NCERT Solutions for Class 12 Physics Chapter 3 Current Electricity

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NCERT Solutions for Class 12 Physics Chapter 3 Current Electricity

NCERT Solutions for Class 12 Physics Chapter 3 Current Electricity part of NCERT Solutions for Class 12 Physics. Here we have given. NCERT Solutions for Class 12 Physics Chapter 3 Current Electricity

Board	CBSE
Textbook	NCERT
Class	Class 12
Subject	Physics
Chapter	Chapter 3
Chapter Name	Current Electricity
Number of Questions Solved	24

Question 1.
The storage battery of a car has an e.m.f. of 12 V. If the internal resistance of the battery is 0.4Ω, what is the maximum current that can be drawn from the battery ?
Answer:

Maximum current $I_{max} = \dfrac{V}{r} = \dfrac{12}{0 \cdot 4} = 30$ A.

Question 2.
A battery of e.m.f. 10 V and internal resistance 3Ω is connected to a resistor. If the current in the circuit is 0.5 A, what is the resistance of the resistor ? What is the terminal voltage of the battery when the circuit is closed ?
Answer:

$I = \dfrac{E}{R + r}$

$\therefore R + r = \dfrac{E}{I} = \dfrac{10}{0 \cdot 5} = 20$

or $R = 20 - r = 20 - 3 = 17$A

Terminal voltage $= IR$

$\qquad = 0 \cdot 5 \times 17 = 8 \cdot 5$ V.

Question 3.
(a) Three resistors IΩ, 2 Ωand 3 Ω are combined in series. What is the total resistance of the combination?
(b) If the combination is connected to a battery of e.m.f. 12 V and negligible internal resistance, obtain the potential drop across each resistor.
Answer:

(a) Using $R_{eq} = R_1 + R_2 + R_3$, we get
$\qquad R_{eq} = 1 + 2 + 3 = 6\ \Omega$

(b) Using $V = IR$, we get

$\qquad I = \dfrac{V}{R} = \dfrac{V}{R_{eq}} = \dfrac{12}{6} = 2$A

Then, Voltage drop across R_1 is given by, $V_1 = IR_1$
$= 2 \times 1 = 2$V

Voltage drop across R_2 is given by, $V_2 = IR_2 = 2 \times 2 = 4$V

Voltage drop across R_3 is given by, $V_3 = IR_3 = 2 \times 3 = 6$V.

Question 4.

(a) Three resistors 2 Ω, 4 Ω, and 5 Ω, are combined in parallel. What is the total resistance of the combination?

(b) If the combination is connected to a battery of e.m.f. 20 V and negligible internal resistance, determine the current through each resistor, and the total current drawn from the battery.

Answer:

(a) Using $\dfrac{1}{R_{eq}} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}$, we get

$$\frac{1}{R_{eq}} = \frac{1}{2} + \frac{1}{4} + \frac{1}{5} = \frac{10+5+4}{20} = \frac{19}{20}$$

or $\quad R_{eq} = \dfrac{20}{19}$ Ω.

(b) Using $V = IR$, we get $I = \dfrac{V}{R}$

i.e. $\quad I = \dfrac{20}{20/19} = 19$ A

Current through 2 Ω resistor

$$= \frac{V}{R_1} = \frac{20}{2} = 10 \text{ A}$$

Current through 4 Ω resistor

$$= \frac{V}{R_2} = \frac{20}{4} = 5 \text{ A}$$

Current through 5 Ω resistor

$$= \frac{V}{R_3} = \frac{20}{5} = 4 \text{ A}$$

Question 5.

At room temperature (27.0 °C) the resistance of a heating element is 100 Ω. What is the temperature of the element if the resistance is found to be 117 Ω, given that the temperature coefficient of the material of the resistor is 1.70 x 10^{-4} °C^{-1}.

