DPP - Daily Practice Problems

Chapter-wise Sheets

Date : ______ **Start Time :** ______ **End Time :** ______

PHYSICS

CP17

SYLLABUS : Current Electricity

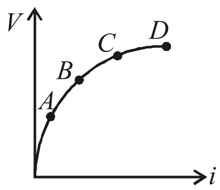
Max. Marks : 180 **Marking Scheme :** (+4) for correct & (–1) for incorrect answer **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 45 MCQs. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. When 5V potential difference is applied across a wire of length 0.1 m, the drift speed of electrons is $2.5 \times 10^{-4}\ \text{ms}^{-1}$. If the electron density in the wire is $8 \times 10^{28}\ \text{m}^{-3}$, the resistivity of the material is close to :

(a) $1.6 \times 10^{-6}\ \Omega\text{m}$ (b) $1.6 \times 10^{-5}\ \Omega\text{m}$
(c) $1.6 \times 10^{-8}\ \Omega\text{m}$ (d) $1.6 \times 10^{-7}\ \Omega\text{m}$

2. Variation of current passing through a conductor as the voltage applied across its ends is varied as shown in the adjoining diagram. If the resistance (R) is determined at the points A, B, C and D, we will find that



(a) $R_C = R_D$
(b) $R_B > R_A$
(c) $R_C > R_B$
(d) $R_A > R_B$

3. The length of a wire of a potentiometer is 100 cm, and the e.m.f. of its standard cell is E volt. It is employed to measure the e.m.f. of a battery whose internal resistance is 0.5Ω. If the balance point is obtained at $\ell = 30$ cm from the positive end, the e.m.f. of the battery is

(a) $\dfrac{30E}{100.5}$ (b) $\dfrac{30E}{(100-0.5)}$
(c) $\dfrac{30(E-0.5i)}{100}$ (d) $\dfrac{30E}{100}$

4. The masses of the three wires of copper are in the ratio of 1 : 3 : 5 and their lengths are in the ratio of 5 : 3 : 1. The ratio of their electrical resistance is

(a) 1 : 3 : 5 (b) 5 : 3 : 1
(c) 1 : 25 : 125 (d) 125 : 15 : 1

5. n equal resistors are first connected in series and then connected in parallel. What is the ratio of the maximum to the minimum resistance ?

(a) n (b) $1/n^2$ (c) n^2 (d) $1/n$

6. A battery is charged at a potential of 15V for 8 hours when the current flowing is 10A. The battery on discharge supplies a current of 5A for 15 hours. The mean terminal voltage during discharge is 14V. The "watt-hour" efficiency of the battery is

(a) 87.5% (b) 82.5% (c) 80% (d) 90%

RESPONSE GRID	
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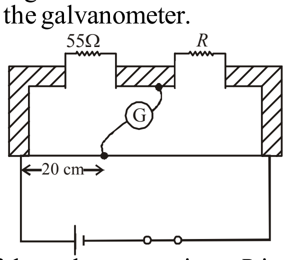
	6. ⓐⓑⓒⓓ

Space for Rough Work

7. Shown in the figure below is a meter-bridge set up with null deflection in the galvanometer.



The value of the unknown resistor R is

(a) 13.75 Ω (b) 220 Ω (c) 110 Ω (d) 55 Ω

8. In the equation AB = C, A is the current density, C is the electric field, Then B is

(a) resistivity (b) conductivity
(c) potential difference (d) resistance

9. The Kirchhoff's first law $(\Sigma i = 0)$ and second law $(\Sigma iR = \Sigma E)$, are respectively based on

(a) conservation of charge, conservation of momentum
(b) conservation of energy, conservation of charge
(c) conservation of momentum, conservation of charge
(d) conservation of charge, conservation of energy

10. You are given a resistance coil and a battery. In which of the following cases the largest amount of heat generated ?

