DPP - Daily Practice Problems

Name :

Date :

Start Time :

End Time :

PHYSICS 37

SYLLABUS : CURRENT ELECTRICITY – 2 Electrical cell and its internal resistance, Potential difference and E.M.F of a cell, Combination of cells in series and in parallel, Kirchoff's laws and their applications, RC transient circuit, Galvanometer, Ammeter, Voltmeter]

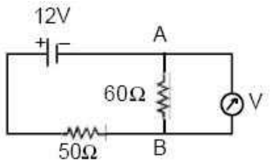
Max. Marks : 104 **Time : 60 min.**

GENERAL INSTRUCTIONS

- The Daily Practice Problem Sheet contains 26 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.
- You have to evaluate your Response Grids yourself with the help of solution booklet.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus. Refer syllabus sheet in the starting of the book for the syllabus of all the DPP sheets.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

DIRECTIONS (Q.1-Q.18) : There are 18 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which **ONLY ONE** choice is correct.

Q.1 The voltmeter shown in fig, reads 6V across the 60 Ω resistor. Then the resistance of the voltmeter is-



(a) 0 Ω
(b) ∞ Ω
(c) 200 Ω
(d) 300 Ω

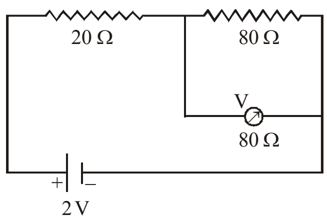
Q.2 If only one hundredth part of total current flowing in the circuit is to be passed through a galvanometer of resistance GΩ, Then the value of shunt resistance required will be-

(a) G/10 (b) G/100 (c) G/99 (d) G/999

Q.3 The shunt required for 10% of main current to be sent through the moving coil galvanometer of resistance 99Ω will be-

(a) 0.9 Ω (b) 11 Ω (c) 90 Ω (d) 9.9 Ω

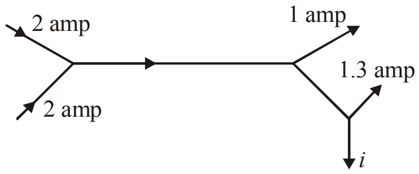
Q.4 The reading of voltmeter in the following circuit will be-



(a) 2 volt (b) 0.80 volt (c) 1.33 volt (d) 1.60 volt

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ

Q.5 The figure below shows currents in a part of electric circuit. The current i is

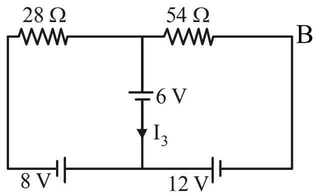


(a) 1.7 amp
(b) 3.7 amp
(c) 1.3 amp
(d) 1 amp

Q.6 A voltmeter can measure upto 25 volt and its resistance is 1000 Ω. The resistance required to add with voltmeter to measure upto 250 volt will be-
(a) 9000 Ω (b) 1000 Ω (c) 2500 Ω (d) 900 Ω

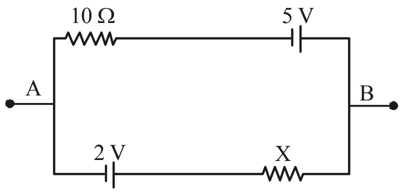
Q.7 When a Laclanche cell is connected to a 10Ω resistance then a current of 0.25 ampere flows in the circuit. If the resistance is reduced to 4Ω then current becomes 0.5ampere. The internal resistance of galvanometer will be-
(a) 1.5 Ω (b) 0.5 Ω (c) 1 Ω (d) 2 Ω

Q.8 Consider the circuit shown in the figure. The value of current I_3 is



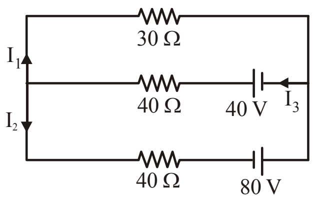
(a) 5 A
(b) 3 A
(c) – 3 A
(d) – 5/6 A

Q.9 If $V_B - V_A = 4$ V in the given figure, then resistance X will be



(a) 5 Ω
(b) 10 Ω
(c) 15 Ω
(d) 20 Ω

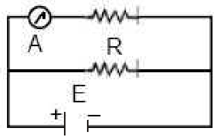
Q.10 In the given circuit the current I_1 is