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Answer:

Using, $R_2 = R_1(1 + \alpha\Delta T)$, we get

$$\Delta T = \frac{R_2 - R_1}{\alpha R_1}$$

i.e. $\quad \Delta T = \dfrac{117 - 100}{(1 \cdot 7 \times 10^{-4}) \times 100}$

$$= \frac{17 \times 10^2}{1 \cdot 7} = 1000 \ °C$$

i.e. $T_2 - T_1 = 1000 \ °C$

$\therefore \qquad T_2 = 1000 + T_1 = 1000 + 27$

$$= 1027 \ °C.$$

Question 6.
A negligibly small current is passed through a wire of length 15 m and uniform cross-section 6.0 x 10⁻⁷ m², and its resistance is measured to be 50 Ω. What is the resistivity of the material at the temperature of the experiment ?

Answer:

Using $R = \rho \dfrac{l}{a}$, we get $\rho = \dfrac{R \times a}{l}$

i.e. $\quad \rho = \dfrac{5 \times 6 \times 10^{-7}}{15} = 2 \times 10^{-7} \ \Omega \ m.$

Question 7.
A silver wire has a resistance of 2.1 Ω at 27.5 °C, and a resistance of 2.7 Ω at 100 °C. Determine the temperature coefficient of resistivity of silver.

Answer:

Using $R_2 = R_1(1 + \alpha\Delta T)$, we get

$$\alpha = \frac{R_2 - R_1}{R_1 \Delta T} = \frac{2 \cdot 7 - 2 \cdot 1}{2 \cdot 1 \times (100 - 27 \cdot 5)}$$

$$= \frac{0 \cdot 6}{2 \cdot 1 (72 \cdot 5)} = 0 \cdot 0039 \ °C^{-1}.$$

Question 8.
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 averages over the temperature range involved is 1.70 x 10⁻⁴ °C⁻¹.

Answer:

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$R_1 = \dfrac{230}{3 \cdot 2} = 71 \cdot 88 \ \Omega$

and $\qquad R_2 = \dfrac{230}{2 \cdot 8} = 82 \cdot 14 \ \Omega$

Using $\qquad \alpha = \dfrac{R_2 - R_1}{R_1 \Delta T}$, we get

$$\Delta T = \dfrac{R_2 - R_1}{R_1 \alpha}$$
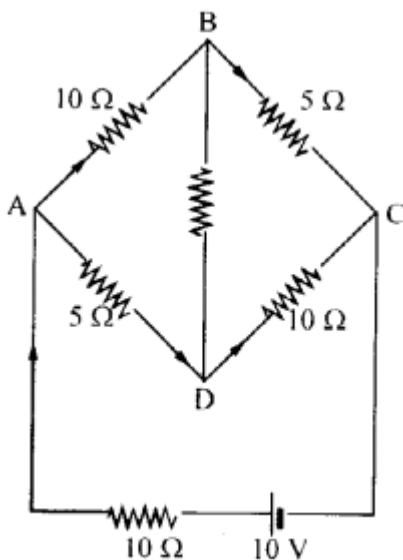
i.e. $T_2 - T_1 = \dfrac{R_2 - R_1}{R_1 \alpha}$

or $\qquad T_2 = \dfrac{R_2 - R_1}{R_1 \alpha} + T_1$

$$= \dfrac{82 \cdot 14 - 71 \cdot 88}{71 \cdot 88 \times 1 \cdot 7 \times 10^{-4}} + 27$$

$$= 27 + 840 = 867 \ ^\circ C.$$

Question 9.
Determine the current in each branch of the network shown in Figure

Answer:

Applying Kirchhoff's second law to network ABDA, we get

$$10I_1 + 5I_2 - 5(I - I_1) = 0$$

i.e. $\quad\quad 3I_1 + I_2 - 1 = 0 \quad\quad ...(i)$

For BCDB,

$$5(I_1 - I_2) - 10(I - I_1 + I_2) - 5I_2 = 0$$

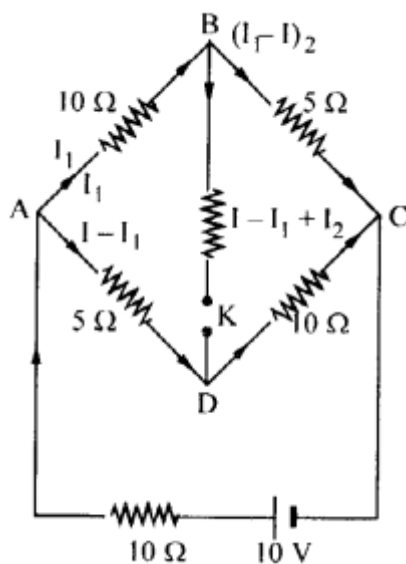or $\quad\quad 3I_1 - 4I_2 - 2I = 0 \quad\quad ...(ii)$

