O P JINDAL SCHOOL, SAVITRINAGAR

PRACTICE PAPER (SOLUTION)

CLASS XII PHYSICS | TOPIC : CURRENT ELECTRICITY

Date : 01/05/20 | MM :25

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1 Why is the potentiometer preferred to a voltmeter for measuring emf of a cell? 1

ANS: Emf measured by the potentiometer is more accurate because the cell is in open circuit giving no current.

2 Why copper is not used for making potentiometer wires? 1

ANS: The resistivity of copper increases with the rise in temperature, hence, it is not preferred.

3 The emf of a cell is always greater than its terminal voltage. Why? Give reason. 1

ANS: The current always flows from higher to lower potential. To produce the current to an external circuit, the emf must be greater than the terminal voltage, i.e. the potential difference across the external circuit.

$\varepsilon = V + Ir$

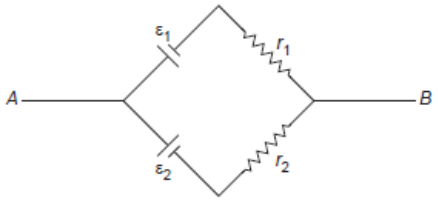
4 How can we increase the sensitivity of a potentiometer? 1

ANS: By reducing potential gradient. Potential gradient can be reduced by (i) increasing length of the wire, and (ii) reducing current in the main circuit.

5 Why do bends in a wire not affect its resistance? 1

ANS: As the mean free path of free electron in a wire is much less than the radius of curvature of the bend, it does not offer any resistance.

6 Two batteries of ε_1 and ε_2 ($\varepsilon_2 > \varepsilon_1$) and internal resistance r_1 and r_2 respectively are connected in parallel as shown in figure. 1



(a) The equivalent emf ε_{eq} of the two cells is between ε_1 and ε_2, i.e. $\varepsilon_1 < \varepsilon_{eq} < \varepsilon_2$.
(b) The equivalent emf ε_{eq} is smaller than ε_1.
(c) The ε_{eq} is given by $\varepsilon_{eq} = \varepsilon_1 + \varepsilon_2$ always.
(a) ε_{eq} is independent of internal resistances r_1 and r_2.

ANS: (a) The equivalent emf of this combination is given by

$$\varepsilon_{eq} = \frac{\frac{\varepsilon_1}{r_1} + \frac{\varepsilon_2}{r_2}}{\left(\frac{1}{r_1} + \frac{1}{r_2}\right)} = \frac{\varepsilon_1\left(\frac{1}{r_1} + \frac{\varepsilon_2/\varepsilon_1}{r_2}\right)}{\left(\frac{1}{r_1} + \frac{1}{r_2}\right)}$$

$$= \frac{\varepsilon_2\left(\frac{\varepsilon_1/\varepsilon_2}{r_1} + \frac{1}{r_2}\right)}{\left(\frac{1}{r_1} + \frac{1}{r_2}\right)}$$

$$\text{As } \frac{\varepsilon_2}{\varepsilon_1} > 1 \Rightarrow \frac{\left(\frac{1}{r_1} + \frac{\varepsilon_2/\varepsilon_1}{r_2}\right)}{\left(\frac{1}{r_1} + \frac{1}{r_2}\right)} > 1 \text{ or } \varepsilon_{eq} > \varepsilon_1$$

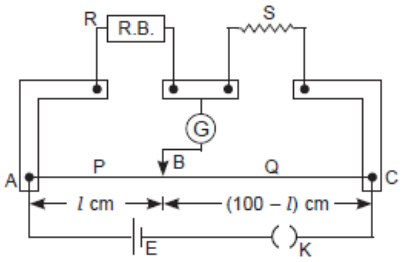
$$\text{Also } \frac{\varepsilon_1}{\varepsilon_2} < 1 \Rightarrow \frac{\left(\frac{\varepsilon_1/\varepsilon_2}{r_1} + \frac{1}{r_2}\right)}{\left(\frac{1}{r_1} + \frac{1}{r_2}\right)} < 1 \text{ or } \varepsilon_{eq} < \varepsilon_2$$

Hence $\varepsilon_1 < \varepsilon_{eq} < \varepsilon_2$.

7 A resistance R is to be measured using a meter bridge. Student chooses the standard resistance S to be 100 Ω He finds the null point at l_1 = 2.9 cm. He is told to attempt to improve the accuracy. Which of the following is a useful way? [NCERT Exemplar] 1

(a) He should measure l1 more accurately.
(b) He should change S to 1000 Ω and repeat the experiment.
(c) He should change S to 3 Ω and repeat the experiment.
(d) He should give up hope of a more accurate measurement with a meter bridge.