(a) 0.4 A
(b) – 0.4 A
(c) 0.8 A
(d) – 0.8 A

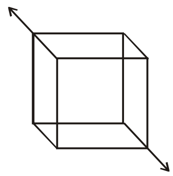
Q.11 To get the maximum current from a parallel combination of n identical cells each of internal resistance r in an external resistance R,
(a) R >> r (b) R << r (c) R > r (d) R = r

Q.12 In the circuit shown below, if the value of R is increased then what will be the effect on the reading of ammeter if the internal resistance of cell is negligible-



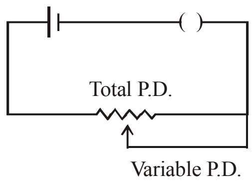
(a) The reading of ammeter will decrease
(b) The reading of ammeter will increase
(c) The reading of ammeter will remain unchanged
(d) The reading of ammeter will become zero.

Q.13 Twelve wires of equal length and same cross-section are connected in the form of a cube. If the resistance of each of the wires is R, then the effective resistance between the two diagonal ends would be



(a) 2 R
(b) 12 R
(c) $\frac{5}{6}$R
(d) 8 R

Q.14 The arrangement as shown in figure is called as



(a) Potential divider
(b) Potential adder
(c) Potential substracter
(d) Potential multiplier

Q.15 When a cell of emf E and internal resistance r, is connected to the ends of a resistance R, then current through resistance is I. If the same cell is connected to the ends of a resistance R/2 then the current would be-
(a) less than I
(b) I
(c) greater then I but less than 2I
(d) greater than 2I

RESPONSE GRID

5. ⓐⓑⓒⓓ 6. ⓐⓑⓒⓓ 7. ⓐⓑⓒⓓ 8. ⓐⓑⓒⓓ 9. ⓐⓑⓒⓓ
10. ⓐⓑⓒⓓ 11. ⓐⓑⓒⓓ 12. ⓐⓑⓒⓓ 13. ⓐⓑⓒⓓ 14. ⓐⓑⓒⓓ
15. ⓐⓑⓒⓓ

Q.16 The resistance of an ideal voltmeter is

(a) Zero (b) Very low

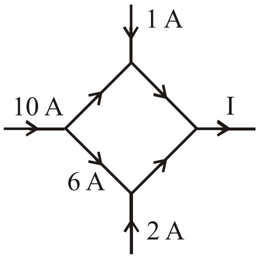
(c) Very large (d) Infinite

Q.17 An ammeter with internal resistance 90 Ω reads 1.85 A when connected in a circuit containing a battery and two resistors 700 Ω and 410 Ω in series. Actual current will be

(a) 1.85 A (b) Greater than 1.85 A

(c) Less than 1.85 A (d) None of these

Q.18 The figure shows a network of currents. The magnitude of currents is shown here. The current *I* will be



(a) 3 A (b) 9 A

(c) 13 A (d) 19 A

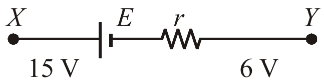
DIRECTIONS (Q.19-Q.21) : In the following questions, more than one of the answers given are correct. Select the correct answers and mark it according to the following codes:

Codes :

(a) 1, 2 and 3 are correct **(b)** 1 and 2 are correct

(c) 2 and 4 are correct **(d)** 1 and 3 are correct

Q.19 In the figure,



(1) current may flow from *X* to *Y*

(2) current may flow from *Y* to *X*

(3) current's direction depends on E

(4) current's direction depends on *r*

Q.20 Kirchoff's laws are based on conservation of

(1) charge (2) potential

(3) energy (4) mass

Q.21 A microammeter has a resistance of 100Ω and a full scale range of 50 μA. It can be used as a voltmeter or a higher range ammeter provided a resistance is added to it. Pick the correct range and resistance combination(s).