For ABCHGA,

$$10I + 10I_1 + 5(I_1 - I_2) = 10$$

or $\quad\quad 3I_1 - I_2 + 2I = 2 \quad\quad ...(iii)$

Adding (ii) and (iii), we get

$$6I_1 - 5I_2 = 2$$

Multiplying (i) by 2 and adding to (ii), we get

$$9I_1 - I_2 = 2 \qquad \dots(iv)$$

i.e. $\qquad I_2 = 2 - 9I_1$

Using (v) for (iv), we get

$$6I_1 - 5(2 - 9I_1) = 2$$

or $\qquad 51I_1 = 12 \quad$ or $\quad I_1 = \dfrac{4}{17} A$

Substituting this value in (v), we get

$$I_2 = 2 - 9 \times \dfrac{4}{17} = -\dfrac{2}{17} A$$

From (i), $\qquad I = 3I_1 + I_2$

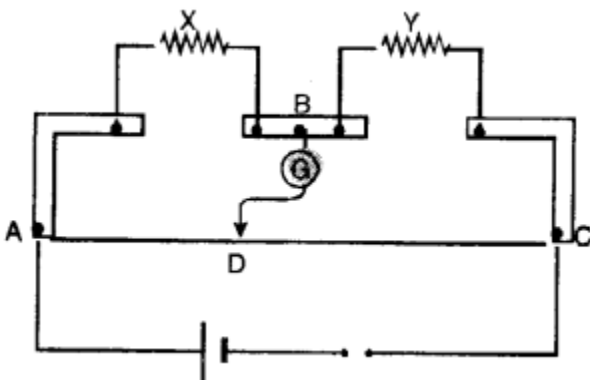$$= 3 \times \dfrac{4}{17} + \left(-\dfrac{2}{7}\right) = \dfrac{10}{17} A$$

Current in $\quad DC = I - I_1 + I_2$

$$= \dfrac{10}{17} - \dfrac{4}{17} + \left(-\dfrac{2}{17}\right)$$

$$= \dfrac{4}{17} A$$

Current in $\quad AD = I - I_1$

$$= \dfrac{10}{17} - \dfrac{4}{17} = \dfrac{6}{17} A$$

Current in $\quad BC = I_1 - I_2$

$$= \dfrac{4}{17} - \left(-\dfrac{2}{17}\right) = \dfrac{6}{17} A$$

Question 10.
(a) In a meter bridge (Figure), the balance point is found to be at 39.5 cm from the end A, when the resistor Y is of 12.5 Ω. Determine the resistance of X. Why are the connections between resistors in a Wheatstone or meter bridge made of thick copper strips?

(b) Determine the balance point of the bridge above if X and Y are interchanged.
(c) What happens if the galvanometer and cell are interchanged at the balance point of the bridge?

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Would the galvanometer show any current? **(C.B.S.E. 2005)**
Answer:

(a) (i) Using $\quad X = R\dfrac{l}{(100-l)}$, we get

$$X = \dfrac{12\cdot5(39\cdot5)}{(100-39\cdot5)}$$

$$= \dfrac{12\cdot5 \times 39\cdot5}{60\cdot5} = 8\cdot2\ \Omega.$$

(ii) Thick copper strips are used to reduce resistance of the connections because this resistance is not accounted for in the calculations.

(b) Interchanging R and X, we get

$$R = X\dfrac{l}{(100-l)}$$

i.e. $100\ R - Rl = Xl$

i.e. $\qquad l = \dfrac{R\ 100}{R + X}$

i.e. $\qquad l = \dfrac{12\cdot5 \times 100}{12\cdot5 + 8\cdot2}$

$= 60\cdot5$ cm from end A.