(a) When the coil is connected to the battery directly
(b) When the coil is divided into two equal parts and both the parts are connected to the battery in parallel
(c) When the coil is divided into four equal parts and all the four parts are connected to the battery in parallel
(d) When only half the coil is connected to the battery

11. The resistance of the coil of an ammeter is R. The shunt required to increase its range n-fold should have a resistance

(a) $\frac{R}{n}$ (b) $\frac{R}{n-1}$ (c) $\frac{R}{n+1}$ (d) nR

12. On increasing the temperature of a conductor, its resistance increases because the

(a) relaxation time increases
(b) mass of electron increases
(c) electron density decreases
(d) relaxation time decreases

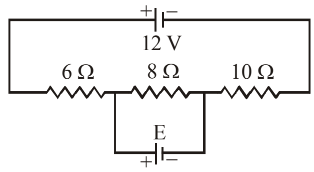
13. An electric current is passed through a circuit containing two wires of the same material, connected in parallel. If the lengths and radii are in the ratio of $\frac{4}{3}$ and $\frac{2}{3}$, then the ratio of the current passing through the wires will be

(a) 8/9 (b) 1/3 (c) 3 (d) 2

14. In a meter bridge experiment null point is obtained at 20 cm. from one end of the wire when resistance X is balanced against another resistance Y. If $X < Y$, then where will be the new position of the null point from the same end, if one decides to balance a resistance of 4 X against Y

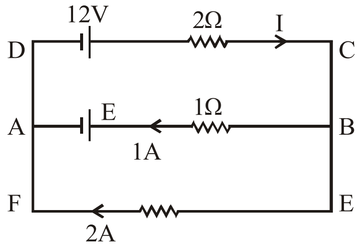
(a) 40 cm (b) 80 cm (c) 50 cm (d) 70 cm

15. In the circuit shown, the current through 8 ohm is same before and after connecting E. The value of E is



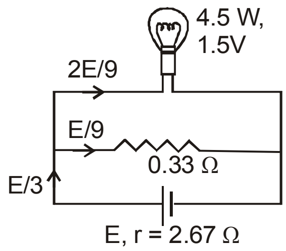
(a) 12 V
(b) 6 V
(c) 4 V
(d) 2 V

16. Find emf E of the cell as shown in figure.



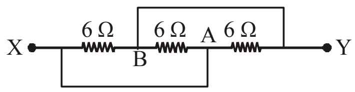
(a) 15V (b) 10V (c) 12V (d) 5V

17. A torch bulb rated as 4.5 W, 1.5 V is connected as shown in fig. The e.m.f. of the cell, needed to make the bulb glow at full intensity is



(a) 4.5 V (b) 1.5 V (c) 2.67 V (d) 13.5 V

18. In a given network, each resistance has value of 6Ω. The point X is connected to point A by a copper wire of negligible resistance and point Y is connected to point B by the same wire. The effective resistance between X and Y will be

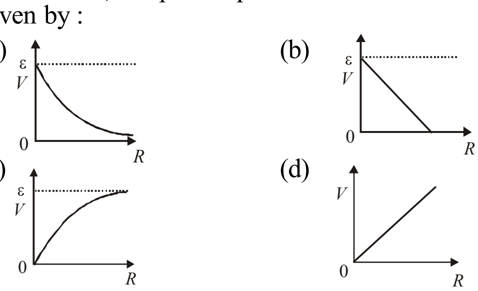


(a) 18Ω (b) 6Ω (c) 3Ω (d) 2Ω

19. If N, e, τ and m are representing electron density, charge, relaxation time and mass of an electron respectively, then the resistance of wire of length ℓ and cross-sectional area A is given by

(a) $\frac{2m\ell}{Ne^2A\tau}$ (b) $\frac{2m\tau A}{Ne^2\ell}$ (c) $\frac{Ne^2\tau A}{2m\ell}$ (d) $\frac{Ne^2A}{2m\tau\ell}$

20. Cell having an emf ε and internal resistance r is connected across a variable external resistance R. As the resistance R is increased, the plot of potential difference V across R is given by :



RESPONSE GRID					
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	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ
	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ	

21. If voltage across a bulb rated 220 Volt-100 Watt drops by 2.5% of its rated value, the percentage of the rated value by which the power would decrease is :