(1) 10V range with 200 kΩ resistance in series.

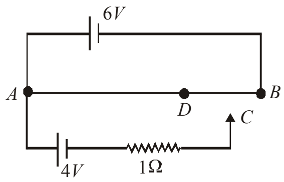
(2) 50V range with 10 kΩ resistance in series.

(3) 5 mA range with 1Ω resistance in parallel.

(4) 10 mA range with 1 kΩ resistance in parallel.

DIRECTIONS (Q.22-Q.23) : Read the passage given below and answer the questions that follows :

A 6V 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 joined to the point *A* as shown in figure. Take the potential at *B* to be zero.



Q.22 What are the potentials at points *A* and *C* ?

(a) 6V, 2V (b) 8V, 4V

(c) 6V, 4V (d) 8V, 3V

Q.23 If the points *C* and *D* are connected by a wire, what will be the current through it ?

(a) zero (b) 1A

(c) 2A (d) 3A

DIRECTIONS (Qs. 24-Q.26) : Each of these questions contains two statements: Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

(a) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(b) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

(c) Statement -1 is False, Statement-2 is True.

(d) Statement -1 is True, Statement-2 is False.

RESPONSE GRID	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ
	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ		

Q.24 Statement -1 : Voltameter measures current more accurately than ammeter.

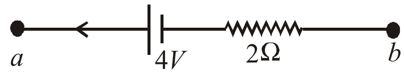
Statement -2 : Relative error will be small if measured from voltameter.

Q.25 Statement - 1 : A larger dry cell has higher emf.

Statement - 2 : The emf of a dry cell is independent of its size.

Q.26 Statement - 1 : In the circuit shown, V_{ab} or $V_a - V_b = 0$, if

$I = 2A$.



Statement - 2 : Potential difference across the terminals of a non ideal battery is less than its emf when a current flows through it.

RESPONSE GRID	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ

DAILY PRACTICE PROBLEM SHEET 37 - PHYSICS			
Total Questions	26	Total Marks	104
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	26	Qualifying Score	42
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

DAILY PRACTICE PROBLEMS — PHYSICS SOLUTIONS 37

(1) **(d).** Let R is resistance of the voltmeter. The effective resistance across points A, B is

$$r = \frac{60 \times R}{60 + R} \quad \text{..............(1)}$$

The current in the circuit is $I = 12/(50 + r)$

The p.d. across AB points is $V = Ir$

or $6 = \frac{12}{50 + r} \times r$ or $50 + r = 2r$

or $r = 50\ \Omega$ ....(2)

using it in (1),

we get $50 = \frac{60}{60 + R}$

$300 + 5R = 6R$

or $R = 300\ \Omega$

(2) **(c).** $S = \frac{G}{n - 1} = \frac{G}{100 - 1} = \frac{G}{99}\Omega$

(3) **(b).** $S = \frac{i_g}{i - i_g}\ G = \frac{10}{100 - 10} \times 99 = 11\Omega$

(4) **(c).** $R = 20 + \frac{80 \times 80}{80 + 80} = 60\Omega$

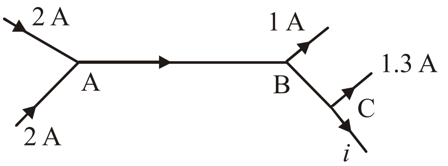
$i = \frac{V}{R} = \frac{2}{60} = \frac{1}{30}$ amp.

$\therefore\ V = iR' = \frac{1}{30} \times 40 = 1.33$ volt.