(c) In this case also the galvanometer will not show current.

Question 11.
A storage battery of e.m.f. 8.0 V and internal resistance 0.5 Ω is being charged by a 120 V dc supply using a series resistor of 15.5 Ω. What is the terminal voltage of the battery during charging? What is the purpose of having a series resistor in the charging circuit ?
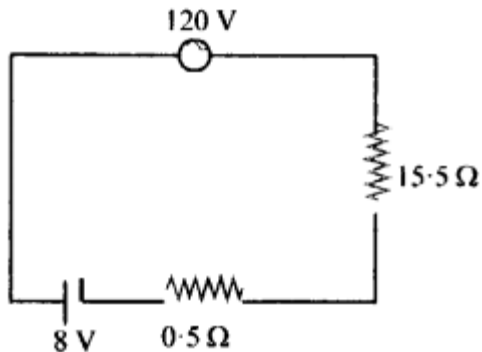**Answer:**
During charging,

$V = E + I(r + R)$

$$I = \frac{E - V}{r + R} = \frac{120 - 8}{0.5 + 15.5} = \frac{112}{16} = 7A$$

Terminal Voltage, $V = E + Ir$

$= 8 + 7 \times 0.5 = 11.5$ V.

Question 12.
In a potentiometer arrangement, a cell of e.m.f. 1.25 V gives a balance point at 35.0 cm length of the wire. If the cell is replaced by another cell and the balance point shifts to 63.0 cm, what is the e.m.f. of the second cell ?

Answer:

Here $E \propto l$ $\therefore$ $\dfrac{E_1}{E_2} = \dfrac{l_1}{l_2}$ i.e. $E_2 = \dfrac{l_2}{l_1} E_1$

i.e. $E_2 = \dfrac{63}{35} \times 1.25 = 2.25$ V.

Question 13.
The number density of free electrons in a copper conductor estimated in Example 3.1 is 8.5 x 10^{28} m³. How long does an electron take to drift from one end of a wire 3.0 m long to its other end? The area of crosssection of the wire is 2.0 x 10^{-6} m² and it is carrying a current of 3.0 A.

Answer:

Using $v_d = \dfrac{I}{ne\,A}$, we get

$$v_d = \frac{3}{(8.5 \times 10^{28})(1.6 \times 10^{-19})(2 \times 10^{-6})}$$

$$= 1.1 \times 10^{-4} \text{ m s}^{-1}$$

Time taken, $t = \dfrac{l}{v_d} = \dfrac{3}{1.1 \times 10^{-4}}$

$$= 2.72 \times 10^4 \text{ s.}$$

Question 14.
The earth's surface has a negative surface charge density of 10^{-9} cm^{-2}. The potential difference of 400 kV between the top of the atmosphere and the surface results (due to the low conductivity of the lower atmosphere) in a current of only 1800 A over the entire globe. If there were no mechanism of sustaining atmospheric electric Held, how much time (roughly) would be required to neutralise the earth's surface ? (This never happens in practice because there is a mechanism to replenish electric charges, namely the continual thunderstorms and lightning in different parts of the globe.)
(Radius of earth = 6.37 x 10^6 m.)
Answer:

Surface area of earth $A = 4\pi r^2$
$= 4 \times 3 \cdot 14 \times 6 \cdot 37 \times 10^6 \times 6 \cdot 37 \times 10^6$
$= 509 \cdot 64 \times 10^{12}$ m^2
Charge, $Q = $ (Charge density, σ) $\times$
$$(\text{Surface area, A})$$
$$= 10^{-9} \times 509 \cdot 64 \times 10^{12}$$
$$= 509 \cdot 64 \times 10^3 \text{ C.}$$
Time, $t = \dfrac{Q}{I} = \dfrac{509 \cdot 64 \times 10^3}{1800}$
$= 283$ s. $\qquad \left(\because I = \dfrac{Q}{t} \right)$

