Answer the following questions, Home - www.mywebpathshala.com

i. If charges flow very slowly through a metal, why does it not require several hours for a light to turn on when you ON a switch?
ii. Why the Wheatstone bridge method is considered unsuitable for the measurement of very high or very low resistance?
iii. It is easier to start a car engine in warm day than a chilly day. Why?
iv. A cell of emf ε and internal resistance r is connected across a variable external resistance R. plot graph to show the variation of (i) ε with R (ii) terminal potential difference V with R (iii)V and I
v. A steady current flows in a metallic conductor of non uniform cross section. Which of these quantities is constant along the conductor: current, current density, drift speed, electric field?
vi. Why an electric bulb becomes dim when an electric heater in parallel circuit is switch on? Why dimness decreases after some time**?**

Problems based on Resistance, Resistivity and Drift velocity, mobility:

1. An electric current passes through a circuit containing two wires of the same material connected in parallel. If the lengths of the wires are in the ratio of 4/3 and radius of the wires are in the ratio of 2/3, then find the ratio of the currents passing through the wires. **Ans: 1/3**
2. A current **i** flow in a wire of circular cross section with the free electrons travelling with velocity v. find the drift velocity of electrons when a current **2i** flow in another wire of twice radius and of the same material. **Ans: v/2**
3. There are two concentric spheres of radius **a** and **b (a>b)** and the space between them is filled with a medium of resistivity ρ. find the resistance between the inner and outer coating of the medium. **Ans: ρ(b-a) /4π ab**
4. If a wire is stretched to make it 0.1% longer, what will be its resistance **Ans: increase by 0.2%**
5. The resistance of a 10 m long wire is 10Ω. Its length is increased by 25% by stretched the wire uniformly. Then the resistance of the wire will be **Ans: 15.6Ω**
6. The drift velocity of the electrons in a copper wire of length 2m under the application of a potential difference of 220 V is 0.5 ms^{-1}. Find their mobility. **Ans: 5 x 10^{-3} $m^2 V^{-1} s^{-1}$**
7. The masses of the three wires of copper are in the ratio 5: 3: 1 and their lengths are in the ratio 1: 3: 5. Find the ratio of their electrical resistances. **Ans: 1: 15:125**
8. Calculate the electric field in a copper wire of cross – sectional area 2.0 mm^2 carrying a current of 1 A. The resistivity of copper = 1.7 x 10^{-8} Ω-m. **Ans:8.5 mili V/m**
9. A copper wire of 2 mm cross sectional area carries a current of 2 A. find the magnitude of drift velocity for the electrons in the wire. It is assumed that only one free electron per atom. Given M = 63g , and density of copper is 8900 Kg/m^{-3} **Ans: 7.35 x10^{-5} m/s**
10. The current through a wire depends on time as $i = i_o + \alpha t$, where i_o = 10A and α = 4 A/s. find the charge crossed through a section of the wire in 10 seconds. **Ans: 300 C**
11. A potential difference of 100 V is applied to the ends of a copper wire one meter long. Calculate the average drift velocity of electrons. Compare it with thermal velocity at 27^0C. Given conductivity of copper is 5.81 x10^7 $\Omega^{-1} m^{-1}$ and number density of conduction electrons is 8.5 x10^{28} m^{-3}. **Ans: 0.43 m/s, V_d/V_{rms} = 3.67 x 10^{-6}.**

Problems based on Temperature dependency of Resistance: Home - www.mywebpathshala.com

12. The resistance of a wire at 300K is found to be 0.3Ω. If the temperature coefficient of resistance of wire is 1.5 x $10^{-3}K^{-1}$, find the temperature at which the resistance becomes 0.6Ω. **Ans: 993K**
13. A silver wire has a resistance of 2.1 Ω at 27.5 ^{O}C and a resistance of 2.7Ω at 100 ^{O}C. Determine the temperature coefficient of resistivity of silver. **Ans: 0.0044 $^O C^{-1}$**

14. Calculate the temperature at which the resistance of a conductor becomes 20 percent more than its resistance at 27 ^{O}C. The value of α is 2 x 10^{-4} K^{-1}. **Ans: 1027** ^{O}C.