(5) **(a).** According to Kirchhoff's first law

At junction A, $i_{AB} = 2 + 2 = 4A$

At junction B, $i_{AB} = i_{BC} - 1 = 3A$



At junction C, $i = i_{BC} - 1.3 = 3 - 1.3 = 17$ amp

(6) **(b).** The current required for a full-scale deflection of the galvanometer is

$i = 4.0 \times 10^{-4} \times 25 = 10^{-2}$ A

Let a resistance R Ω is to be connected in series

Then by the ohm's law, we have $i = \frac{V}{G + R}$

Here G = 50 Ω, V = 2.5 V and $i = 10^{-2}$ A

$\therefore\ G + R = \frac{V}{i} = \frac{2.5}{10^{-2}} = 250$

$\Rightarrow\ R = 250 - G = 250 - 50 = 200\Omega.$

(7) **(a).** $\therefore\ i = \frac{V}{R} = \frac{25}{1000}$ A

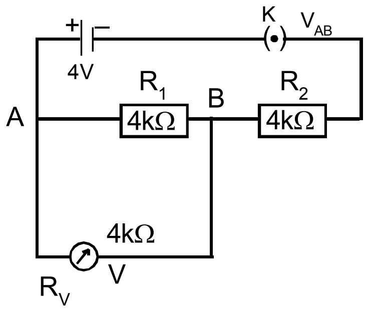
Let R' be the required resistance to be connected in series with voltmeter.

So $i = \frac{V'}{R + R'}$

Here $V' = 250$, $R = 1000\ \Omega$ and $i = \frac{25}{1000}$ A

$\therefore\ \frac{25}{1000} = \frac{250}{1000 + R'} \Rightarrow R' = 9000\ \Omega.$

(8) **(d).** The potential difference between A and B in the absence of voltmeter = 2 volt.



Current flowing in the circuit

$$I = \frac{E}{R_2 + \frac{R_1 R_V}{R_1 + R_V}} = \frac{E}{R_2 + R'}$$

$$I = \frac{4}{4 + \frac{4 \times 4}{4 + 4}} = \frac{2}{3} \text{ ampere}$$

Potential difference measured by voltmeter

$$V'_{AB} = IR' = \frac{2}{3} \times 2 = \frac{4}{3}$$

Error in the reading of voltmeter

$$= V_{AB} - V'_{AB} = 2 - \frac{4}{3} = \frac{2}{3} \text{ volt}$$

The error in voltmeter reading for 2 volt p.d. $= \frac{2}{3}$ volt

The error in voltmeter reading for 1 volt p.d.

$$= \frac{2}{3} \times \frac{1}{2} = \frac{1}{3} \text{ volt}$$

the error in voltmeter reading for 100 volt p.d.

$$= \frac{100}{3} = 33.3\% \text{ volt}$$

(9) (d). $E = V + Ir = IR + Ir$

$\Rightarrow E = 0.25 \times 10 + 0.25 \times r$

In second stage

$\Rightarrow E = 0.5 \times 4 + 0.5\,r$

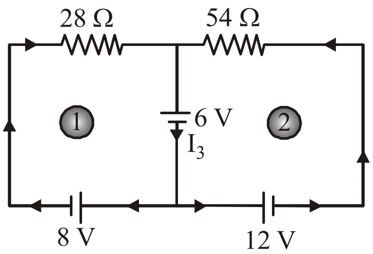
Subtracting eq. (b) from eq. (a)

$2.5 + 0.25\,r - 2.0 - 0.5\,r = 0$

$0.5 = 0.25\,r$

$r = \frac{0.5}{0.25} = 2\Omega.$

(10) (d) Suppose current through different paths of the circuit is as follows.



After applying KVL for loop (1) and loop (2)

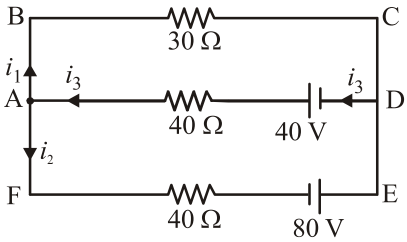
We get $28i_1 = -6 - 8 \Rightarrow \quad i_1 = -\frac{1}{2}A$

and $\quad 54i_2 = -6 - 12 \Rightarrow i_2 = -\frac{1}{3}A$

Hence $i_3 = i_1 + i_2 = -\frac{5}{6}A$

(11) (d) $V_{AB} = 4 = \frac{5X + 2 \times 10}{X + 10} \quad \Rightarrow = 20\,\Omega$

12. (b) The circuit can be simplified as follows



Applying KCL at junction A

$i_3 = i_1 + i_2$ ...(*i*)

Applying Kirchoff's voltage law for the loop ABCDA

$-30i_1 - 40i_3 + 40 = 0$

$\Rightarrow \quad -30i_1 - 40(i_1 + i_2) + 40 = 0$

$\Rightarrow \quad 7i + 4i_2 = 0$ ...(*ii*)

Applying Kirchoff's voltage law for the loop ADEFA.

