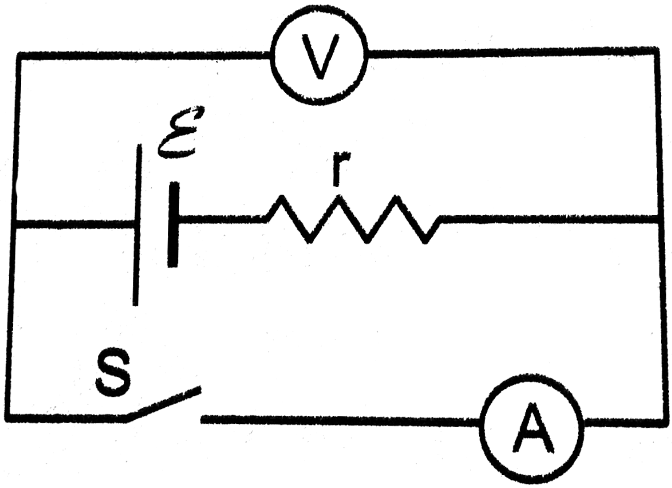
24. Shown an arrangement to measure the emf $(\varepsilon)$and internal resistance r of a battery. The voltmeter has a very high resistance and the ammeter also has some resistance.The voltmeter reads 1.52 V when the switch S is open.When the switch is closed the voltmeter reading drops to 1.45 V and the ammeter read 1.0A Find the emf and the internal resistance of the battery.



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25. A voltmeter consists of a 25Ω coil connected in series with a 575Ω resistor. The coil takes 10 mA for full-scale deflection. What maximum potential difference can be measured on this voltmeter?

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26. An ammeter is to be constructed which can read currents up to 2.0 A. If the coil has a resistance of 25Ω and takes 1 mA for full-scale deflection, what should be the resistance of the shunt used?

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27. A volmeter coil has resistance 50.0Ω and a resistor of $1.15k\Omega$ is connected in series. It can read potential differences upto 12 V. If this same coil is used to construct an ammeter which can measure currents up to 2.0 A, what should be the resistance of the shunt used?

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28. A $3.00M\Omega$ resistor and a $1.00\mu F$ capacitor are connected in series with an ideal battery of emf $\varepsilon = 4.00V$. At 6.00 s after the connection is made, what is the rate at which (a) the charge of the capacitor is increasing, (b) energy is being stored in the capacitor, (c) thermal energy is appearing in the resistor, and (d) energy is being delivered by the battery?

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29. In an RC series circuit, emf $\varepsilon = 12.0V$, resistance $R = 1.40M\Omega$ and capacitance $C = 2.70\mu F$. (a) Calculate the time constant. (b) Find the maximum charge that will appear on the capacitor during charging. (C) How long does it take for the charge to build up to $16.0\mu C$?

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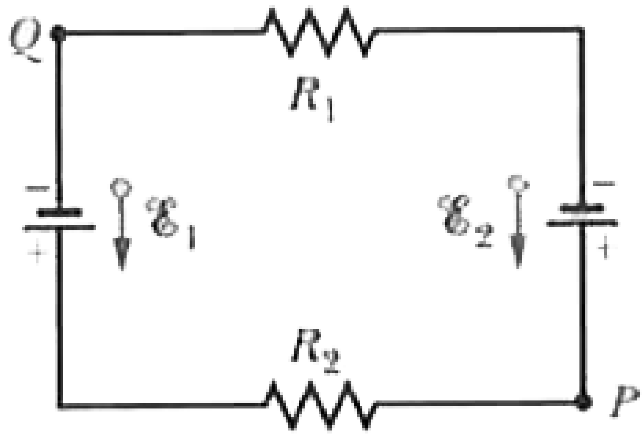
30. In Fig 27-56, the ideal batteries have emf $emf_1 2 = 200V$ and $\varepsilon_2 = 50V$ and the resistances are

$R_1 = 3.0\Omega$ and $R_2 = 2.0\Omega$. If the potential at P is 100 V, what is



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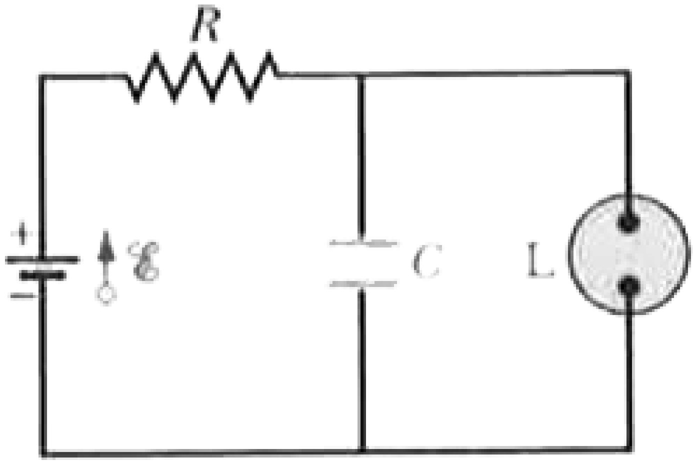
31. Figure 27-56 shows the circuit of a flashing lamp, like those attached to barrels at highway construction sites. The fluorescent lamp L (of negligible capacitance) is connected in parallel, across the capacitor C of can RC circuit. There is a current through the lamp only when it potential difference across it reaches the breakdown voltage V_L, then the capacitor discharges completely through the lamp and the lamp flashes briefly. For a lamp with breakdown voltage $V_L = 75.0V$, wired to a 95.0 V ideal battery and a $0.150 \mu F$ capacitor, what resistance R is needed for two flashes per second?



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32. Six 18.0Ω resistors are connected in parallel across a 12.0V ideal battery. What is the current through the battery?

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33. In Fig. 27-9, what is the potential difference $V_{\cdot d} - V_c$ between points d and c if $\varepsilon_1 = 4.0V.\ \varepsilon_2 - 1.0V,\ R_1 = R_2 = 10\Omega,$ and $R_3 = 8.0\Omega,$ and the battery is ideal?

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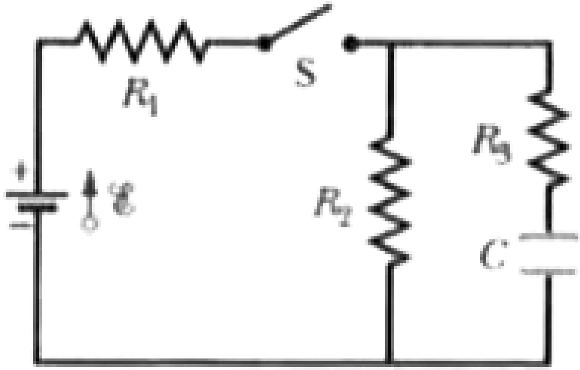
34. In the circuit of Fig 27-57 $\varepsilon = 1.2kV,\ c = 6.5\mu F,\ R_1 = R_2 = R_3 = 0.73M\Omega.$ With C completely uncharged switch S is suddenly closed (at t=0). At t=0, what are (a) current i_1 in resistor 1, (b) current i_2 in resistor 2, and (c) current i_3 in resistor 3? At $t = \infty$ (thta is after many time constants). what are (d) $i_1, (e) i_2$ and $(f) i_3$? What is the potential difference V_2 across resistor 2 at (g) t=0 and (h) $t = \infty$?

Sketch V_2 versus t between these two extreme times.



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35. When resistors 1 and 2 are connected in series, the equivalent resistance is 20.0Ω. When they are connected in parallel, the equivalent resistance is 3.75Ω. What are (a) the smaller resistance and (b) the larger resistance of these two resistors?

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36. A car battery with a 12 V emf and an internal resistance of 0.030Ω is being charged with a current of 40 A. What are (a) the potential difference V across the terminals, (b) the rate P_r. of energy dissipation inside the battery, and (c) the rate P_{emf} of energy conversion to chemical form? When the battery is used to supply 40 A to the starter motor, what are (d) V and (e) P?

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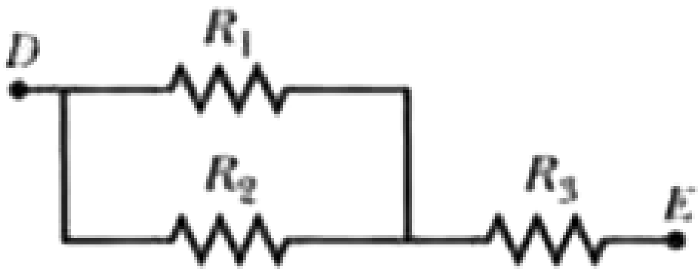
37. In Fig. 27-58, $R_1 = R_2, 4.00\Omega$ and $R_3 = 1.50\Omega.$ Find the equivalent resistance between points D and E. (Hint : Imagine that a battery is connected across those points).



