DPP - Daily Practice Problems

Name : _____ Date : _____

Start Time : _____ End Time : _____

PHYSICS 38

SYLLABUS : CURRENT ELECTRICITY-3 : Wheatstone bridge, Meter bridge, Potentiometer-principle and its applications.

Max. Marks : 100 **Time : 60 min.**

GENERAL INSTRUCTIONS

- The Daily Practice Problem Sheet contains 25 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.16) : There are **16** multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which **ONLY ONE** choice is correct.

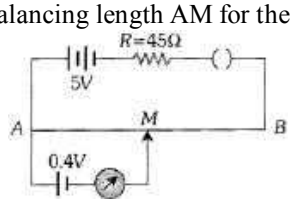
Q.1 A Potentiometer wire of length 1 m is connected in series with 490 Ω resistance and 2V battery. If 0.2 mV/cm is the potential gradient, then resistance of the potentiometer wire is
(a) 4.9 Ω (b) 7.9 Ω (c) 5.9 Ω (d) 6.9 Ω

Q.2 Two resistances are connected in two gaps of a metre bridge. The balance point is 20 cm from the zero end. A resistance of 15 ohms is connected in series with the smaller of the two. The null point shifts to 40 cm. The value of the smaller resistance in ohm is
(a) 3 (b) 6 (c) 9 (d) 12

Q.3 In a potentiometer experiment the balancing with a cell is at length 240 cm. On shunting the cell with a resistance of 2 Ω, the balancing length becomes 120 cm. The internal resistance of the cell is
(a) 4 Ω (b) 2 Ω (c) 1 Ω (d) 0.5 Ω

Q.4 A potentiometer consists of a wire of length 4 m and resistance 10 Ω . It is connected to cell of emf 2 V. The potential difference per unit length of the wire will be
(a) 0.5 V/m (b) 10 V/m (c) 2 V/m (d) 5 V/m

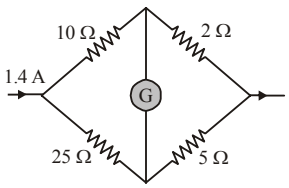
Q.5 In given figure, the potentiometer wire AB has a resistance of 5 Ω and length 10 m. The balancing length AM for the emf of 0.4 V is
(a) 0.4 m
(b) 4 m
(c) 0.8 m
(d) 8 m



RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ

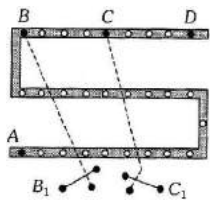
Space for Rough Work

Q.6 In the circuit shown in the figure, the current flowing in 2Ω resistance



(a) 1.4 A
(b) 1.2 A
(c) 0.4 A
(d) 1.0 A

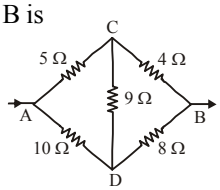
Q.7 For the post office box arrangement to determine the value of unknown resistance the unknown resistance should be connected between



(a) B and C (b) C and D (c) A and D (d) B_1 and C_1

Q.8 The e.m.f. of a standard cell balances across 150 cm length of a wire of potentiometer. When a resistance of 2Ω is connected as a shunt with the cell, the balance point is obtained at 100 cm. The internal resistance of the cell is
(a) 0.1 Ω (b) 1Ω (c) 2Ω (d) 0.5Ω

Q.9 Five resistors are connected as shown in the diagram. The equivalent resistance between A and B is



(a) 6 Ω
(b) 9 Ω
(c) 12 Ω
(d) 15 Ω

Q.10 A potentiometer has uniform potential gradient. The specific resistance of the material of the potentiometer wire is 10^{-7} ohm-meter and the current passing through it is 0.1 ampere; cross-section of the wire is $10^{-6}m^2$. The potential gradient along the potentiometer wire is
(a) 10^{-4} V/m (b) 10^{-6} V/m
(c) 10^{-2} V/m (d) 10^{-8} V/m

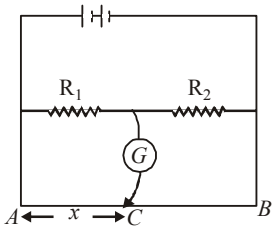
Q.11 Resistance in the two gaps of a meter bridge are 10 ohm and 30 ohm respectively. If the resistances are interchanged the balance point shifts by
(a) 33.3 cm (b) 66.67 cm (c) 25 cm (d) 50 cm