$-40i_2 - 40i_3 + 80 + 4 = 0$

$\Rightarrow \quad -40i_2 - 40(i_1 + i_2) = -120$

$\Rightarrow \quad i_2 + 2i_2 = 3$ ...(*iii*)

On solving equation (*ii*) and (*iii*) $i_1 = -0.4$ A.

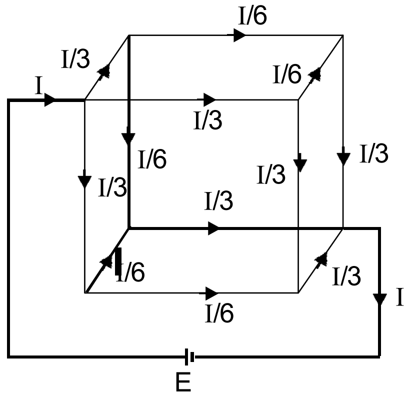
13. (b) Cells area joined in parallel when internal resistance is higher then a external resistance. ($R << r$)

$$i = \frac{E}{R + \frac{r}{n}}$$

14. (b). Current in the ammeter $I = \frac{E}{R' + r\left[1 + \frac{R'}{R}\right]}$

On increasing the value of R, the denominator will decrease and consequently the value of I will increase.

15. (a)



Let ABCDEFGH be skeleton cube formed of twelve equal wires each of resistance R. Let a battery of e.m.f. E be connected across A and G. Let the total current entering at the corner A and leaving the diagonally opposite corner G be I. By symmetry the distribution of currents in wires of cube, according to Kirchoff's Ist law is shown in fig. ApplyingKirchoff's IInd law to mesh ADCGEA, we get

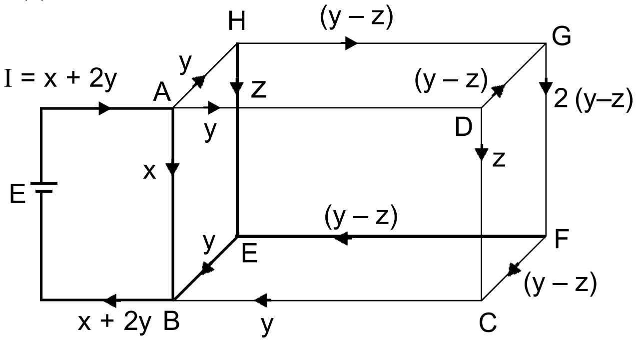
$$-\frac{1}{3}R - \frac{1}{6}R - \frac{1}{3}R + E = 0$$

or $E = \frac{5}{6}IR$ ......(a)

If R_{AB} is equivalent resistance between comers A and B, then from Ohm's law comparing (a) and (b), we get

$$IR_{AB} = \frac{5}{6}IR$$

16. (d).



Let $I = x + 2y$ current enter at point A, when a battery of e.m.f. E and no internal resistance is connected across edge AB. The edges AD and AH are symmetrically connected to A, therefore they will carry equal currents. The distribution of currents according to Kirchoff's I[st] law is shown in fig.

If R_{AB} is equivalent resistance, then from Ohm's law,

$$E = R_{AB} I = R_{AB}(x + 2y) \qquad ....(a)$$

and from Kirchoff's law applied to mesh containing AB and cell E is

$$R x = E \qquad .....(b)$$

(since R is resistance of each wire)

Applying Kirchoff's II law to mesh AHEB

$$yR + zR + yR - xR = 0 \text{ or } x - 2y - z = 0 \qquad .....(c)$$

Applying Kirchoff's II law to mesh DGFC

$$(y - z)R + 2(y - z)R - zR = 0$$

or $4(y - z) - z = 0$ or $4y = 5z$ .....(d)

i.e. $z = (4/5)y$

.....(E)