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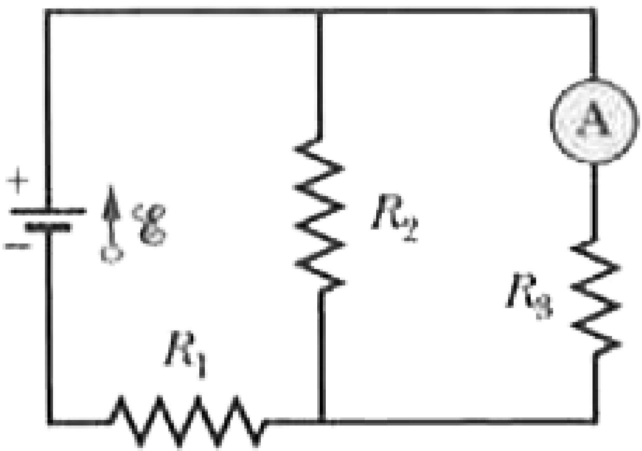
38. In Fig 27-59, what current does the ammeter read if $\varepsilon = 5.0V$ (ideal battery), $R_1 = 2.0\Omega$, $R_2 = 9.0\Omega$ and $R_3 = 6.0\Omega$? (b) The ammeter and battery are now interchanged. Show that are ammeter reading is unchanged.



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39. A total resistance of 5.00Ω is to be produced by connecting an unknown resistance. a) What must be the value of the unknown resistance and (b) should it be connected in series or in parallel (c) What is the total resistance if the unknown resistance is connected the other way?

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40. A 5.7 A current is set up in a circuit for 15.0 min by a rechargeable battery with a 6.0 V emf. By how much is the chemical energy of the battery reduced?

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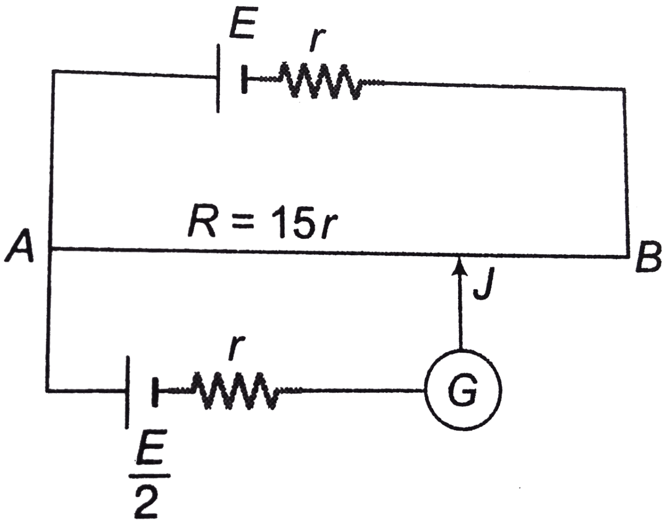
41. The potentiometer wire AB is 600 cm long.



a. At what distance from A should be jockey J touch the wire to get zero deflection i the galvanometer.

b. If the jockey touches the wire at a distance $560cm$ from A, what will be the current through the galvanometer.

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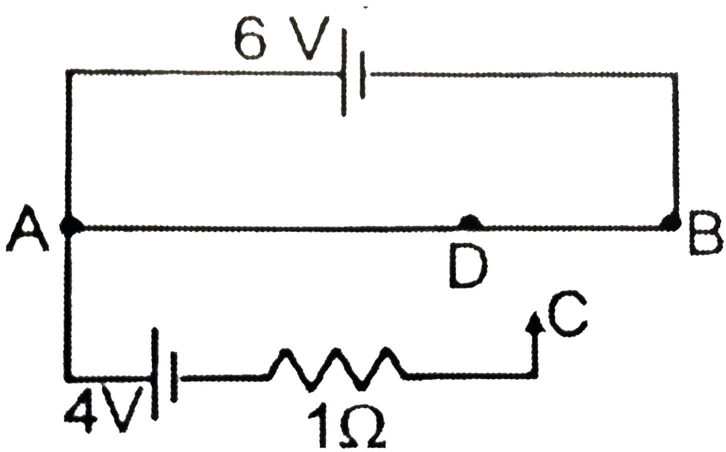
42. A 6 volt battery of negligible internal resistance is connected across a uniform wire AB of length $100cm$. The positive terminal of another battery of emf 4V and internal resistance 1Ω is joind to the point A as shown in figure. Take the potential at B to be zero. (a) What are the potentials at the points A and C ? (b) At which D of the wire AB, the potential is equal to the potential at C. (c) If the point C and D are connected by a wire. What will be the current through is ? (d) Id the 4V batteryt is replaced by 7.5 V battery, what whould be the answers of parts (a) and (b) ?



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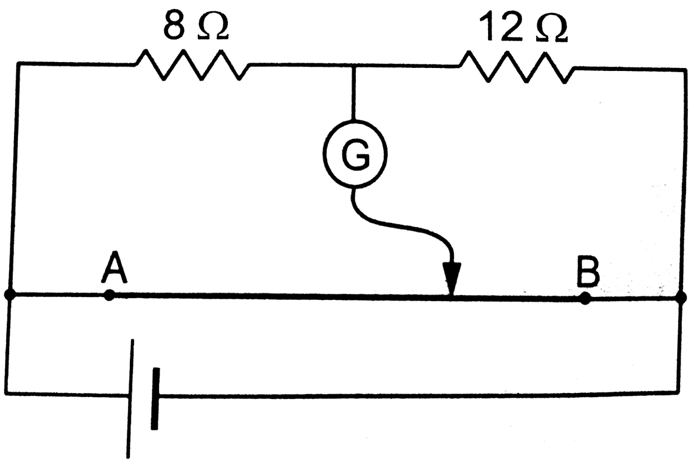
43. The potentiometer wire AB shown in figure is 40 cm long. Where should the free end of the galvanometer be connected on

AB so that the galvanometer may show zero deflection?



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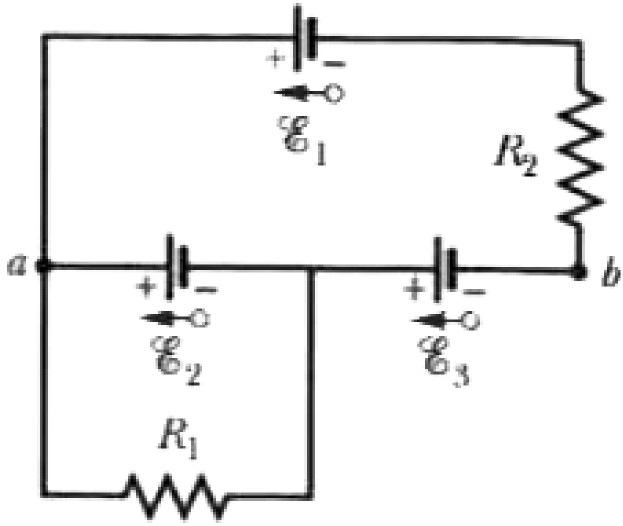
44. In Fig. 27-63, $R_1 = 100\Omega, R_2 = 50\Omega,$ and the ideal batteries have emfs, $\varepsilon_1 = 6.0V, \varepsilon_2 = 10V,$ and $\varepsilon_3 = 4.0V$. Find (a) the current in resistor 1, (b) the current in resistor 2, and (c) the potential difference between points a and b.



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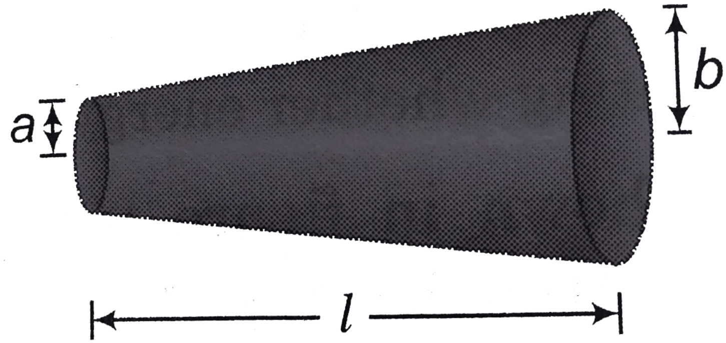
45. A conductor of length l has a non-uniform cross-section. The radius of cross-section varies linearly from a to b. The resistivity of the material is ρ. Find the resistance of the conductc across its ends.