Question 15.
(a) Six lead-acid type of secondary cells each of e.m.f. 2.0 V and internal resistance 0.015 Ω are joined in series to provide a supply to a resistance of 8.5 Ω. What are the current drawn from the supply and its terminal voltage ?
(b) A secondary cell after long use has an e.m.f. of 1.9 V and a large internal resistance of 380 Ω. What maximum current can be drawn from the cell ? Could the cell drive the starting motor of a car ?
Answer:

(a) Here, $I = \dfrac{nE}{R + nr} = \dfrac{6 \times 2}{8 \cdot 5 + 6 \times 0 \cdot 015}$
$= 1 \cdot 397$ A
Terminal voltage,
$V = IR = 1 \cdot 397 \times 8 \cdot 5$
$= 11 \cdot 88$ V

(b) $I_{max} = \dfrac{E}{r} = \dfrac{1 \cdot 9}{380} = 0 \cdot 005$ A.
It cannot be used for starting motor of a car because large current is needed to start the car.

Question 16.
Two wires of equal length, one of aluminium and the other of copper have the same resistance. Which of the two wires is lighter? Hence explain why aluminium wires are preferred for overhead power cables. (P_{AL} = 2.63 x 10^8 Ω m, P_{cu}= 1.72 X 1(H Ω m. Relative density of A1 = 2.7, of Cu = 8.9.)
Answer:

Using $v_d = \dfrac{I}{ne\,A}$, we get

$$v_d = \frac{3}{(8\cdot5\times10^{28})(1\cdot6\times10^{-19})(2\times10^{-6})}$$

$$= 1\cdot1 \times 10^{-4}\ m\ s^{-1}$$

Time taken, $t = \dfrac{l}{v_d} = \dfrac{3}{1\cdot1\times10^{-4}}$

$$= 2\cdot72 \times 10^{4}\ s.$$

Current	Voltage	Current	Voltage
A	V	A	V
0.2	3.94	3.0	59.2
0.4	78.7	4.0	78.8
0.6	11.8	5.0	98.6
0.8	15.7	6.0	118.5

1.0	19.7	7.0	138.2
2.0	39.4	8.0	158.0

Then $\quad \dfrac{M_{Cu}}{M_{Al}} = \dfrac{A_{Cu}l(8 \cdot 9 \times 10^3)}{A_{Al}l(2 \cdot 7 \times 10^3)}$

$$= \dfrac{8 \cdot 9 \; A_{Cu}}{2 \cdot 7 \; A_{Al}}$$

As resistance R_{Al} and R_{Cu} are equal,

$$\therefore \dfrac{(2 \cdot 63 \times 10^{-8})}{A_{Al}} l = \dfrac{1 \cdot 72 \times 10^{-8}}{A_{Cu}} l$$

i.e. $\quad \dfrac{A_{Cu}}{A_{Al}} = \dfrac{1 \cdot 72}{2 \cdot 63}$

$$\therefore \quad \dfrac{M_{Cu}}{M_{Al}} = \dfrac{8 \cdot 9 \times 1 \cdot 72}{2 \cdot 7 \times 2 \cdot 63} = 2 \cdot 16.$$

Aluminium is lighter, so it is used for overhead power cables.

Question 17.
What conclusion can you draw from the following observations on a resistor made of alloy manganin?

Answer:
It indicates that Ohm's law i.e.V α I is valid for a wide range.
Resistivity of Manganin remains nearly same with change in temperature.

Question 18.
Answer the following questions :
(a) 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, electric field, drift speed?
(b) Is Ohm's law universally applicable for all conducting elements? If not, give examples of

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elements which do not obey Ohm's law.
(c) A low voltage supply from which one needs high currents must have very low internal resistance. Why?
(d) A high tension (HT) supply of, say, 6 kV must have a very large internal resistance. Why?
Answer:
(a) Current
(b) No. Devices are and vacuum tubes, semiconductor diodes, transistors, thermisters, thyristors, etc.
(c) Lesser the value of 'r', the higher the current.

$$= \frac{e.m.f.}{\text{internal resistance}} = \frac{E}{r}.$$

Clearly low r will ensure high current
(d) If internal resistance is not large, then the heavy current drawn during an accidental short circuit can damage the supply.