Substituting this value in (c), we get

$$x - 2y - \frac{4}{5}y = 0$$

or $\frac{14}{5}y = x$ i.e. $y = \frac{5}{14}x$

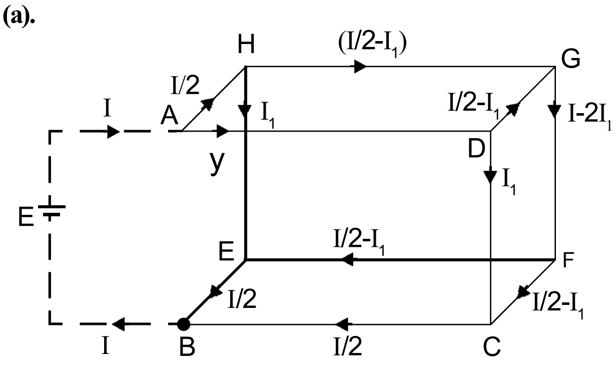
Substituting value of y in (a), we get

$$E = R_{AB}\left(x + \frac{10}{14}x\right)$$

$$E = R_{AB}\frac{24}{14}x = R.x$$

$$R_{AB} = \frac{24}{14}R \therefore R_{AB} = \frac{7}{12}R.$$

17. (a).



Let a battery of e.m.f. E is applied between points A and B. Let a current I, enter through point A.

If R_{AB} is equivalent resistance between points A and B, then from Ohm's law

$$R_{AB} I = E$$

The distribution of currents, keeping in mind symmetry condition, is shown in fig.

Let R (= 2Ω) be the resistance of each wire.

Applying Kirchoff's II law to mesh DGFC, we get

$$\left(\frac{1}{2} - I_1\right) R + (I - 2I_1)$$

$$R + \left(\frac{1}{2} - I_1\right) R - I_1 R = 0$$

or $2\left(\frac{1}{2} - I_1\right) + (I - 2I_1) - I_1 = 0$

or $2I - 5I_1 = 0$ or $I_1 = \frac{2}{5}I$ ...... (b)

Applying Kirchoff's II[nd] law to external circuit AHEBE', we get

$$\frac{1}{2}R + I_1 R + \frac{1}{2}R = E$$

$$IR + \frac{2}{5}IR = E' \qquad \text{[Using (b)]}$$

or $\frac{7}{5}IR = E$ ......(c)

Comparing (a) and (c), wet get

$$R_{AB} I = \frac{7}{5}IR \text{ i.e. } R_{AB} = \frac{7}{5}R = \frac{7}{5} \times 2 = 2.8\Omega$$

18. (c). In the first case $I = E/(r + R)$ and in the second case $I' = E/(r + R/2) = 2E/(2r + R)$

Using $E = I(r + R)$, we get

$$I' = I\left(\frac{2r + 2R}{2r + R}\right) = I\left(1 + \frac{R}{2r + R}\right)$$

Thus the term in bracket is greater than 1 but less than 2. Thus $2I > I' > I$

19. (b). Let R be the combined resistance of galvanometer and an unknown resistance and r the internal resistance of each battery. When the batteries, each of e.m.f. E are connected in series, the net e.m.f. = 2E and net internal resistance = 2r

$$\therefore \text{Current } i_1 = \frac{2E}{R + 2r} \text{ or } 1.0 = \frac{2 \times 15}{R + 2r}$$

$\therefore R + 2r = 3.0.$ ...(i)

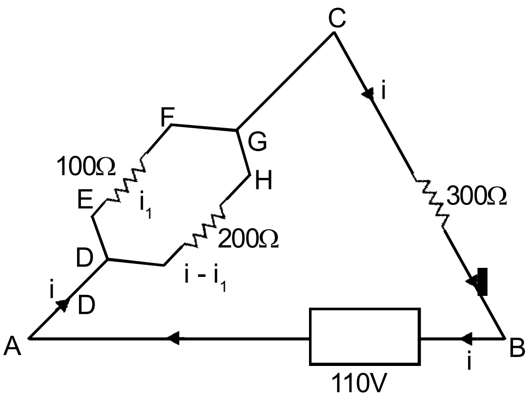
When the batteries are connected in parallel, the e.m.f. remains E and net internal resistance becomes r/2. therefore

$$\text{Current } i_2 = \frac{E}{R + \frac{r}{2}} = \frac{2E}{2R + r}$$

$$\therefore 2R + r = \frac{2E}{i_2} = \frac{2 \times 15}{0.6} = 5.0 \qquad ...(i)$$

Solving (i) and (ii), we get $r = 1/3\ \Omega$.