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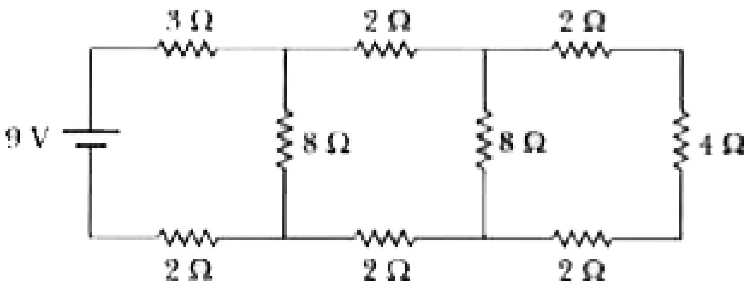
Practice Questions Single Correct Choice Type

1. In the circuit shown in the figure, the current through



A. The 3Ω resistor is 0.50A

B. The 3Ω resistor is 0.25A

C. The 4Ω resistor is 0.50A

D. The 4Ω resistor is 0.25A

Answer: D

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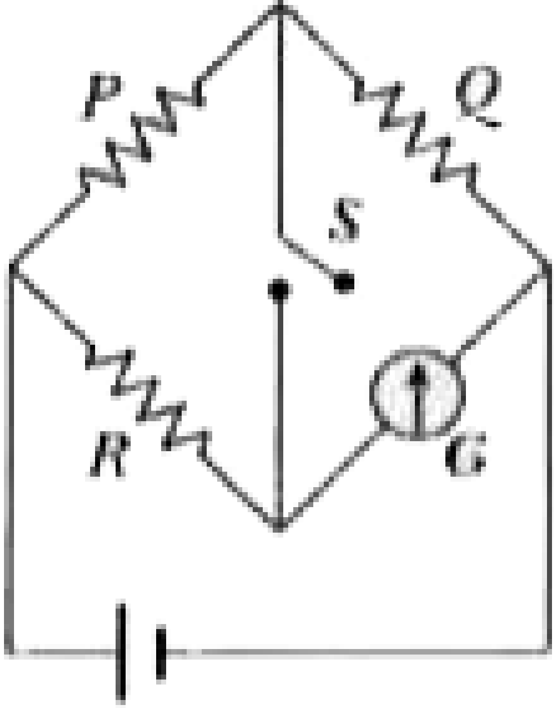
2. In the circuit shown $P \neq R$ the reading of galvonometer is same switch S open or closed. Then



A. $I_R = I_G$

B. $I_P = I_G$

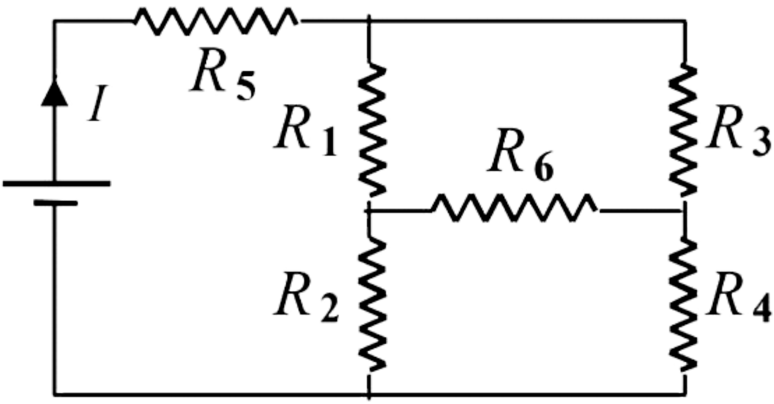
C. $I_Q = I_G$

D. $I_Q = I_S$

Answer: A

Watch Video Solution

3. In the given circuit, it is observed that the current I is independent of the value of the resistance R_6. Then the resistance values must satisfy



A. $R_1R_2R_5 = R_3R_4R_6$

B. $\frac{1}{R_5} + \frac{1}{R_6} = \frac{1}{R_1 + R_2} + \frac{1}{R_3 + R_4}$

C. $R_1R_4 = R_2R_3$

D. $R_1R_3 = R_2R_4 = R_5R_6$

Answer: C

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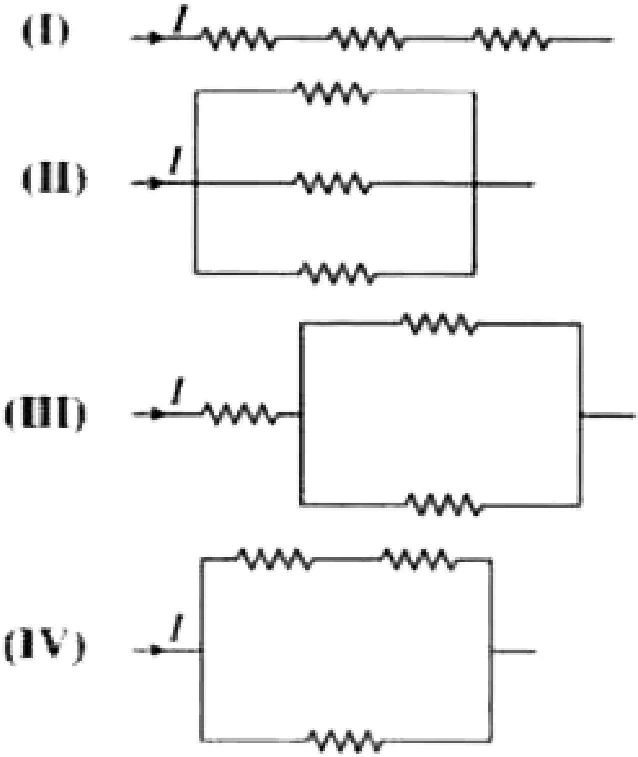
4. The three resistances of equal values are arranged in the different combination shown in the figure. Arrange them in the increasing order of dissipation of power.



A. $II < IV < I < III$

B. $II < IV < III < I$

C. $IV < II < I < III$

D. $IV < I < II < III$

Answer: B

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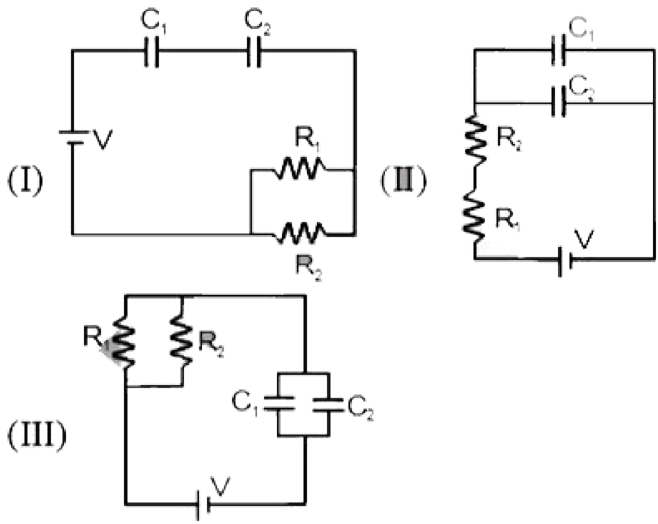
5. Given : $R_1 = 1 ohm, R_2 = 2 ohm, C_1 = 2\mu F, C_2 = 4\mu F$ The time constants (in μS) for the circuits I, II, III are respectively



A. 18, 8/9, 4

B. 18, 4, 8/9

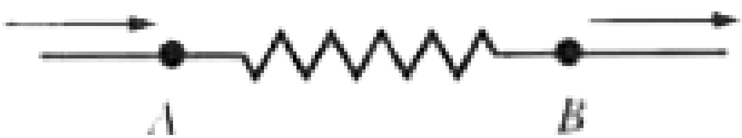
C. 4, 8/9, 18

D. 8/9, 18, 4

Answer: D

Watch Video Solution

6. Somewhere in a circuit is a resistor. A constant current is flowing in the direction as indicated in the following figure. In going from A to B, we measure $\int_A^B \overrightarrow{E} . d\bar{l}$ What do we find?



A. A positive value

B. A negative value

C. Zero

D. We do not have enough information to answer

Answer: A

Watch Video Solution

7. If we go from A to B through the wire to the resistor, or choose a random routing through free space (thus not through the resistor itself), starting ai A and ending at B. Which of the following statement is correct?