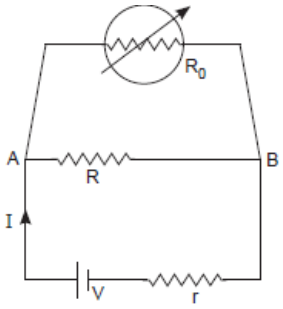
ANS: (c) The bridge is said to be balanced if the ratio of the resistances in same branch is equal $\frac{R}{S} = \frac{l_1}{(100 - l_1)}$ Since here, R : S = 2.9 : 97.1, then the value of S is nearly 33 times to that of R. In order to make this ratio 1 : 1, it is necessary to reduce the value of S nearly $\frac{1}{33}$ times i.e., nearly 3 Ω.



8 Two cells of emf's approximately 5 V and 10 V are to be accurately compared using a potentiometer of length 400 cm. [NCERT Exemplar]
(a) The battery that runs the potentiometer should have voltage of 8 V.
(b) The battery of potentiometer can have a voltage of 15 V and R adjusted so that the potential drop across the wire slightly exceeds 10 V. 1
(c) The first portion of 50 cm of wire itself should have a potential drop of 10 V.
(d) Potentiometer is usually used for comparing resistances and not voltages.

ANS: (b) The potential drop along the wires of potentiometer should be greater than emfs of cells. Here, values of emfs of two cells are given as 5 V and 10 V, therefore, the potential drop along the potentiometer wire must be more than 10 V.

9 Consider a simple circuit shown in figure stands for a variable resistance R′. R′ can vary from R_0 to infinity. r is internal 1



resistance of the battery (r << R << R_0). (a) Potential drop across AB is not constant as R0 is varied.

(b) Current through R0 is nearly a constant as R0 is varied.

(c) Current I depends sensitively on R0. (d) $I \geq \frac{V}{r+R}$ always.

ANS: (d) In parallel grouping of resistance, same potential difference appeared across each resistance but current distributed in reverse ratio of their resistance,

i.e. $i \propto \frac{1}{R}$

P.d across AB and r = v, equivalent resistance of parallel combination R′ < R, therefore current

$I \leq \frac{V}{R+r}$

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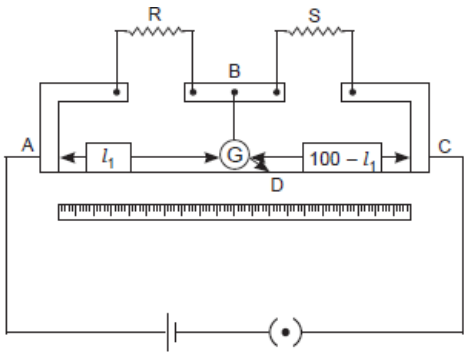

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In a meter bridge, the point D is a neutral point (figure). (a) The meter bridge can have other neutral point for this set of resistances.

(b) When the jockey contacts a point on meter wire left of D, current flows to B from the wire.

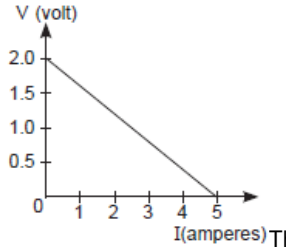
(c) When the jockey contacts a point on the meter wire to the right of D, current flows from B to the wire through galvanometer.
(d) When R is increased, the neutral point shifts to left.

ANS: (c) If in balanced position of bridge AB = l, $BC = (100 - l)$ so that $\frac{Q}{P} = \frac{(100 - l)}{l}$.
Also $\frac{P}{Q} = \frac{R}{S} \Rightarrow S = [(100 - l)/l] \times R$ When there is no deflection in galvanometer there is no current across the galvanometer, then points B and D are at same potential. That point at which galvanometer shows no deflection is called null point, When the jockey contacts a point on the meter wire to the right of D, the potential drop across AD is more than potential drop across AB, which brings the potential of point D less than that of B, hence current flows from B to D in the galvanometer wire.

11 For measurement of potential difference, a potentiometer is preferred over voltmeter because
(a) potentiometer is more sensitive than voltmeter.
(b) the resistance of potentiometer is less than voltmeter. 1
(c) potentiometer is cheaper than voltmeter.
(d) potentiometer does not take current from the circuit.

ANS: (d) Potentiometer works on null deflection method.

12 For a cell, the graph between the potential difference (V) across the terminals of the cell and the current (I) drawn from the cell 1



is shown in the figure. The e.m.f. and the internal resistance of the cell are
(a) 2V, 0.5 Ω (b) 2V, 0.4 Ω
(c) > 2V, 0.5 Ω (d) > 2V, 0.4 Ω

ANS: (b) E.m.f. is the value of voltage, when no current is drawn from the circuit so E = 2 V.