20. (a). The circuit with current distribution is shown in fig.



Applying Kirchoff's second law to the loop DEFGHID,

we have $i_1 \times 100 - (i - i_1) \times 200 = 0$

$300\, i_1 - 200\, i = 0$ ......(1)

Now applying Kirchoff's second law to loop ADIHGCBA,

we have. $(i - i_1)\, 200 + i \times 300 = 110$

$500i - 200\, i_1 = 110$ .....(2)

Solving eqs. (1) and (2), we get

$i = \frac{3}{10}$ amp and $i_1 = \frac{1}{5}$ amp.

Current in 100 ohm resistance $i_1 = \frac{1}{5}$ amp.

Current in 200 ohm resistance $i - i_1 = \frac{1}{10}$

Current in 300 ohm resistance $i = \frac{3}{10}$ amp.

Potential difference between A and C

= Potential difference across 100 ohm resistance

or potential difference across 200 ohm resistance

$\therefore V_A - V_C$ = current × resistance

$= i_1 \times 100 = \frac{1}{5} \times 100 = 20$ volt.

Potential difference between C and B is given by

$V_C - V_B = i \times 300 = \frac{3}{10} \times 300 = 90$ volt.

21. (a). After full charging, the steady current in the condenser is zero, hence no current will flow in 4Ω resistance.

$$I = \frac{E}{R + R'} = \frac{6}{28 + \left(\frac{2 \times 3}{2 + 3}\right)} = \frac{6}{28 + 12} = 1.5\,A$$

Let current flowing in 2Ω resistance is I_1

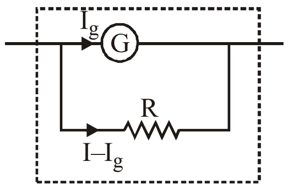
$\therefore$ 2Ω and 3Ω resistance are connected in parallel

$\therefore 2I_1 = (1.5 - I_1) \times 3$

$5I_1 = 4.5$

$I_1 = 0.9$ amp.

24. (d).



For Ammeter $I_g G = (I - I_g)\, R$

$50 \times 10^{-6} \times 100 = 5 \times 10^{-3} \times (R) \Rightarrow R \approx 1\Omega$

For voltmeter $I_g\,(R + G) = V$

$50\,\mu A\,(R + G) = 10V \Rightarrow R + G = 200\,k\Omega \Rightarrow R \approx 200k\Omega$

25. (a) Potential at $A = 6V$

$V_A - V_C = 4$

$\Rightarrow V_C = 2V$

26. (d) $\frac{V_{AD}}{V_{AB}} = \frac{V_{AC}}{V_{AB}} = \frac{AD}{AB} = \frac{4}{6} = \frac{2}{3}$;

$AD = \frac{200}{3}$ cm.

27. (a) D is balance point, hence no current

28. (a) Voltameter measures current indirectly in terms of mass of ions deposited and electrochemical equivalent of the substance $\left(I = \frac{m}{Zt}\right)$. Since value of m and Z are measured to 3rd decimal place and 5th decimal place respectively. The relative error in the emasurement of current by voltmeter will be very small as compared to that when measured by ammeter directly.

29. (c) The e.m.f. of a dry cell is dependent upon the electrode potential of cathode and anode which in turn is dependent upon the reaction involved as well as concentration of the electrolyte. It has nothing to do with size of the cell.

So, statement-1 is false and statement-2 is true.

30. (d) $V = E - ir = 4 - 2 \times 2 = 0$, During charging $V > E$.