A. There is no difference in both cases

B. There is a major difference due to path chosen

C. We cannot choose a random routine path

D. None of these

Answer: A

Watch Video Solution

8. 10C of charge start from the negative terminal of a battery, flow through the battery and then leave the positive terminal through a wire, flow through a resistor and then return to the starting point on this circuit. In this complete process, the 10C....

A. Have no net change in potential energy

B. Receive heat energy from the resistor

C. Have a net loss of potential energy

D. Do positive work on the battery

Answer: A

Watch Video Solution

9. A battery of emf E has an internal resistance r. A variable resistacne R is connected to the terminals of the battery. A current i is drawn from the battery. V is the terminal potential difference. If R alone is gradually reduced to zero, which of the following best describes i and V?

A. i decreases te zeros, V approach ε

B. i approaches an infinite value, V decreases to zero

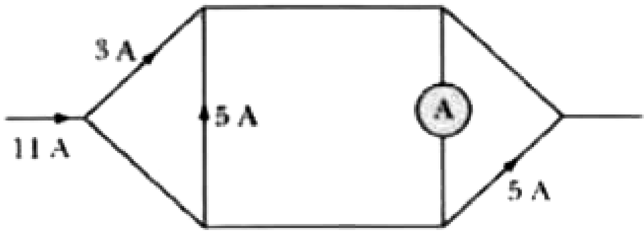
C. i approaches $\varepsilon r, V$ aaproches ε

D. I approaches ε / r, V approaches zero

Answer: D

Watch Video Solution

10. The given gure shows a network of wiers carrying various currents. What is the current through A?



A. 1A

B. 2A

C. 6A

D. 8A

Answer: B

Watch Video Solution

11. A current-carrying wire got pulled, stretching it and making it thinner in its middle. The cross-section of that wire is shown in the following figure. Which of the following statements about the current and the temperature of the wire is true?

A. The current and temperature at the thin section of the wire is higher than at the thick section

B. The current and temperature at the thick section of the wire is higher than at the thin section

C. The current and temperature at the wire is the same everywhere

D. The current in the wire is the same everywhere, but the temperature of the wire is higher in the thin section

Answer: D

Watch Video Solution

12. Four unequal resistors are connected in parallel. Which one of the following statements is correct?

A. The total resistance is less than the smallest resistor

B. The total resistance is equal to the average of the individual resistances

C. The total resistance is more than the largest resistor

D. The total resistance is in between the smallest and largest resistor but not the average of the individual resistances

Answer: A

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13. Three 100 W light bulbs are connected in series to a 220V power source. If two of the light bulbs are replaced by 60 W bulbs, the brightness of the remaining on w bulb is

A. Brighter than it was before

B. Dinner than it was before

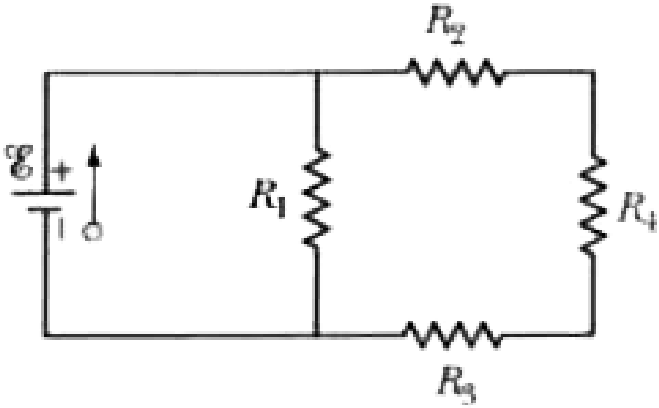
C. The same brightness as it was before

D. will not illuminate

Answer: A

Watch Video Solution

14. An ideal battery is connected to a circuit of four resistors as shown in the following figure. If the resistance R_4 is increased,



then

A. The current through R_1 decreases

B. The potential difference across R_1 increases

C. The potential difference across R_4 increases

D. The potential difference across R_2 decreases

Answer: A

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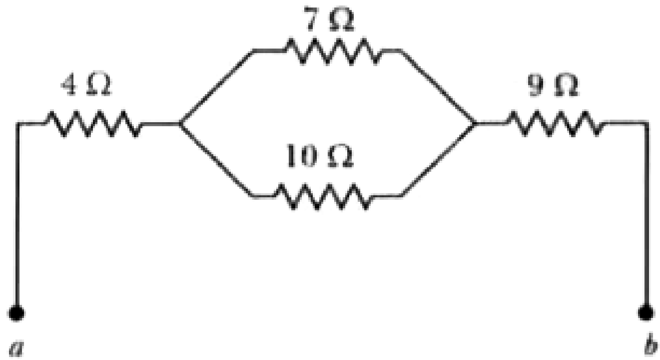
15. If voltage V is applied across terminals a and b of the circuit shown in the following figure, which of the statements below is true? (Notation: i_4 is current through 4.00Ω resistor,...)



A. $i_7 < i_{10} < i_9$

B. $i_4 = i_7 = i_9$

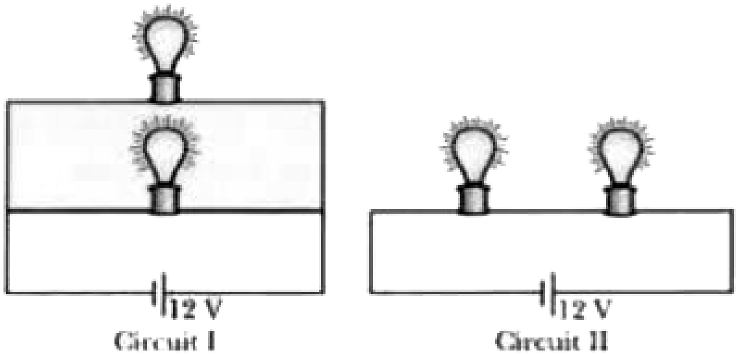
C. $i_4 > i_7 + i_{10} > i_9$

D. $i_{10} < i_7$

Answer: D

Watch Video Solution

16. If the four light bulbs in the following figure are identical which circuit gives out more light?



A. I

B. The two emit the same amount of light

C. II

D. None of these

Answer: A

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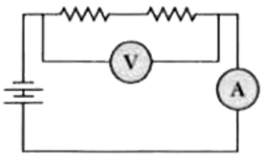
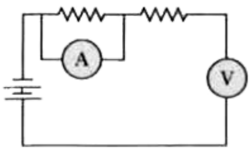
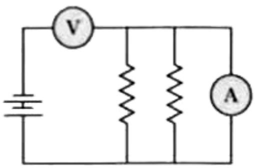
17. Which circuit diagram shows voltmeter V and ammeter A correctly positioned to measure the total potential difference of the circuit and the current through each resistor?



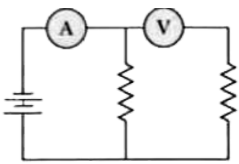
A.



B.



C.



D.

Answer: A

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18. When a capacitor is discharged through a resistor, which of the following is false?

A. The current in the capacitor is equal to the current in the resistor

B. The capacitor voltage decreases by half after a time equal to RC

C. The voltage across the capacitor is equal to the voltage across the resistor at any instant

D. The current in the circuit takes an infinite time to reach zero

Answer: D

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19. Two identical resistors of magnitude R and two identical capacitors of magnitude C are used to form an RC circuit. In which case the time constant of that RC circuit is the highest?

A. Two resistors and two capacitors connected in series with a power supply

B. Two resistors and two capacitors connected in parallel with a power supply

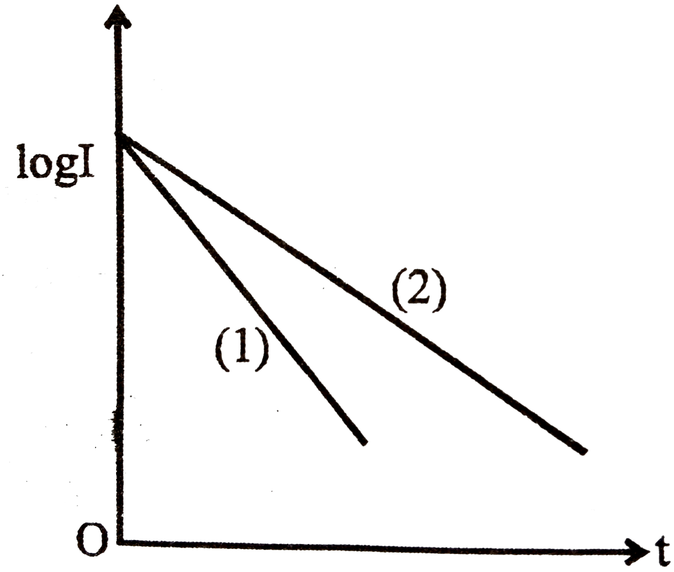
C. Two resistors connected in parallel, two capacitors connected in parallel, and those two combinations are connected in series with a power supply