15. The resistances of an iron wire and a copper wire at 20˚C are 3.9Ω and 4.1Ω respectively. At what temperature will the resistances be equal? Temperature coefficient of resistivity for iron is 5.0 x 10^{-3} K^{-1} and for copper it is 4.0 x 10^{-3} K^{-1}. Neglect any thermal expansion. **Ans: 84.5 ˚C**

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16. A heating element using nichrome connected to a 230 V supply draws an initial current of 3.2 A which settles after a few seconds to a steady value of 2.8 A. What is the steady temperature of the heating element if the room temperature is 27.0 °C? Temperature coefficient of resistance of nichrome averaged over the temperature range involved is 1.70 × 10^{-4} °C^{-1}.
Ans: 867.5°C

Problems based on Internal Resistance of cell, cell combination:

17. The storage battery of a car has an emf of 12V. If the internal resistance of the battery is 0.4Ω. What is the maximum current that can be drawn from the battery? **Ans: 30 A**

18. A 10-V battery of negligible internal resistance is charged by a 200 V D.C. supply. The resistance in the charging circuit is 38Ω. What is the value of the charging current? **Ans: 5 A**

19. Three identical cells, each of emf 2 V and internal resistance 0.2Ω are connected in series to an external resistance of 7.4Ω. Find the p.d. across each cell. **Ans: 1.85 V**

20. How would you arrange 64 similar cells each of having an emf 2V and internal resistance 2 Ω so as to send maximum current through an external resistance of 8 Ω. **Ans: n=16, m= 4, 4.0 A**

21. Two cells, each of emf 1.5V are joined in series and send 1.0 A current in an external resistor. If the same cells are joined in parallel, then they send 0.6 A current in the same resistor. What is the internal resistance of each cell? **Ans: 1/3 Ω**

22. Two cells of emf's 6V and 12V and internal resistances 1Ω and 2Ω respectively are connected in parallel so as to send current in the same direction through an external resistance of 15Ω. Draw the circuit diagram. Using kirchhoff's laws, calculate current through each branch of the circuit and p.d. across the 15Ω resistance.
Ans: 78/47 A, 102/ 47 A, 24/47 A , 7.66 V

23. N identical cells, each of e.m.f. E and internal resistance **r** are joined in series to form a closed circuit. One cell A is joined with reverse polarity. Find the potential difference across each cell except A. **Ans: 2E / N**

24. Four identical cells, each of e.m.f. 2V, are joined in parallel providing supply of current to external circuit consisting of two 15Ω resistors joined in parallel. The terminal voltage of the cells, as read by an ideal voltmeter is 1.6V. Calculate internal resistance of each cell. **Ans: 7.5 Ω**

25. The ends of a resistance are connected to 19 cells each of internal resistance 0.1 ohm in series. The current is found to be 2 A. When the number of cells is reduced to 15 and an additional resistance 9.5 ohm is connected in series to the given resistance, the current reduced to half. Calculate the given resistance and the e.m.f. of each cell. **Ans: 13.82 ohm , 1.65 V**

26. The emf ε and the internal resistance r of the battery shown in figure (32-E23) are 4.3 V and 1.0Ω. Respectively R is 50 Ω. The resistances of the ammeter and voltmeter are 2.0 Ω and 200 Ω respectively. (a) Find the readings of the two meters. (b) The switch is thrown to the other side. What will be the readings of the two meters now? **Ans: (a) 0.1A 4.0V (b) 0.08 A, 4.2 V**

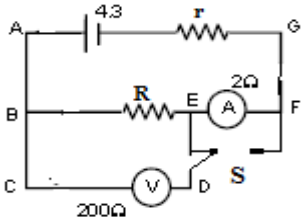

fig. (32-E23)

27. The internal resistance of an accumulator battery of emf 6V is 10Ω when it is fully discharged. As the battery gets charged up, its internal resistance decreases to 1Ω. The battery in its completely discharged state is connected to a charger which maintains a constant potential difference of 9V. Find the current through the battery (a) just after the connections are made and (b) after a long time when it is completely charged. **Ans: (a) 0.3A (b) 3A**

28. Figure (32-E2) shows an arrangement to measure the emf **ε** and internal resistance **r** of a battery. The voltmeter has a very high resistance and the ammeter also has some resistance. The voltmeter reads 1.52V when the switch S is open when the switch is closed the voltmeter reading drops to 1.45V and the ammeter reads 1.0A. Find the emf and the internal resistance of the battery. **Ans: 1.52 V, 0.07 ohm**

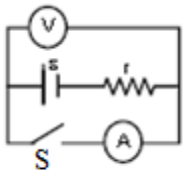

Figure (32-E2)

29. An electric motor runs on a dc source of emf ε and internal resistance r. show that the power output of the source is maximum when the current down by the motor is ε/2r.

30. First a set of n equal resisters of R each are connected in series to a battery of emf E and internal resistance R. A current I is observed to flow.Then n resisters are connected in parallel to the same battery. It is observed that the current increased 10 times.What is 'n'? **Ans: n=10**

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31. A battery of emf **ε** and internal resistance **r** is connected across a pure resistive device of resistance R. show that output of the device is maximum when there a perfect matching between internal resistance r and external resistance R. Determine the maximum power output. What will be output power if battery is shorted?