Question 19.
Choose the correct alternative:
(a) Alloys of metals usually have (greater/less) resistivity than that of their constituent metals.
(b) Alloys usually have much (lower/higher) temperature coefficients of resistance than pure metals.
(c) The resistivity of the alloy manganin is nearly independent of/increases rapidly with the increase of temperature.
(d) The resistivity of a typical insulator (e.g., amber) is greater than that of a metal by a factor of the order of $(10^{22}/10)^3$).
Answer:
(a) Greater
(b) Lower
(c) Nearly independent
(d) 10^{22}

Question 20.
(a) Given n resistors each of resistance R, how will you combine them to get the
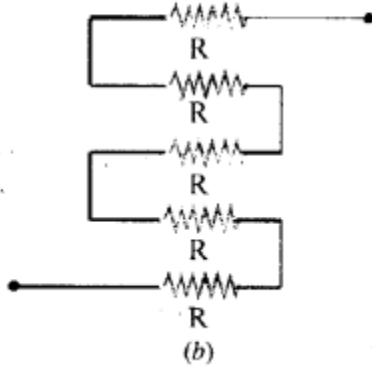(i) maximum (ii) minimum effective resistance? What is the ratio of the maximum to minimum resistance?
(b) Given the resistances of 1 Q, 2 G, 3 Q, how will combine them to get an equivalent resistance of
(i) $(11/3)\Omega$ (ii) $(11/5)$ Ω, (iii) 6 Ω, (iv) $(6/11)$ Ω?
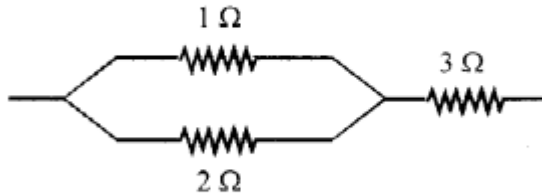**(c)** Determine the equivalent resistance of networks shown in the figure. **(N.C,E.R,T.)**
Answer:

(a)

(b)

(i) Maximum resistance can be obtained by combining them in series with each other.
The maximum resistance R_{max} = R + R + R + ...n times = nR.
(ii) Minimum effective resistance can be obtained by combining them in parallel with each other.
Minimum resistance R_{max} is found as

$$\frac{1}{R_{min}} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} + \ldots n \text{ times}$$

$$= \frac{n}{R}.$$

1 Ω

3 Ω

2 Ω

$$\therefore \quad R_{min} = \frac{R}{n}$$

$$\therefore \quad \frac{R_{max}}{R_{min}} = \frac{nR}{\dfrac{R}{n}} = n^2.$$

(b) Here $R_1 = 1 \ \Omega$, $R_2 = 2 \ \Omega$
and $R_3 = 3 \ \Omega$.

(i) If we combine R_1 and R_2 in parallel and R_3 in series with them as shown, then equivalent resistance
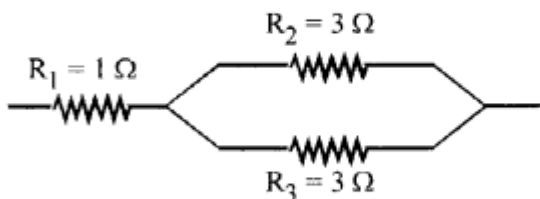
$$R = \frac{R_1 R_2}{R_1 + R_2} + R_3 = \frac{1 \times 2}{1 + 2} + 3$$

$$= \frac{2}{3} + 3 = \frac{11}{3} \Omega.$$

(ii) If we combine R_2 and R_3 in parallel with each other and this combination is connected in series with R_1, then the equivalent resistance is

$$R = R_1 + \frac{R_2 R_3}{R_2 + R_3} = 1 + \frac{2 \times 3}{2 + 3}$$

$$= 1 + \frac{6}{5} = \frac{11}{5} \Omega.$$

$R_1 = 1 \ \Omega$

$R_2 = 3 \ \Omega$

$R_3 = 3 \ \Omega$

(iii) If R_1, R_2 and R_3 are combined in series, then
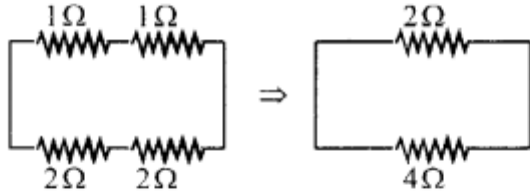$$R = R_1 + R_2 + R_3 = 1 + 2 + 3$$
$$= 6 \Omega$$