D. Two resistors connected in series, two capacitors connected in parallel, and those two combinations are connected in series with a power supply

Answer: D

Watch Video Solution

20. A capacitor of capacity C is charged to a steady potential difference V and connected in series with an opne key and a pure resistor 'R'. At time $t=0$, the key si closed. If $I=$ current at time t, a plot of $\log I$ against 't' is as shown in (1) in the graph. Later one of the parametrs i.e. V, R or C is charged keeping the other two constant, and graph (2) is recored. then-



A. C is reduced

B. C is increased

C. R is reduced

D. R is increased

Answer: B

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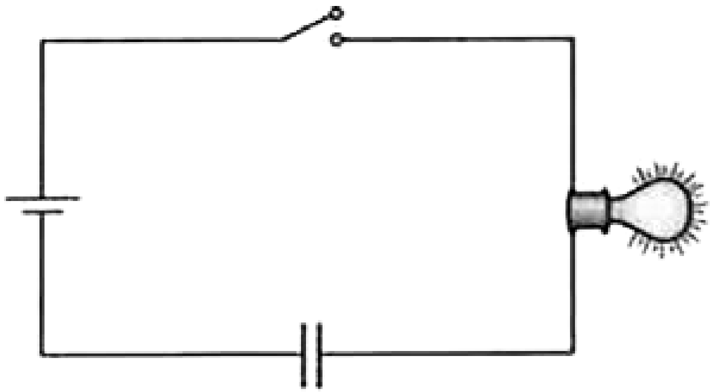
21. When the switch is closed in the circuit as shown in the following figure, the light bulb become bright in an inperceptibly short-time interval, and then gradually goes out. We interpret this to mean that



A. Electrons on the negative terminal of the battery reach a capacitor plate almost instantaneously

B. Electrons from a capacitor plate travel to the positive terminal of the battery almost instantaneously

C. The capacitor must already have had charge on its plates

D. The battery establishes an electric field in the circuit almost instantaneously

Answer: D

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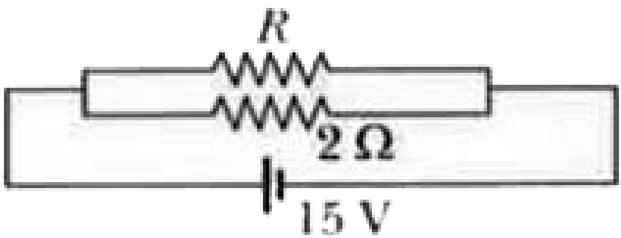
22. If in the circuit, power dissipation is 150 W. then R is



A. 2Ω

B. 6Ω

C. 5Ω

D. 4Ω

Answer: B

Watch Video Solution

23. A wire when connected to 220 V mains supply has power dissipation P_1. Now the wire is cut into two equal pieces which are connected in parallel to the same supply. Power dissipation in this case is P_2. Then $P_2 : P_1$ is

A. 1

B. 4

C. 2

D. 3

Answer: B

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24. The mass of product liberated on anode in an electrochemical cell depends on

(where t is the time period for which the current is passed.)

A. $(It)^{1/2}$

B. It

C. I/t

D. I^2t

Answer: B

Watch Video Solution

25. The negative Zn pole of a Daniell cell, sending a constant current through a circuit, decreases in mass by 0.13 g in 30 minutes. If the electeochemical equivalent of Zn and Cu are 32.5

and 31.5 respectively, the increase in the mass of the positive. Cu pole in this time is

A. 0.180 g

B. 0.141 g

C. 0.126 g

D. 0.242 g

Answer: C

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26. An ammeter reads upto 1 ampere. Its internal resistance is 0.81 ohm. To increase the range to 10 A the value of the required shunt is

A. 0.03Ω

B. 0.3Ω

C. 0.9Ω

D. 0.09Ω

Answer: D

Watch Video Solution

27. The length of a given cylindrical wire is increased by 100%. Due to the consequent decrease in diameter the change in the resistance of the wire will be

A. 2

B. 1

C. 0.5

D. 3

Answer: D

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28. The thermo e.m.f. of a thermo- couple is $25\mu V/^{\circ}C$ at room temperature. A galvanometer of 40 ohm resistance, capable of detecting current as low as 10^{-5}A, is connected with the thermo couple. The smallest temperature difference that can be detected by this system is

A. $16^{\circ}C$

B. $12^{\circ}C$

C. $8^{\circ}C$

D. $20^{\circ}C$

Answer: A

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29. The length of a wire of a potentiometer is 100 cm, and the emf of its stand and cell is E volt. It is employed to measure the emf of a battery whose internal resistance is 0.5Ω. If the balance point is obtained at l= 30 cm from the positive end, the emf of the battery is

A. $\frac{30E}{100.5}$

B. $\frac{30E}{100-0.5}$

C. $\frac{30(E-0.5i)}{100}$ wher I is the current in the potentiometer wire

D. $\frac{30E}{100}$

Answer: D

Watch Video Solution

30. The electrochemical equivalent of a metal is 3.35109^{-7} kg per Coulomb. The mass of the metal liberated at the cathode when a 3A current is passed for 2 seconds will be

A. $19.8 \times 10^{-7} kg$

B. $9.9 \times 10^{-7} kg$

C. $6.6 \times 10^{-7} kg$

D. $1.1 \times 10^{-7} kg$

Answer: A

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31. The thermistors are usually made of

A. Metals with low temperature coefficient of resistivity

B. Metals with high temperature coefficient of resistivity

C. Metal oxides with high temperature coefficient of resistivity

D. Semiconducting materials having low temperature coefficient of resistivity

Answer: C

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32. If a given volume of water in a $220V$ heater is boiled in 5 min, then how much time will it take for the same volume of water in a $110V$ heater to be boiled?

A. 1000s

B. 1200s

C. 1100s

D. 1250s

Answer: B

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33. If two bulbs of wattage 25 and 100 respectively each rated at 220 volt are connected in series with the supply of 440 volt , then which bulbs will fuse

A. 100 W

B. 25 W

C. Both of them

D. None of them

Answer: B

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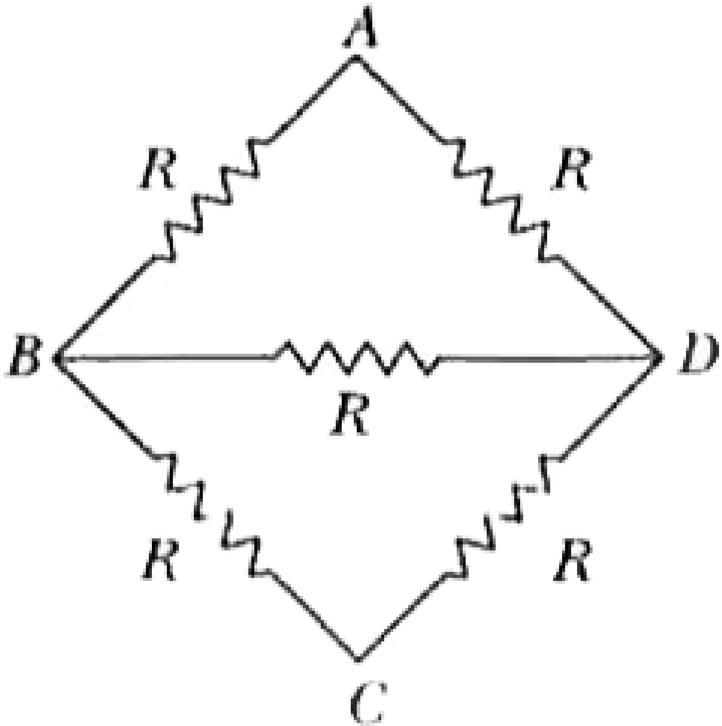
Practice Questions More Than One Correct Choice Type

1. Five equal resistances each of value R are connected in a form shown in the following figure. The equivalent resistance of the



network

A. Between points B and D is R/2

B. Between points A and C is R

C. Between points B and D is R

D. Between points A and C is R/2

Answer: A::B

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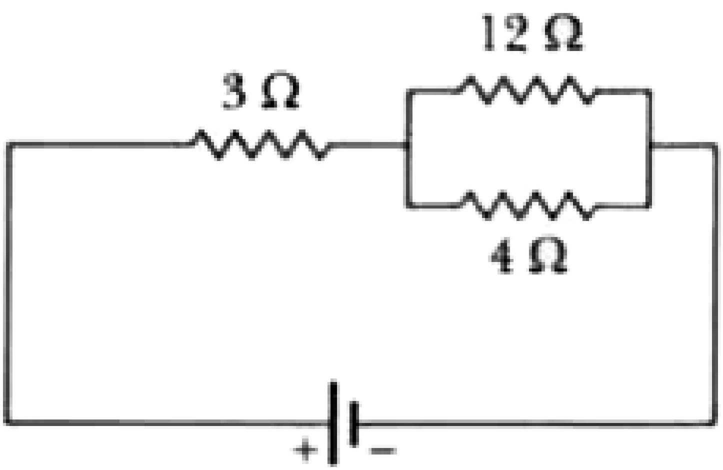
2. For the circuit shown in the following figure.