Ans: $\varepsilon^2/4r$, 0

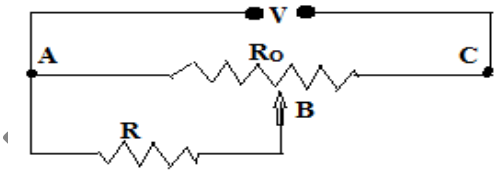
Problems based on Potentiometer and Meter Bridge: Home - www.mywebpathshala.com

32. A 10 m long potentiometer wire has a potential gradient of 0.0025V / cm along its length. Calculate the length of the wire at which null-point is obtained for a 1.025-V standard cell. Also, find the emf of another cell for which the null – point is obtained at 860cm length. What maximum p.d. can be measured by this potentiometer?

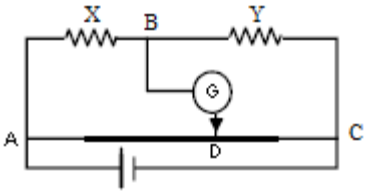
Ans: 410 cm, 2.15 V, 2.5 V

33. A potentiometer is being used to compare two resistances. The balancing length for a standard resistor R = 10.0Ω is 58.3cm, while that for an unknown resistance X is 68.5cm. Determine the value of X. what would you do if you failed to find null – point on the potentiometer wire AB? **Ans: 11.75 Ω**

34. A resistance of RΩ draws a current from a potentiometer. The potentiometer has a total resistance R_oΩ (figure). A voltage V is supplied to the potentiometer. Derive an expression for the voltage fed into the circuit when the slide is in the middle of the potentiometer. **Ans: $2VR_O/(R+4R)$**



35. The figure shows experimental set up of a meter bridge. When the two unknown resistances X and Y are inserted, the null point D is obtained 40cm from end A. when a resistance of 10Ω is connected in series with X, the null point shifts by 10cm. find the position of the null point when 10Ω resistance is instead connected in series with resistor Y. Determine the value for resistance X and Y. **Ans:** 33.3 cm



36. Consider the potentiometer circuit arranged as in figure (32-E29). The potentiometer wire is 600 cm long. (a) At what distance from the point A should the jockey touch the wire to get zero deflection in the galvanometer? (b) if the jockey touches the wire at a distance of 560 cm from A, what will be the current in the galvanometer?

Ans: (a) 320 cm (b) 3ε/22r

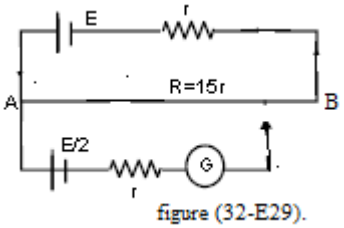


figure (32-E29).

Problems based on Kirchhoffs law and combination of resistance:

37. In the circuit of fig. (326.11) find the final voltage drop across the capacitor C. **Ans: $Vr_2 / r_1 + r_2$**

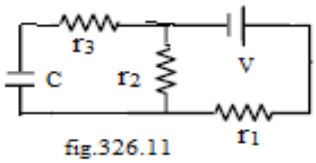


fig.326.11

38. In the given circuit, fig.327.16 with steady current, what will be the potential difference across the capacitor? **Ans: V/3**

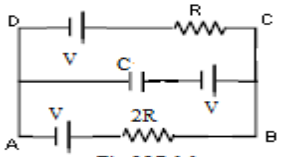


Fig.327.16

39. An infinite ladder is constructed with 1Ω and 2Ω resistors as shown in figure (32-E22). (a) Find the effective resistance between the points A and B. (b) find the current that passes through the 2Ω resistor nearest to the battery. **Ans: (a) 2Ω (b) 1.5A**

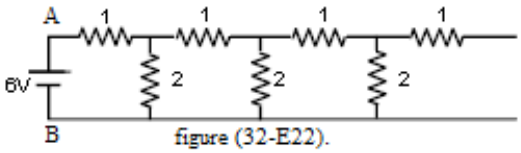


figure (32-E22).