(iv) If R_1, R_2 and R_3 are combined in parallel, then

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{1} + \frac{1}{2} + \frac{1}{3}$$

$$= \frac{6+3+2}{6} = \frac{11}{6}$$

$$\therefore \quad R = \frac{6}{11}\Omega.$$

(c) (i) The network consists of four similar units.

Resistance of one unit is given by R_{eq} =
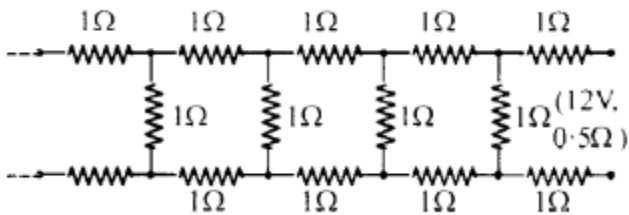
$$\frac{2 \times 4}{2+4} = \frac{4}{3}\Omega$$

Total resistance $= 4 \times \frac{4}{3} = \frac{16}{3}\Omega$

(ii) All the resistors are in series

$R_{eq} = R + R + R + R + R = 5R$.

Question 21.
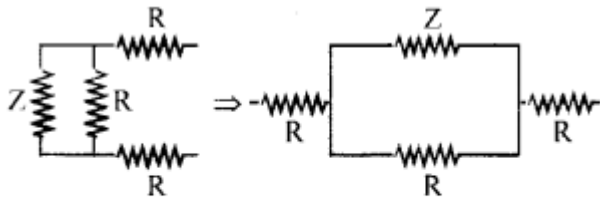Determine the current drawn from a 12 V supply with internal resistance 0.5Ω by the infinite network shown in the figure. Each resistor has 1 Ω resistance. **(N.C.E.R.T.)**

Answer:
Let the total resistance of the circuit be Z and a set of three resistors of value R each is connected to it as shown in the figure.

Adding of these resistors will not change the value of Z because the network is infinite then

$$Z = R + \frac{ZR}{Z+R} + R$$

$$= 2R + \frac{ZR}{Z+R}$$

or

$$Z = 2 + \frac{Z}{1+Z}$$

i.e. $Z^2 - 2Z - 2 = 0$

or

$$Z = 1 \pm \sqrt{3}$$

or

$$Z = 1 \pm \sqrt{3} = 2\cdot73 \ \Omega$$

(Value of Z can not be negative)

Current drawn, $I = \dfrac{E}{Z+r} = \dfrac{12}{2\cdot73+0\cdot5}$

$$= 3\cdot71 \ A.$$

Question 22.
The figure shows a potentiometer with a cell of 2.0 V and internal resistance of 0.40 Ω maintaining a potential drop across the resistor wire AB. A standard cell which maintains a constant e.m.f. of 1.02 V (for very moderate currents up to a few mA) gives a balance point at 67.3 cm length of the wire. To ensure very low currents drawn from the standard cell, very high resistance of 600 kΩ is put in series with it, which is shorted close to the balance point. The standard cell is then replaced by a cell of unknown e.m.f. e and the balance point found similarly, turns out to be at 82.3 cm length of the wire.
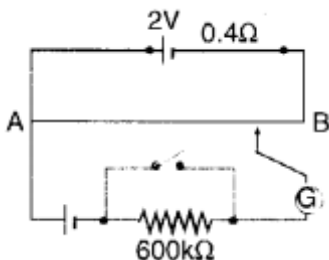
(a) What is the value e?
(b) What purpose does the high resistance of 600 kΩ have?
(c) Is the balance point affected by this high resistance?
(d) Is the balance point affected by the internal resistance of the driver cell?
(e) Would the method work in the above situation if the driver cell of the potentiometer had an e.m.f. of 1.0 V instead of 2.0 V?
(f) Would the circuit work cell for determining an extremely small e.m.f., say of the order of a few

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mV (such as the typical e.m.f. of a Thermo couple not, how will you modify the circuit?