A. The heat dissipated in 4Ω resistance is more than that dissipated in 12Ω resistance

B. Maximum heat is dissipated in 3Ω resistance

C. The heat dissipated in 12Ω resistance is more than that dissipated in 4Ω resistance

D. The power dissipated in 3Ω resistance is 18 W

Answer: A::B

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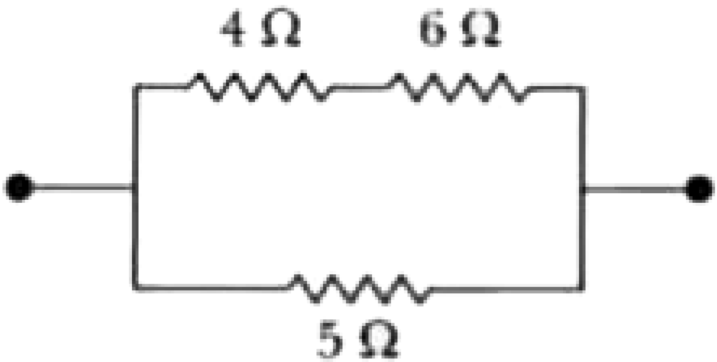
3. In the circuit shown in the following figure, the heat product in the 5Ω resistance due to the current flowing it is 10 cal/s. The heat generated in 4Ω resistance and 6Ω resistor is



A. 1 cal/s

B. 2 cal/s

C. 3 cal/s

D. 4 cal/s

Answer: B::C

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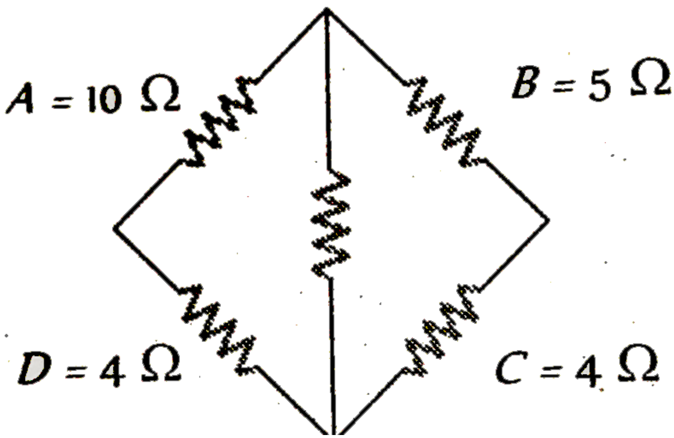
4. In a typical Wheatstone network, the resistances in cyclic order are $A = 10\Omega, B = 5\Omega, C = 4\Omega\ D = 4\Omega$ for the bridge to be balanced



A. 10Ω should be connected in series with P

B. 10Ω should be connected in parallel with P

C. 5Ω should be connected in series with Q

D. 5Ω should be connected in parallel with Q

Answer: B::C

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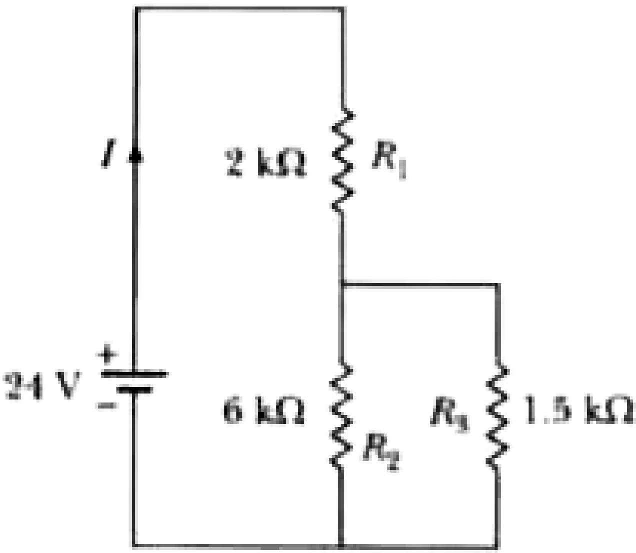
5. For the circuit shown in the following figure,



A. The current I through the battery is 7.5 mA

B. The potential difference across R_3 is 18 V

C. Ratio of powers dissipated in R_1 and R_2 is 3

D. If R_1 and R_2 are interchanged, magnitude of the power dissipated in R_3 will decrease by a factor of 9

Answer: A::D

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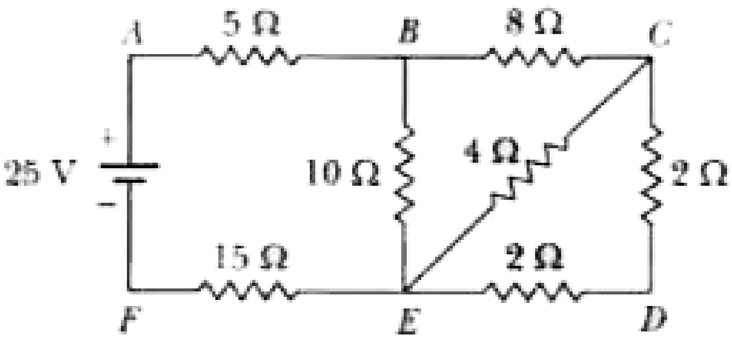
6. For the circuit shown in the following figure, the



A. Potential difference between points B and E is 5 V

B. Potential difference between points A and B is 10 V

C. Current in the 4Ω resistor is 0.25A

D. Current in the 4Ω resistor is 0.5 A

Answer: A::D

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7. Which of the following statements is/are correct?

A. If n identical cells are connected in series and then the battery thus formed is short circuited by a conduction wire, current through the wire will be independent of n

B. If n identical cells are connected in parallel and then the battery thus formed is short circuited by conducting wire, the current through the wire will be proportional to n

C. If n identical cells are connected in parallel are then the battery thus formed is short circuited by a wire having a constant resistance, the current through the wire will increase as n increases

D. None of these

Answer: A::B::C

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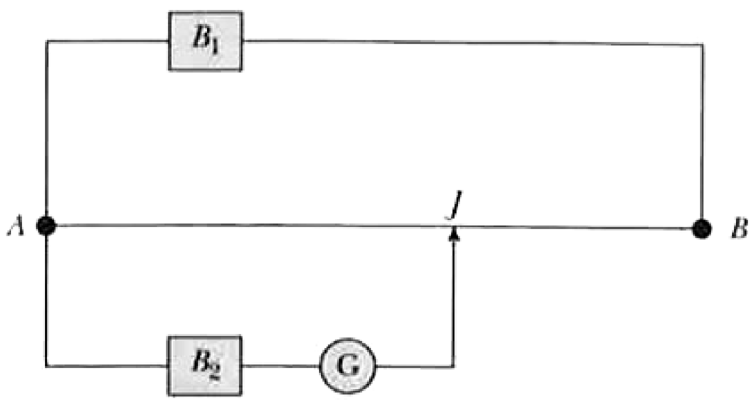
8. The below figure shows a potentiometer arrangement, where B_1 is the driving cell, B_2 is the cell whose emf is to be determined. AB is the potentiometer wire and G is the galvanometer. J is a sliding contact which can touch any point on AB. Which of the following are essential conditions for obtaining balance?