(a) 20% (b) 2.5% (c) 5% (d) 10%

22. If specific resistance of a potentiometer wire is 10^{-7} Ωm, the current flow through it is 0.1 A and the cross-sectional area of wire is 10^{-6} m^2 then potential gradient will be

(a) 10^{-2} volt/m (b) 10^{-4} volt/m
(c) 10^{-6} volt/m (d) 10^{-8} volt/m

23. Two resistances R_1 and R_2 are made of different materials. The temperature coefficient of the material of R_1 is α and that of material of R_2 is – β. The resistance of the series combination of R_1 and R_2 will not change with temperature if $\frac{R_1}{R_2}$ equal to

(a) $\frac{\alpha}{\beta}$ (b) $\frac{\alpha+\beta}{\alpha-\beta}$ (c) $\frac{\alpha^2+\beta^2}{2\alpha\beta}$ (d) $\frac{\beta}{\alpha}$

24. Five cells each of emf E and internal resistance r send the same amount of current through an external resistance R whether the cells are connected in parallel or in series. Then the ratio $\left(\frac{R}{r}\right)$ is

(a) 2 (b) $\frac{1}{2}$ (c) $\frac{1}{5}$ (d) 1

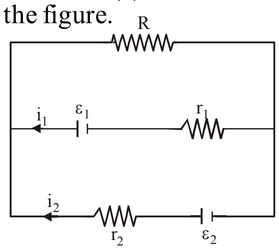
25. The length of a given cylindrical wire is increased by 100%. Due to the consequent decrease in diameter the change in the resistance of the wire will be

(a) 200% (b) 100% (c) 50% (d) 300%

26. Potentiometer wire of length 1 m is connected in series with 490Ω resistance and 2 V 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

27. See the electric circuit shown in the figure. Which of the following equations is a correct equation for it?



(a) $\varepsilon_2 - i_2 r_2 - \varepsilon_1 - i_1 r_1 = 0$
(b) $-\varepsilon_2 - (i_1+i_2)R + i_2 r_2 = 0$
(c) $\varepsilon_1 - (i_1+i_2)R + i_1 r_1 = 0$
(d) $\varepsilon_1 - (i_1+i_2)R - i_1 r_1 = 0$

28. In a large building, there are 15 bulbs of 40 W, 5 bulbs of 100 W, 5 fans of 80 W and 1 heater of 1 kW. The voltage of electric mains is 220 V. The minimum capacity of the main fuse of the building will be:

(a) 8 A (b) 10 A (c) 12 A (d) 14 A

29. Two sources of equal emf are connected to an external resistance R. The internal resistance of the two sources are R_1 and R_2 ($R_1 > R_1$). If the potential difference across the source having internal resistance R_2 is zero, then

(a) $R = R_2 - R_1$
(b) $R = R_2 \times (R_1 + R_2)/(R_2 - R_1)$
(c) $R = R_1R_2/(R_2 - R_1)$
(d) $R = R_1R_2/(R_1 - R_2)$

30. The resistance of the series combination of two resistances is S. when they are joined in parallel the total resistance is P. If $S = nP$ then the minimum possible value of n is

(a) 2 (b) 3 (c) 4 (d) 1

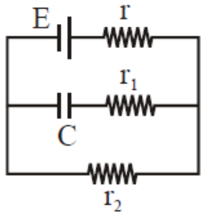
31. If an ammeter is to be used in place of a voltmeter, then we must connect with the ammeter a

(a) low resistance in parallel
(b) high resistance in parallel
(c) high resistance in series
(d) low resistance in series.