Answer:

(a) Using $E \propto l$, we get

$$\frac{E_2}{E_1} = \frac{l_2}{l_1}$$

$$\text{or } E_2 = \frac{l_2}{l_1} \times E_1 = \frac{82\cdot3}{67\cdot3} \times 1\cdot02 = 1\cdot25 \text{ V}.$$

(b) It allows only a small current to flow through the galvanometer when the circuit is not balanced.

(c) No

(d) No

(e) No

(f) No. The circuit will not work ($E \propto l$).

The circuit can be modified by putting a suitable resistor 'R' in series with the wire AB.

Question 23.

The figure shows a potentiometer circuit for the comparison of two resistances. The balance point with a standard resistor R = 10.0 Ω is found to be 58.3 cm, while that with the unknown resistance X is 68.5 cm. Determine the value of X. What might you do if you failed to find a balance point with the given cell of emf ε?

Answer:
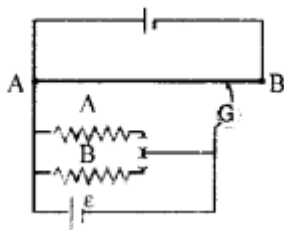
(a) $\quad \frac{E_2}{E_1} = \frac{X}{R} \quad \therefore X = \frac{E_2}{E_1} \times R = \frac{l_2}{l_1} R$

$$X = \frac{68\cdot5}{58\cdot3} \times 10 = 11\cdot75 \ \Omega.$$

(b) We fail to get the balance point with the given cell of emf E, if the potential difference across the wire AB. In order to obtain the balance point with the given cell E, either the emf of the auxiliary[7] battery (between A and B) should be increased or a suitable resistance should be put in series with R and X (so as to decrease the potential drop across the wire AB).

Question 24.

The figure shows a 2.0 V potentiometer used for the determination of internal resistance

2.0V

A ● ────────────────── ● B

1.5V

9.5Ω
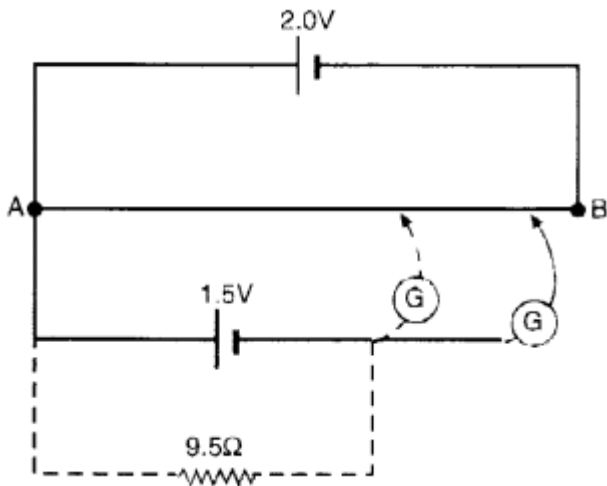
1.5 V cell. The balance point of the cell in open circuit is 76.3 cm. When a resistor of 9.5 Ω is used in the external circuit of the cell, the balance point shifts to 64.8 cm length of the potentiometer wire. Determine the internal resistance of the cell.

Answer:

Here, $(l_1 - l_2)R = l_2 r$ i.e. $r = (l_1 - l_2)\dfrac{R}{l_2}$

Where $l_1 = 76 \cdot 3$ cm ;

                 $l_2 = 64 \cdot 8$ cm

and $R = 8 \cdot 5$ Ω

$\therefore$ $r = (76 \cdot 3 - 64 \cdot 8)\dfrac{9 \cdot 5}{64 \cdot 8}$

           $= 1 \cdot 68$ Ω.