A. The emf of B_1 must be greater than the emf of B_2

B. Either the positive terminals of both B_1 and B_2 or the negative terminals of both B_1 and B_2 must be joined at A

C. The positive terminals of B_1 and B_2 must be joined to A

D. The resistance of G must be less than the resistance of AB

Answer: A::B

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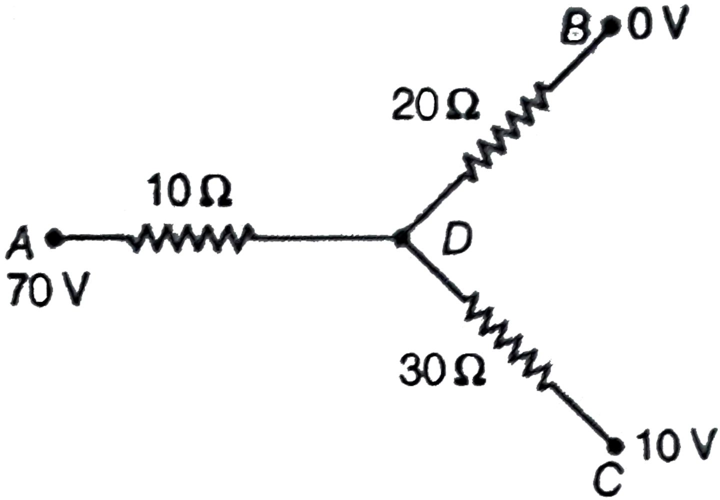
9. For the network shown in figure, points A, B and C are at potentials of 70 V, zero and 10 V respectively



A. The potential of point D is 40 V

B. The currents in the sections AD, DB, and DC are in the ratio

3:2:1

C. The currents in the sections AD, DB, and DC are in the ratio of

1:2:3

D. The network draws a total power of 200 W

Answer: A::B::D

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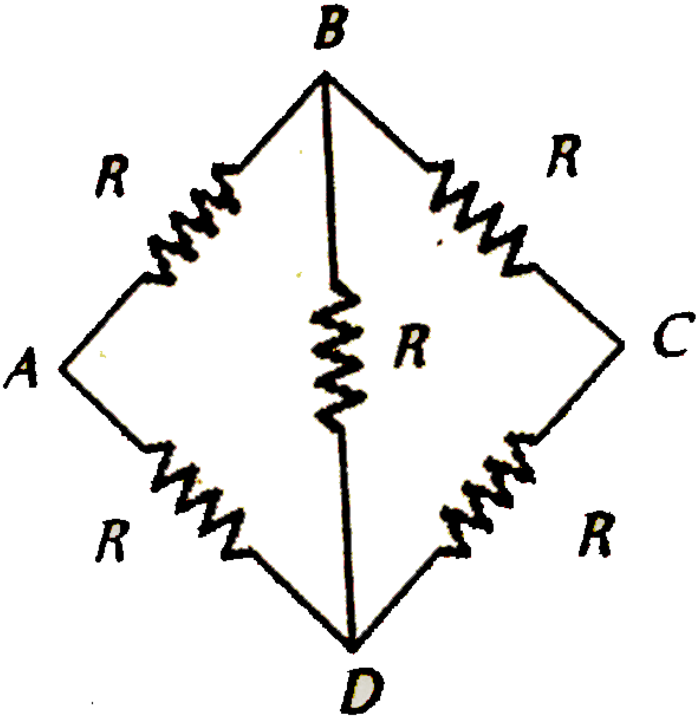
10. Five equal resistances each of value R are connected in a form shown alongside. The equivalent resistance of the network



A. Between the points B and D is R

B. Between the points B and D is R/2

C. Between the points A and C is R

D. Between the points A and C is R/2

Answer: B::C

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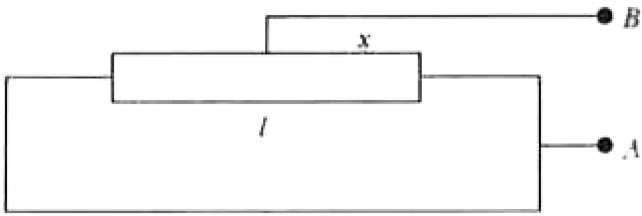
11. Two ends of an $0.1 M\Omega$ potentiometer are connected in the way as shown in the following figure.



A. $R_{AB} = 0.1 M\Omega$ for all values of x

B. $R_{AB} > 0.1 M\Omega$ for all values of x

C. $R_{AB} \leq 0.1 M\Omega$ for all values of x

D. $R_{AB} \leq 0.1 M\Omega$ for all values of x

Answer: C::D

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12. Capacitor C_1 of capacitance 1 micro-farad and capacitor C_2 of capacitance 2 microfarad are separately charged fully by a common battery. The two capacitors are then separately allowed to discharged through equal resistors at time t = 0.

A. The current in each of the two discharging circuits is zero at t=0

B. The current in the two discharging circuits at t= 0 are equal but not zero

C. The current in the two discharging circuits at t= 0 are unequal

D. Capacitor C_1 loses 50% of its initial charge sooner than C_2 loses 50% of its initial charge

Answer: B::D

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Practice Questions Linked Comprehension

1. An electrolytic cell containing a solution of $CuSO_4$ has an internal resistance of 1Ω. It is connected in series with 3 V battery of negligible resistance and a 4Ω resistance. The mass of copper which will be deposited on the copper electrode in 30 min is calculated. If 4Ω resistance is connected in parallel across the electrolytic cell and the same battery is used, the amount of copper deposited in 30 min is calculated ECE of Cu= 0.00033 g/C. Using Faraday's first law of electrolysis, the mass deposited on the copper electrode can be calculated.

For series connection of 4Ω resistor, the current flowing through electrolyte is

A. 6A

B. 0.6A

C. 0.2A

D. 1A

Answer: B

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2. An electrolytic cell containing a solution of $CuSO_4$ has an internal resistance of 1Ω. It is connected in series with 3 V battery of negligible resistance and a 4Ω resistance. The mass of copper which will be deposited on the copper electrode in 30 min is calculated. If 4Ω resistance is connected in parallel across the electrolytic cell and the same battery is used, the amount of copper deposited in 30 min is calculated ECE of Cu= 0.00033 g/C.

Using Faraday's first law of electrolysis, the mass deposited on the copper electrode can be calculated.

Mass of copper deposited in 30 min when resistance of 4Ω is in series is

A. 0.214g

B. 0.156g

C. 0.356g

D. 0.653g

Answer: C

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3. An electrolytic cell containing a solution of $CuSO_4$ has an internal resistance of 1Ω. It is connected in series with 3 V battery of negligible resistance and a 4Ω resistance. The mass of copper which will be deposited on the copper electrode in 30 min is calculated. If 4Ω resistance is connected in parallel across the electrolytic cell and the same battery is used, the amount of copper deposited in 30 min is calculated ECE of Cu= 0.00033 g/C. Using Faraday's first law of electrolysis, the mass deposited on the copper electrode can be calculated.

For the resistance of 4Ω connected in parallel to cell, the current in the circuit is

A. 3.75A

B. 7.35A

C. 5.73A

D. 5A

Answer: A

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4. An electrolytic cell containing a solution of $CuSO_4$ has an internal resistance of 1Ω. It is connected in series with 3 V battery of negligible resistance and a 4Ω resistance. The mass of copper which will be deposited on the copper electrode in 30 min is calculated. If 4Ω resistance is connected in parallel across the electrolytic cell and the same battery is used, the amount of copper deposited in 30 min is calculated ECE of Cu= 0.00033 g/C. Using Faraday's first law of electrolysis, the mass deposited on the copper electrode can be calculated.

Mass of copper deposited in 30 min when resistance of 4Ω is in parallel is

A. 4.214g

B. 3.337g

C. 2.227g

D. 1.117g

Answer: C

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5. The alternate discs of iron and carbon, having same area of cross-section are cemented together to make a cylinder whose temperature coefficient of resistivity is zero. The change in temperature in two alternate discs is same. The ratio of their thickness and ratio of heat produced in them is found out. The resistivity of iron and carbon at $20^\circ C$ are 1×10^{-7} and $3 \times 10^{-5} \Omega m$ and their temperature coefficient of resistance are $5 \times 10^{-3} {}^\circ C$ and $-7.5 \times 10^{-4} {}^\circ C$, respectively. Thermal expansion is neglected. Here, $\triangle R_1 + \triangle R_2 = 0$ (where $\triangle R_1$ and $\triangle R_2$ are the increase in resistances of iron and carbon, respectively, with the rise in temperature) because combined temperature coefficient of resistivity is given as zero.