32. A d.c. main supply of e.m.f. 220 V is connected across a storage battery of e.m.f. 200 V through a resistance of 1Ω. The battery terminals are connected to an external resistance 'R'. The minimum value of 'R', so that a current passes through the battery to charge it is:

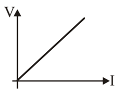
(a) 7 Ω (b) 9 Ω (c) 11 Ω (d) Zero

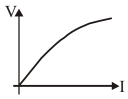
33. In the given circuit diagram when the current reaches steady state in the circuit, the charge on the capacitor of capacitance C will be :

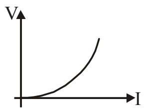


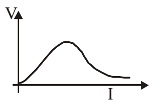
(a) $CE\frac{r_2}{(r+r_2)}$
(b) $CE\frac{r_1}{(r_1+r)}$
(c) $CE\frac{r_2}{(r+r_1)}$
(d) $CE\frac{r_1}{(r_2+r)}$

34. Suppose the drift velocity v_d in a material varied with the applied electric field E as $v_d \propto \sqrt{E}$. Then V – I graph for a wire made of such a material is best given by :

(a) 

(b) 

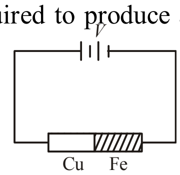
(c) 

(d) 

35. In a neon gas discharge tube Ne^+ ions moving through a cross-section of the tube each second to the right is 2.9 × 10^{18}, while 1.2 × 10^{18} electrons move towards left in the same time; the electronic charge being 1.6 × 10^{-19} C, the net electric current is

(a) 0.27 A to the right (b) 0.66 A to the right
(c) 0.66 A to the left (d) zero

36. Two rods are joined end to end, as shown. Both have a cross-sectional area of 0.01 cm^2. Each is 1 meter long. One rod is of copper with a resistivity of 1.7 × 10^{-6} ohm-centimeter, the other is of iron with a resistivity of 10^{-5} ohm-centimeter. How much voltage is required to produce a current of 1 ampere in the rods?



(a) 0.117 V
(b) 0.00145 V
(c) 0.0145 V
(d) 1.7 × 10^{-6} V

RESPONSE GRID					
	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ
	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ	28. ⓐⓑⓒⓓ	29. ⓐⓑⓒⓓ	30. ⓐⓑⓒⓓ
	31. ⓐⓑⓒⓓ	32. ⓐⓑⓒⓓ	33. ⓐⓑⓒⓓ	34. ⓐⓑⓒⓓ	35. ⓐⓑⓒⓓ
	36. ⓐⓑⓒⓓ				

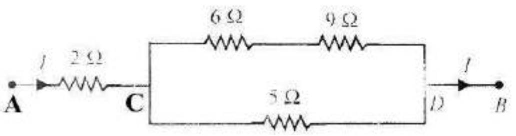
Space for Rough Work

37. An energy source will supply a constant current into the load if its internal resistance is
(a) very large as compared to the load resistance
(b) equal to the resistance of the load
(c) non-zero but less than the resistance of the load
(d) zero

38. The resistance of a wire at room temperature 30°C is found to be 10 Ω. Now to increase the resistance by 10%, the temperature of the wire must be [The temperature coefficient of resistance of the material of the wire is 0.002 per °C]
(a) 36°C (b) 83°C
(c) 63°C (d) 33°C

39. If current flowing in a conductor changes by 1% then power consumed will change by
(a) 10% (b) 2% (c) 1% (d) 100%

40. In the circuit shown in figure, the 5Ω resistance develops 20.00 cal/s due to the current flowing through it. The heat developed in 2 Ω resistance (in cal/s) is



(a) 23.8 (b) 14.2 (c) 11.9 (d) 7.1

41. In a Wheatstone's bridge, three resistances P, Q and R connected in the three arms and the fourth arm is formed by two resistances S_1 and S_2 connected in parallel. The condition for the bridge to be balanced will be
(a) $\frac{P}{Q}=\frac{2R}{S_1+S_2}$ (b) $\frac{P}{Q}=\frac{R(S_1+S_2)}{S_1S_2}$
(c) $\frac{P}{Q}=\frac{R(S_1+S_2)}{2S_1S_2}$ (d) $\frac{P}{Q}=\frac{R}{S_1+S_2}$