Q.12 A potentiometer has uniform potential gradient across it. Two cells connected in series (i) to support each other and (ii) to oppose each other are blanced over 6m and 2m respectively on the potentiometer wire. The e.m.f's of the cells are in the ratio of
(a) 1 : 2 (b) 1 : 1 (c) 3 : 1 (d) 2 : 1

Q.13 In a potentiometer experiment two cells of e.m.f E_1 and E_2 are used in series and in conjunction and the balancing length is found to be 58 cm of the wire. If the polarity of E_2 is reversed, then the balancing length becomes 29 cm. The ratio $\frac{E_1}{E_2}$ of the e.m.f. of the two cells is
(a) 1 : 1 (b) 2 : 1 (c) 3 : 1 (d) 4 : 1

Q.14 The resistance of a 10 meter long potentiometer wire is 1 ohm/metre. A cell of e.m.f. 2.2 volts and a high resistance box are connected in series with this wire. The value of resistance taken from resistance box for getting potential gradient of 2.2 millivolt/metre will be
(a) 790 Ω (b) 810 Ω (c) 990 Ω (d) 1000 Ω

Q.15 In the shown arrangement of the experiment of the meter bridge if AC corresponding to null deflection of galvanometer is x, what would be its value if the radius of the wire AB is doubled



(a) x (b) $x/4$ (c) $4x$ (d) $2x$

Q.16 In meter bridge or Wheatstone bridge for measurement of resistance, the known and the unknown resistances are interchanged. The error so removed is
(a) End correction
(b) Index error
(c) Due to temperature effect
(d) Random error

RESPONSE GRID					
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ
	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ
	16. ⓐⓑⓒⓓ				

Space for Rough Work

DIRECTIONS (Q.17-Q.19) : In the following questions, more than one of the answers given are correct. Select the correct answ]ers 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

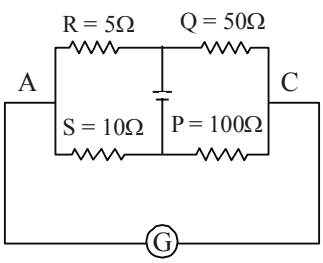
Q.17 Which of the following statements are correct?

(1) Voltmeter should have high resistance.
(2) Ammeter should have low resistance.
(3) Voltmeter is placed in parallel across the conductor in a circuit.
(4) Ammeter is placed in parallel across the conductor in a circuit.

Q.18 Which are correct statements?

(1) The Wheatstone bridge is most sensitive when all the four resistances are of the same order
(2) Kirchhoff's first law (for currents meeting at a junction in an electric circuit) expresses the conservtion of charge.
(3) The rheostat can be used as a potential divider.
(4) In a balanced Wheatstone bridge, interchanging the positions of galvanometer and cell affects the balance of the bridge.

Q.19 Figure shows a balanced Wheatstone's bridge



(1) If P is slightly increased, the current in the galvanometer flows from A to C.
(2) If P is slightly increased, the current in the galvanometer flows from C to A.
(3) If Q is slightly increased, the current in the galvanometer flows from C to A.
(4) If Q is slightly increased, the current in the galvanometer flows from A to C.

DIRECTIONS (Q.20-Q.22) : Read the passage given below and answer the questions that follows :

A battery is connected to a potentiometer and a balance point is obtained at 84 cm along the wire. When its terminals are connected by a 5Ω resistor, the balance point changes to 70 cm

Q.20 Calculate the internal resistance of the cell.

(a) 4 Ω (b) 2Ω (c) 5 Ω (d) 1 Ω

Q.21 Find the new position of the balance point when 5Ω resistance is replaced by 4Ω resistor.

(a) 26.5 cm (b) 52 cm (c) 67.2 cm (d) 83.3 cm

Q.22 How can we change a galvanometer with $R_e = 20.0\Omega$ and $I_{fs} = 0.00100$ A into a voltmeter with a maximum range of 10.0 V?

(a) By adding a resistance 9980 Ω in parallel with the galvanometer
(b) By adding a resistance 9980 Ω in series with the galvanometer
(c) By adding a resistance 8890 Ω in parallel with the galvanometer
(d) By adding a resistance 8890 Ω in series with the galvanometer

DIRECTIONS (Q. 23-Q.25) : 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.

Q.23 **Statement -1 :** In meter bridge experiment, a high resistance is always connected in series with a galvanometer.
Statement -2 : As resistance increases current through the circuit increases.

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

Space for Rough Work

Q.24 **Statement -1:** A potentiometer of longer length is used for accurate measurement.
Statement -2: The potential gradient for a potentiometer of longer length with a given source of *e.m.f.* becomes small.