Ratio of their thickness is

A. 54

B. 45

C. 35

D. 21

Answer: B

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6. The alternate discs of iron and carbon, having same area of cross-section are cemented together to make a cylinder whose temperature coefficient of resistivity is zero. The change in temperature in two alternate discs is same. The ratio of their thickness and ratio of heat produced in them is found out. The resistivity of iron and carbon at $20^\circ C$ are 1×10^{-7} and $3 \times 10^{-5} \Omega m$ and their temperature coefficient of resistance are $5 \times 10^{-3 \circ} C$ and $-7.5 \times 10^{-4 \circ} C$, respectively. Thermal expansion is neglected. Here, $\triangle R_1 + \triangle R_2 = 0$ (where $\triangle R_1$ and $\triangle R_2$ are the increase in resistances of iron and carbon, respectively, with the rise in temperature) because combined temperature coefficient of resistivity is given as zero.

Ratio of heat produced in them is

A. 0.51

B. 1

C. 0.15

D. 2

Answer: C

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7. The alternate discs of iron and carbon, having same area of cross-section are cemented together to make a cylinder whose temperature coefficient of resistivity is zero. The change in temperature in two alternate discs is same. The ratio of their thickness and ratio of heat produced in them is found out. The resistivity of iron and carbon at $20^\circ C$ are 1×10^{-7} and $3 \times 10^{-5} \Omega m$ and their temperature coefficient of resistance are $5 \times 10^{-3} {}^\circ C$ and $-7.5 \times 10^{-4} {}^\circ C$, respectively. Thermal expansion is neglected. Here, $\triangle R_1 + \triangle R_2 = 0$ (where $\triangle R_1$ and $\triangle R_2$ are the increase in resistances of iron and carbon, respectively, with the rise in temperature) because combined temperature coefficient of resistivity is given as zero.

A copper wire is stretched to make it 1% longer. The percentage change in its resistance is

A. 0.002

B. 0.01

C. 0.015

D. 0.025

Answer: A

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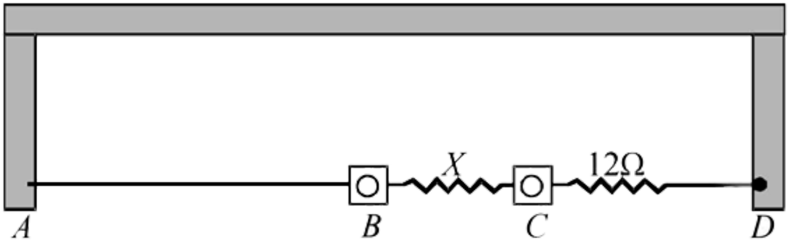
8. A thin uniform wire Ab of length 1m, an unknown resistance X and a resistance of 12Ω are connected by thick conducting strips, as shown in the figure. A battery and a galvanometer (with a sliding jockey connected to it) are also available. Connections are to be made to measure the unknown resistance X using the principle of Wheatstone bridge. Answer the following questions.



(a) Are there positive and negative terminals on the galvanometer?

(b) Copy the figure in your answer book and show the battery and the galvanometer (with jockey) connected at appropriate points.

A. Positive terminal marked on it

B. Negative termimnal marked on it

C. Both A and B

D. None of these

Answer: C

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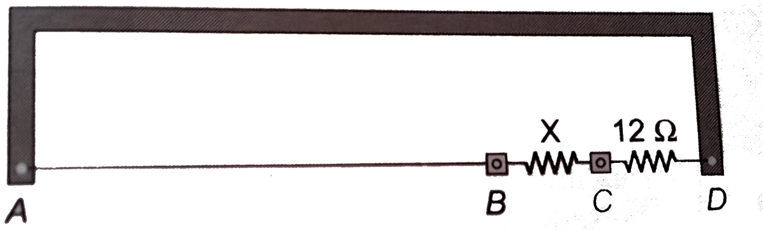
9. A thin uniform wire AB of length $1m$, an unknown resistance X and a resistance of 12Ω are connected by thick conducting strips, as shown in the figure. A battery and a galvanometer (with a sliding jockey connected to it) area also available. Connections are to be made to measure the unknown resistance X using the principle of Wheatstone bridge. Answer the following questions.



(a) Are there positive and negative terminals on the galvanometer ?

(b) Copy the figure in your answer book and show the battery and the galvanometer (with jockey) connected at apalphariate points.

(c) After apalphariate connections are made, it is found that no deflection takes place in the galvanometer when the sliding jockey touches the wire at a distance of $60cm$ from A. Obtain the value of the resistance X.

A. 6Ω

B. 8Ω

C. 12Ω

D. 9Ω

Answer: B

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10. A resistor, capacitor, switch, and ideal battery are in series. Originally the capacitor is uncharged. The switch is then closed, allowing current of flow

While the current is flowing, the potential difference across the resistor is

A. Increasing

B. Decreasing

C. Fixed

D. First increase then decreases

Answer: B

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11. A resistor, capacitor, switch, and ideal battery are in series. Originally the capacitor is uncharged. The switch is then closed, allowing current of flow

While the current is flowing, the potential difference across the capacitor is

A. Increasing

B. Decreasing

C. Fixed

D. First increase then decreases

Answer: A

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Practice Questions Matrix Match

1. Match the following

Column I	Column II
(a) The capacity of supplying the current in the circuit	(p) Voltmeter
(b) The electric energy consumed in the circuit	(q) Potentiometer
(c) emf of the cell in a closed circuit	(r) watt-hour
(d) Maximum potential difference between two points of a circuit	(s) ampere-hour

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2. Electrical current is the flow of charged particles. The electric current flows through a wire the same way as how water moves in a river. The electricity is nothing but the flow of electrons. There are two main combinations of resistors in circuit, that is series and parallel. In the given table, Column I shows different combinations of resistors, Column II shows voltages of different arrangements of resistors and Column III shows currents and voltage division needed or not in different arrangements of resistors.

Column I	Column II	Column III
(I) Series connected resistors	(i) voltage is different while current is same	(J) voltage division needed
(II) Parallel connected resistors	(ii) voltage and current are different	(K) voltage division not needed
(III) When resistors are equal	(iii) voltage and current are same	(L) current division not needed
(IV) Both series and parallel resistors.	(iv) voltage is same while current is different	(M) current division needed

When does the voltage division problem arise?

A. (I) (i) (J)

B. (IV) (i) (M)

C. (III) (ii) (L)

D. (I) (iii) (L)

Answer: A

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3. Electrical current is the flow of charged particles. The electric current flows through a wire the same way as how water moves in a river. The electricity is nothing but the flow of electrons. There are two main combinations of resistors in circuit, that is series and parallel. In the given table, Column I shows different combinations of resistors, Column II shows voltages of different arrangements of resistors and Column III shows currents and voltage division needed or not in different arrangements of resistors.

Column I	Column II	Column III
(I) Series connected resistors	(i) voltage is different while current is same	(J) voltage division needed
(II) Parallel connected resistors	(ii) voltage and current are different	(K) voltage division not needed
(III) When resistors are equal	(iii) voltage and current are same	(L) current division not needed
(IV) Both series and parallel resistors.	(iv) voltage is same while current is different	(M) current division needed

When there is no voltage division problem arise?

A. (II) (iv) (K)

B. (IV) (i) (M)

C. (III) (ii) (L)

D. (III) (iv) (K)

Answer: A

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4. Electrical current is the flow of charged particles. The electric current flows through a wire the same way as how water moves in a river. The electricity is nothing but the flow of electrons. There are two main combinations of resistors in circuit, that is series and parallel. In the given table, Column I shows different combinations of resistors, Column II shows voltages of different arrangements of resistors and Column III shows currents and voltage division needed or not in different arrangements of resistors.

Column I	Column II	Column III
(I) Series connected resistors	**(i)** voltage is different while current is same	**(J)** voltage division needed
(II) Parallel connected resistors	**(ii)** voltage and current are different	**(K)** voltage division not needed
(III) When resistors are equal	**(iii)** voltage and current are same	**(L)** current division not needed
(IV) Both series and parallel resistors.	**(iv)** voltage is same while current is different	**(M)** current division needed

When does the current division problem arise?

A. (III) (i) (K)

B. (IV) (i) (J)

C. (III) (iii) (M)

D. (II) (iv) (M)

Answer: D

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Practice Questions Integer Type

1. When two identical batteries of internal resistance 1Ω each are connected in series across a resistor R, the rate of heat produced in R is J_1. When the same batteries are connected in parallel across R, the rate is J_2 = 2.25 J_$2thenthevalueofR \in$ Omega` is

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2. A battery of emf E and internal resistance r is connected is to external resistance R The maximum power in the external circuit is $9W$ The current flowing in the circuit under this condition is $3A$ What is the value of E in volt ?

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3. 32 cells each of emf $3V$ are connected in series. The combination as shown andthe total emf is $84V$ How many number of cells are connected reversely?

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