42. The electric resistance of a certain wire of iron is R. If its length and radius are both doubled, then
(a) the resistance and the specific resistance, will both remain unchanged
(b) the resistance will be doubled and the specific resistance will be halved
(c) the resistance will be halved and the specific resistance will remain unchanged
(d) the resistance will be halved and the specific resistance will be doubled

43. A car battery has e.m.f. 12 volt and internal resistance 5×10^{-2} ohm. If it draws 60 amp current, the terminal voltage of the battery will be
(a) 15 volt (b) 3 volt (c) 5 volt (d) 9 volt

44. A conducting wire of cross-sectional area 1 cm^2 has 3×10^{23} charge carriers per m^3. If wire carries a current of 24 mA, then drift velocity of carriers is
(a) 5×10^{-2} m/s (b) 0.5 m/s
(c) 5×10^{-3} m/s (d) 5×10^{-6} m/s

45. In the series combination of n cells each cell having emf ε and internal resistance r. If three cells are wrongly connected, then total emf and internal resistance of this combination will be
(a) $n\varepsilon, (nr - 3r)$ (b) $(n\varepsilon - 2\varepsilon)\ nr$
(c) $(n\varepsilon - 4\varepsilon), nr$ (d) $(n\varepsilon - 6\varepsilon), nr$

RESPONSE GRID					
	37. ⓐⓑⓒⓓ	38. ⓐⓑⓒⓓ	39. ⓐⓑⓒⓓ	40. ⓐⓑⓒⓓ	41. ⓐⓑⓒⓓ
	42. ⓐⓑⓒⓓ	43. ⓐⓑⓒⓓ	44. ⓐⓑⓒⓓ	45. ⓐⓑⓒⓓ	

DAILY PRACTICE PROBLEM DPP CHAPTERWISE CP17 - PHYSICS			
Total Questions	45	Total Marks	180
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	45	Qualifying Score	60
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

DAILY PRACTICE PROBLEMS

PHYSICS SOLUTIONS

DPP/CP17

1. **(b)** $V = IR = (neAv_d)\rho\frac{\ell}{A}$

$\therefore \quad \rho = \frac{V}{V_d lne}$

Here V = potential difference

l = length of wire

n = no. of electrons per unit volume of conductor.

e = no. of electrons

Placing the value of above parameters we get resistivity

$\rho = \frac{5}{8\times10^{28}\times1.6\times10^{-19}\times2.5\times10^{-4}\times0.1}$

$= 1.6\times10^{-5}\Omega m$

2. **(d)** From the curve it is clear that slopes at points A, B, C, D have following order $A > B > C > D$.

And also resistance at any point equals to slope of the V-i curve.

So order of resistance at three points will be

$R_A > R_B > R_C > R_D$

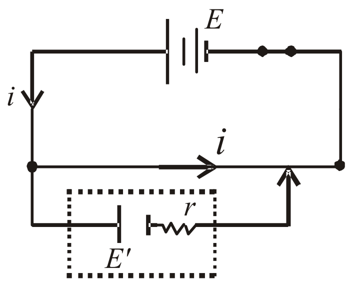
3. **(d)** From the principle of potentiometer, $V \propto l$

$\Rightarrow \frac{V}{E} = \frac{l}{L}$; where

V = emf of battery, E = emf of standard cell.

L = length of potentiometer wire

$V = \frac{El}{L} = \frac{30E}{100}$



NOTE In this arrangement, the internal resistance of the battery E does not play any role as current is not passing through the battery.

4. **(d)** $R = \frac{\rho l}{\pi r^2}$. But $m = \pi r^2\, ld \therefore \pi r^2 = \frac{m}{ld}$

$\therefore R = \frac{\rho l^2 d}{m}$, $R_1 = \frac{\rho l_1{}^2 d}{m_1}$, $R_2 = \frac{\rho l_2{}^2 d}{m_2}$