40. In the circuit of Figure P28.24, determine the current in each resistor and the voltage across the 200 Ω resistor.

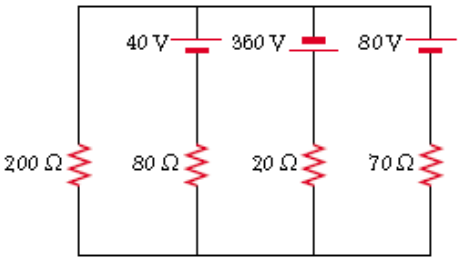
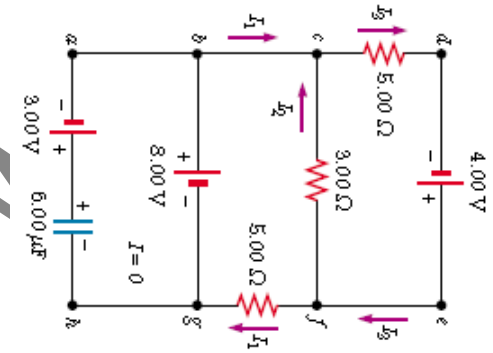


Figure P28.24

41. Under steady-state conditions, find the unknown currents I_1, I_2, and I_3 in the multi loop circuit shown in Figure (below). Ans: **I_1 = 1.38 A, I_2 = - 0.364 A, I_3 = 1.02 A**



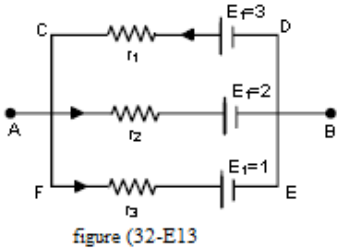


figure (32-E13

42. In the circuit shown in figure (32-E13), ε_1=3V, ε_2=2V, ε_3=1V and r_1= r_2= r_3= 1Ω. Find the potential difference between point A and B and current through each branch. **Ans: 2V, i_1= 1A, i_2=0, i_3= -1A**

Problems based on electric power and electric energy:

43. If two bulbs of wattage 25 and 100 respectively each rated at 220 volt are connected in series with the supply of 440 volt, which bulb will fuse? **Ans: 25-watt bulb**

44. A 25 watt and 100watt bulbs are joined in series and connected to the mains. Which bulb will glow brighter **Ans: 25watt**

45. An electric heater and an electric bulb are rated 500W, 220V and 100W, 220V respectively. Both are connected in series to a 220V a.c. main. Calculate the power consumed by (i) the heater and (ii) electric bulb.
Ans: 14W, 70 W

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

47. A bulb is made using two filaments. A switch selects whether the filaments are used individually or in parallel. When used with a 15 V battery, the bulb can be operated at 5 W, 10 W or 15 W. what should be the resistances of the filaments? **Ans: 45 Ω, 22.5 Ω**

48. A series battery of 6 lead accumulators each of 2.0V and internal resistance 0.5Ω is charged by a 100 V battery. What series resistance should be used in the charging circuit in order to limit the current of 8 A. Using the required resistance obtain (a) the power supplied by the dc source (b) the power supplied by dc energy stored in the battery in 15 min. **Ans: 800W , 86400 J**

49. A 24 V battery of internal resistance 4 Ω is connected to a variable resistor. At what value the current drawn from the battery is the rate of heat produced in the resistor is maximum? **Ans: 3A**

50. A fuse with a circular cross sectional area of radius 0.15 mm blows at 15A. What should be the radius of cross section of a fuse made of the same material which will blow at 30 A? **Ans: 0.24 mm**

51. The resistivity of seawater is about 25 cm Ω·. The charge carriers are chiefly Na^{+} and Cl^{-1} ions, and of each there are about $3x10^{20}$ cm^{-3}. If we fill a plastic tube 2 meters long with seawater and connect a 12-volt battery to the electrodes at each end, what is the resulting average drift velocity of the ions, in cm/s? Ans: 2.5 $x10^{-5}$ cm/s

52. Find the equivalent resistance of the circuit shown in the figure (32E-72) between the points a and b. each resistance have value 'r' ohm.

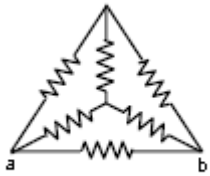


figure (32E-72)

53. The voltmeter shown in the figure 32-E25 reads 18V across the 50 Ω resistors. Find the resistance of voltmeter.

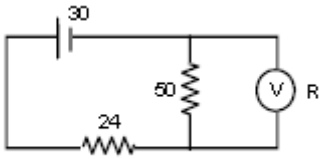


figure 32-E25

54. Find the current measured by ammeter. figure (32E-18)

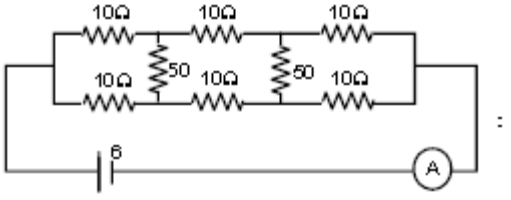


figure (32E-18)