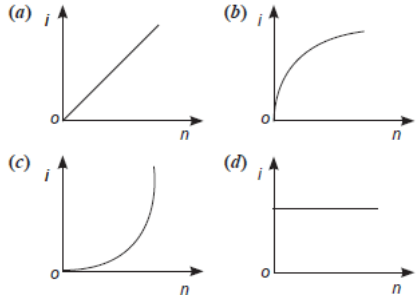
Also r = slope = $\frac{2}{5}$ = 0.4 Ω

13 A Daniel cell is balanced on 125 cm length of a potentiometer wire. Now the cell is short-circuited by a resistance 2 ohm and the balance is obtained at 100 cm. The internal resistance of the Daniel cell is
(a) 0.5 ohm (b) 1.5 ohm
(c) 1.25 ohm (d) 4/5 ohm

1

ANS: $(a)\ r = \left(\frac{l_1 - l_2}{l_2}\right) R = \left(\frac{25}{100}\right) 2 = 0.5\ \Omega$

14 A battery consists of a variable number 'n' of identical cells having internal resistances connected in series. The terminals of battery are short circuited and the current i is measured. Which of the graph below shows the relationship between i and n?



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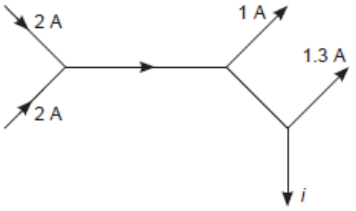
ANS: $(d)\ I = \frac{nE}{nr} = \frac{E}{r}$. current is independent of n.

15



1

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

ANS: 1.7 A

16 Kirchhoff's junction rule is a reflection of
(a) conservation of current density vector.

1

(b) conservation of potential.
(c) the fact that the momentum with which a charged particle approaches a junction is unchanged (as a vector) as the charged particle leaves the junction.
(d) the fact that there is no accumulation of charges at a junction.

ANS: (d) Junction rule: Algebraic sum of the currents flowing towards any point in an electric network is zero, i.e. charges are conserved in an electric network.
The proof of this rule follows from the fact that when currents are steady, there is no accumulation of charges at any junction or at any point in a line.

17 Ohm's law is true.
(a) For metallic conductors at low temperature.
(b) For metallic conductors at high temperature. 1
(c) For electrolytes when current passes through them.
(d) For diode when current flows.

ANS: (a) Because with rise in temperature, the resistance of a conductor increases, so the graph between V and i becomes non-linear.

18 A cell of internal resistance 1.5 Ω and e.m.f. 1.5 volt balances on 500 cm length of a potentiometer wire. If a wire of 15 Ω is connected between the balance point and the cell, then the balance point will shift 1
(a) to zero (b) by 500 cm
(c) by 750 cm (d) no change

ANS: (d)

19 The terminal potential difference of a cell is greater than its e.m.f. when it is
(a) being discharged.
(b) in open circuit. 1
(c) being charged.
(d) being either charged or discharged.

ANS: (c) In charging $V > E$

20 If the length of potentiometer wire is increased, then the length of the previously obtained balance point will
(a) increase. 1
(b) decrease.
(c) remain unchanged.

(d) become two times.

ANS: (a) When the length of potentiometer wire is increased, the potential gradient decreases and the length of previous balance point is increased.

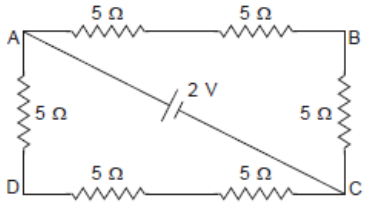
21 Kirchhoff's first law, i.e. $\Sigma i = 0$ at a junction is based on the law of conservation of _____. 1

ANS: charge

22 Kirchhoff 's second law is based on the law of conservation of _____. 1

ANS: energy

23 The potential difference between points A and B of given figure is _____. 1



ANS: 4/3V

24 A cell of e.m.f. 1.5V having a finite internal resistance is connected to a load resistance of 2Ω. For maximum power transfer the internal resistance of the cell should be _____. 1

ANS: 2 Ω. For maximum power, external resistance = internal resistance.

25 When the current i is flowing through a conductor, the drift velocity is v. If 2i current flows through the same metal but having the double area of cross-section, then the drift velocity will be _____. 1

ANS: v

$$v_d = \frac{J}{ne} \Rightarrow v_d \propto J, \frac{J_1}{J_2} = \frac{v_{d1}}{v_{d2}} = v$$