$R_3 = \frac{\rho l_3{}^2 d}{m_3}$

$R_1 : R_2 : R_3 = \frac{l_1^2}{m_1} : \frac{l_2^2}{m_2} : \frac{l_3^2}{m_3}$

$R_1 : R_2 : R_3 = \frac{25}{1} : \frac{9}{3} : \frac{1}{5} = 125 : 15 : 1$

5. **(c)** In series, $R_s = nR$

In parallel, $\frac{1}{R_p} = \frac{1}{R} + \frac{1}{R} + \ldots n$ terms

$\therefore R_s/R_p = n^2/1 = n^2$

6. **(a)** Efficiency is given by $\eta = \frac{\text{output}}{\text{input}}$

$= \frac{5\times15\times14}{10\times8\times15} = 0.875$ or $87.5\,\%$

7. **(b)** According to the condition of balancing

$\frac{55}{20} = \frac{R}{80} \Rightarrow R = 220\Omega$

8. **(a)** $J = \sigma E \Rightarrow J\rho = E$

J is current density, E is electric field

so B = ρ = resistivity.

9. **(d)** Kirchhoff's first law is based on conservation of charge and Kirchhoff's second law is based on conservation of energy.

10. **(c)** $R = \frac{\rho\ell}{A}$

When wire is cut into 4 pieces and connected in parallel.

$R_{eff.} = \frac{R}{16} \Rightarrow P_C = 16P$

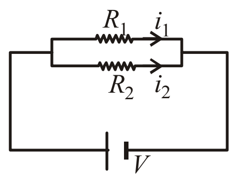
$P_A : P_B : P_C : P_D = \frac{V^2}{R} : \frac{V^2}{R/4} : \frac{V^2}{R/16} : \frac{V^2}{R/2}$

11. **(b)** $S = \frac{I_g R}{nI_g - I_g} \Rightarrow S = \frac{I_g}{(n-1)I_g}R$

12. **(d)** Resistance of a conductor, $R = \frac{m}{ne^2\tau}\frac{l}{A}$

As the temperature increases, the relaxation time τ decreases because the number of collisions of electrons per second increases due to increase in thermal energy of electrons.

13. **(b)**



$R_1 = \frac{\rho \ell_1}{\pi r_1^2}$; $R_2 = \frac{\rho \ell_2}{\pi r_2^2}$

$i_1 R_1 = i_2 R_2$ (same potential difference)

$\therefore \frac{i_1}{i_2} = \frac{R_2}{R_1} = \frac{\ell_2}{\ell_1} \times \frac{r_1^2}{r_2^2} = \frac{3}{4} \times \frac{4}{9} = \frac{1}{3}$

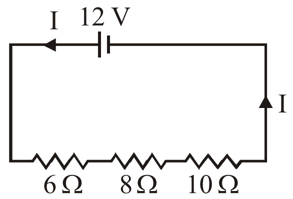
14. **(c)** $\frac{R_1}{R_2} = \frac{\ell_1}{\ell_2}$ where $\ell_2 = 100 - \ell_1$

In the first case $\frac{X}{Y} = \frac{20}{80}$

In the second case

$\frac{4X}{Y} = \frac{\ell}{100 - \ell} \Rightarrow \ell = 50$

15. **(c)** Before connecting E, the circuit diagram is



Then, $R_{eq} = 6\,\Omega + 8\,\Omega + 10\,\Omega = 24\,\Omega$

Current in the 8 Ω resistance, $I = \frac{12\text{V}}{24\Omega} = \frac{1}{2}\text{A}$

After connecting E, the current through 8 Ω is

$I = \frac{1}{2}\text{A}$

$\therefore \quad E = \frac{1}{2}\text{A} \times 8\Omega = 4\text{V}$

16. **(d)** By junction rule at point B

$-I + 1A + 2A = 0$

So, $I = 3A$

By Loop rule,

$-3 \times 2 - 1 \times 1 - E + 12 = 0$

$E = 5V$

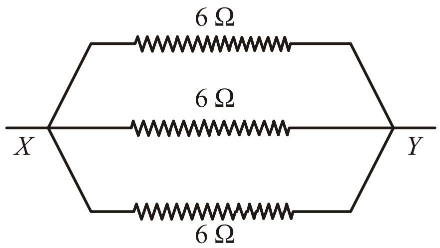
17. **(d)** Resistance of bulb $R_b = \frac{(1.5)^2}{4.5} = 0.5\Omega$

Current drawn from battery $= \frac{E}{2.67 + 0.33} = \frac{E}{3}$

Share of bulb $= \frac{2}{3} \times \frac{E}{3} = \frac{2E}{9}$

$\therefore \left(\frac{2E}{9}\right)^2 \times 0.5 = 4.5$ or $E = 13.5$ V.