Q.25 **Statement -1:** The e.m.f. of the driver cell in the potentiometer experiment should be greater than the e.m.f. of the cell to be determined.
Statement -2: The fall of potential across the potentiometer wire should not be less than the e.m.f. of the cell to be determined.

RESPONSE GRID	24. ⓐⓑⓒⓓ 25. ⓐⓑⓒⓓ

DAILY PRACTICE PROBLEM SHEET 38 - PHYSICS			
Total Questions	25	Total Marks	100
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	26	Qualifying Score	44
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

DAILY PRACTICE PROBLEMS — PHYSICS SOLUTIONS — 38

1. (a) Potential gradient $x = \frac{e}{(R+R_h+r)}.\frac{R}{L}$

$\Rightarrow \frac{0.2\times10^{-3}}{10^{-2}} = \frac{2}{(R+490+0)}\times\frac{R}{1} \Rightarrow R = 4.9\Omega.$

2. (c) Let S be larger and R be smaller resistance connected in two gaps of meter bridge.

$\therefore S = \left(\frac{100-l}{l}\right)R = \frac{100-20}{20}R = 4R$ .....(i)

When 15Ω resistance is added to resistance R, then

$S = \left(\frac{100-40}{40}\right)(R+15) = \frac{6}{4}(R+15)$ .....(ii)

From equations (i) and (ii) $R = 9\Omega$

3. (b) $r = R\left(\frac{l_1}{l_2}-1\right) = 2\left(\frac{240}{120}-1\right) = 2\Omega$

4. (a) Potential difference per unit length

$= \frac{V}{L} = \frac{2}{4} = 0.5V/m$

5. (d) $E = \frac{e}{(R+R_h+r)}.\frac{R}{L}\times l \Rightarrow 0.4 = \frac{5}{(5+45+0)}\times\frac{5}{10}\times l$

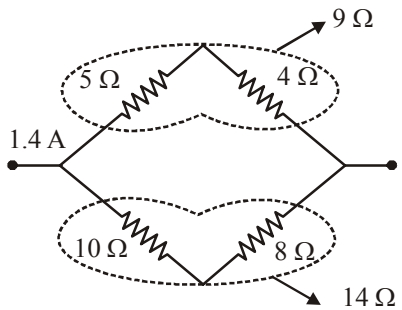
$\Rightarrow l = 8m$

6. (d) Current through $2\Omega = 1.4\left\{\frac{(25+5)}{(10+2)+(25+5)}\right\} = 1A$

7. (c) Post office box is based on the principle of Wheatstone's bridge.

8. (b) Using $r = R\left(\frac{l_1}{l_2}-1\right) = 2\left(\frac{150}{100}-1\right) = 1\Omega$

9. (a) Since the given bridge is balanced, hence there will be no current through 9Ω resistance. This resistance has no effect and must be ignored in the calculations.



$R_{AB} = \frac{9\times18}{27} = 6\Omega$

10. (c) Potential gradient $(x) = \frac{i\rho}{A} = \frac{0.1\times10^{-7}}{10^{-6}} = 10^{-2}V/m$

11. (d) $S = \left(\frac{100-l}{l}\right).R$

Initially, $30 = \left(\frac{100-l}{l}\right)\times10 \Rightarrow l = 25cm$

Finally, $10 = \left(\frac{100-l}{l}\right)\times30 \Rightarrow l = 75cm$

So, shift $=50cm$.

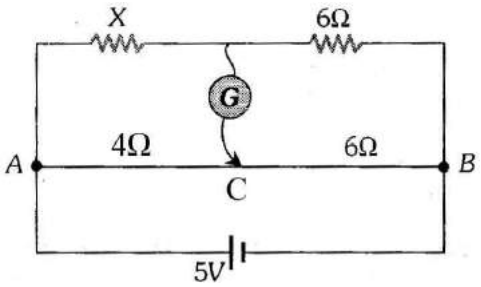
12. (d) $\frac{E_1}{E_2} = \frac{l_1+l_2}{l_1-l_2} = \frac{(6+2)}{(6-2)} = \frac{2}{1}$

13. (c) $\frac{E_1}{E_2} = \frac{l_1+l_2}{l_1-l_2} = \frac{58+29}{58-29} = \frac{3}{1}$

14. (d)

$E = \frac{e}{(R+R_h+r)}\frac{R}{L}\times l = \frac{2}{(10+40+0)}\times\frac{10}{1}\times0.4 = 0.16\,\text{V}$

15. (c)



Resistance of the part AC

$R_{AC} = 0.1\times40 = 4\Omega$ and $R_{CB} = 0.1\times60 = 6\Omega$

In balanced condition $\frac{X}{6} = \frac{4}{6} \Rightarrow X = 4\Omega$

Equivalent resistance $R_{eq} = 5\Omega$

so current drawn from battery $i = \frac{5}{5} = 1A$.

16. (a) $r = \left(\frac{l_1-l_2}{l_2}\right)\times R' \Rightarrow r = \left(\frac{55-50}{50}\right)\times10 = 1\Omega$

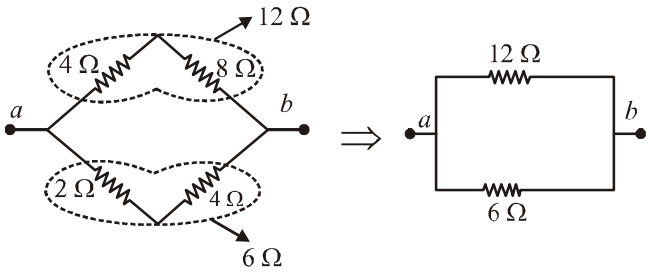
17. **(c)** Potential gradient

$$x = \frac{V}{L} = \frac{e}{(R + R_h + r)}\frac{R}{L}$$

$$\Rightarrow 2.2\times10^{-3} = \frac{2.2}{(10 + R_h)}\times1 \Rightarrow R' = 990\Omega$$

18. **(a)** $E = xl = i\rho l \Rightarrow i = \frac{E}{\rho l} = \frac{2.4\times10^{-3}}{1.2\times5} = 4\times10^{-4}\,A$

19. **(b)** Give circuit is a balanced Wheaststone bridge circuit, hence it can be redrawn as follows



$$R^{AB} = \frac{12\times6}{(12+6)} = 4\Omega.$$

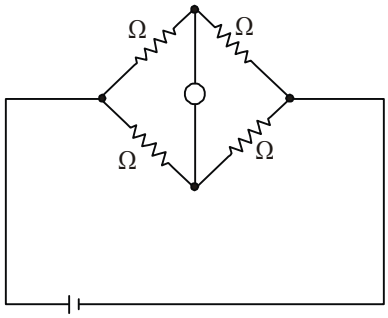
20. **(a)** Balancing length is independent of the cross sectional area of the wire.

21. **(a)** In meter bridge experiment, it is assumed that the resistance of the L shaped plate is negligible, but actually it is not so. The error created due to this is called, end error. To remove this the resistance box and the unknown resisance must be interchanged and then the mean reading must be taken.

22. **(a)** Ammeter is always connected in series with circuit.

23. **(a)** In balanced Wheastone bridge, the arms of galvanometer and cell can be interchanged without affecting the balance of the bridge.

24. **(d)**



If P is slightly icnreased, potential of C will decrease.

Hence current will from A to C.

If Q is slightly increased, potential of C will increase.

Hence current will flow from C to A.

25-27

We have

$$R_s = \frac{V}{I_{fs}} - R_c = \frac{10.0V}{0.00100A} - 20.0\Omega = 9980\Omega$$

At full-scale deflection, V_{ab} = 10.0V, voltage across the meter is 0.0200 V, voltage across R_s is 9.98 V, and current through the voltmeter is 0.00100 A. In this case most of the voltage appears across the series resistor.

The equivalent meter resistance is R_{eq} = 20.0 Ω + 9980 Ω = 10,000Ω . Such a meter is described as a "1,000 ohms-per-volt meter" referring to the ratio of resistance to full-scale deflection. In normal operation the current through the circuit element being measured is much greater than 0.00100 A, and the resistance between points a and b in the circuit is much less than 10,000Ω. So the voltmeter draws off only a small fraction of the current and disturbs, only slightly the circuit being measured.

25. **(d),** **26.** **(c),** **27.** **(b)**

28. **(d)** The resistance of the galvanometer is fixed. In meter bridge experiments, to protect the galvanometer from a high current, high resistance is connected to the galvanometer in order to protect it from damage.

29. **(a)** Sensitivity $\propto \frac{1}{\text{Potential gradiant}} \propto$ (Length of wire)

30. **(a)** If either the e.m.f. of the driver cell or potential difference across the whole potentiometer wire is lesser than the e.m.f. of the experimental cell, then balance point will not obtained.