18. **(d)** The equivalent circuit is given below :



The equivalent resistance is given by

$\frac{1}{R} = \frac{1}{6} + \frac{1}{6} + \frac{1}{6} = \frac{3}{6} = \frac{1}{2}$

$\Rightarrow R_{eq} = 2\Omega$

19. **(a)** Since average drift velocity $= \frac{1}{2}\frac{eE}{m} \times (\tau)$

Now I = NeA × (avg. drift velocity)

$= \frac{Ne^2AE}{2m\ell} \times \tau = \frac{Ne^2AV}{2m\ell} \times \tau$

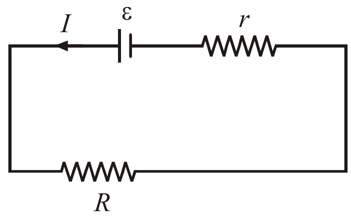
$R = \frac{V}{I} = \frac{2m\ell}{Ne^2\tau A}$, where N is electron density.

20. **(c)** The current through the resistance R

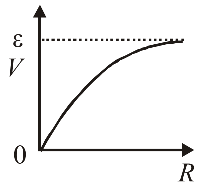
$I = \left(\frac{\varepsilon}{R + r}\right)$

The potential difference across R

$V = IR = \left(\frac{\varepsilon}{R + r}\right) R$



$V = \frac{\varepsilon}{\left(1 + \frac{r}{R}\right)}$



when $R = 0$, $V = 0$,

$R = \infty$, $v = \varepsilon$

Thus V increases as R increases upto certain limit, but it does not increase further.

21. **(c)** Resistance of bulb is constant

$P = \frac{V^2}{R} \Rightarrow \frac{\Delta p}{p} = \frac{2\Delta V}{V} + \frac{\Delta R}{R}$

$\frac{\Delta p}{p} = 2 \times 2.5 + 0 = 5\%$

22. **(a)** Potential gradient = Potential fall per unit length. In this case resistance of unit length.

$R = \frac{\rho l}{A} = \frac{10^{-7} \times 1}{10^{-6}} = 10^{-1}\Omega$

Potential fall across R is

$V = I.R = 0.1 \times 10^{-1} = 0.01$ volt/m.

$= 10^{-2}$ volt / m

23. **(d)** $R_1 + R_2$ = Constant, R_1 will increase, R_2 will decrease.

$R_1\alpha\Delta T - R\beta\Delta T = 0 \Rightarrow R_1\alpha\Delta T = R_2\beta\Delta T$

$\therefore \frac{R_1}{R_2} = \frac{\beta}{\alpha}$

24. (d) Given : Number of cells, $n = 5$, emf of each cell $= E$

Internal resistance of each cell $= r$

In series, current through resistance R

$$I = \frac{nE}{nr + R} = \frac{5E}{5r + R}$$

In parallel, current through resistance R

$$I' = \frac{E}{\frac{r}{n} + R} = \frac{nE}{r + nR} = \frac{5E}{r + 5R}$$

According to question, $I = I'$

$$\therefore \frac{5E}{5r + 5R} = \frac{5E}{r + 5R} \Rightarrow 5r + R = r + 5R$$

or $R = r$ $\quad \therefore \frac{R}{r} = 1$

25. (d) The total volume remains the same before and after stretching.

Therefore $A \times \ell = A' \times \ell'$

Here $\ell' = 2\ell$

$$\therefore A' = \frac{A \times \ell}{\ell'} = \frac{A \times \ell}{2\ell} = \frac{A}{2}$$

Percentage change in resistance

$$= \frac{R_f - R_i}{R_i} \times 100 = \frac{\rho\left(\frac{\ell'}{A'} - \frac{\ell}{A}\right)}{\rho \frac{\ell}{A}} \times 100$$

$$= \left[\left(\frac{\ell'}{A'} \times \frac{A}{\ell}\right) - 1\right] \times 100 = \left[\left(\frac{2\ell}{A/2} \times \frac{A}{\ell}\right) - 1\right] \times 100$$

$= 300\%$

26. (a) Pot. gradient $= 0.2$ mV/cm

$$= \frac{0.2 \times 10^{-3}}{10^{-2}} = 2 \times 10^{-2} \text{ V/m}$$

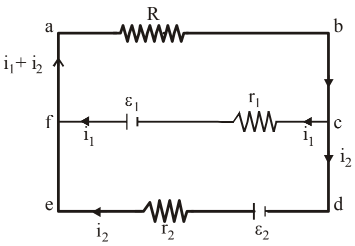
Emf of cell $= 2 \times 10^{-2} \times 1\text{m} = 2 \times 10^{-2}\text{ V} = 0.02$ V

As per the condition of potentiometer

$0.02\,(R + 490) = 2\,(R)$ or $1.98\,R = 9.8$

$$\Rightarrow \quad R = \frac{9.8}{1.98} = 4.9\ \Omega$$

27. (d)



Applying Kirchhoff's rule in loop **abcfa**

$\varepsilon_1 - (i_1 + i_2)R - i_1 r_1 = 0.$

28. (c) Total power consumed by electrical appliances in the building, $P_{total} = 2500$W

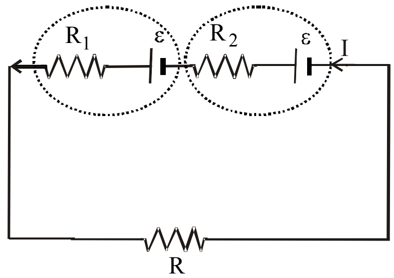
Watt = Volt × ampere

$\Rightarrow 2500 = V \times I \Rightarrow 2500 = 220\,I$

$$\Rightarrow \quad I = \frac{2500}{220} = 11.36 \approx 12\text{A}$$

(Minimum capacity of main fuse)

29. (a)



$$I = \frac{2\varepsilon}{R + R_1 + R_2}$$

Potential difference across second cell

$= V = \varepsilon - iR_2 = 0$

$$\varepsilon - \frac{2\varepsilon}{R + R_1 + R_2}.R_2 = 0$$

$R + R_1 + R_2 - 2R_2 = 0$

$R + R_1 - R_2 = 0$

$\therefore R = R_2 - R_1$

30. (c)

Resistance of the series combination,

$S = R_1 + R_2$

Resistance of the parallel combination,

$$P = \frac{R_1 R_2}{R_1 + R_2}$$

$$S = nP \Rightarrow R_1 + R_2 = \frac{n(R_1 R_2)}{(R_1 + R_2)}$$

$\Rightarrow (R_1 + R_2)^2 = nR_1R_2$

Minimum value of n is 4 for that

$(R_1 + R_2)^2 = 4R_1R_2 \Rightarrow (R_1 - R_2)^2 = 0$

31. (c) To convert a galvanometer into a voltmeter we connect a high resistance in series with the galvanometer.

The same procedure needs to be done if ammeter is to be used as a voltmeter.

32. (c) Given, emf of cell $E = 200$ V

Internal resistance of cells $= 1\ \Omega$

D. C. main supply voltage $V = 220$ V

External resistance $R = ?$

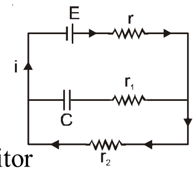
$$r = \left(\frac{E - V}{V}\right) R$$

$$1 = \left(\frac{20}{220}\right) \times R$$

$\therefore \quad R = 11\ \Omega.$

33. (a) In steady state, flow fo current through capacitor will be zero.

Current through the circuit,



$$i = \frac{E}{r + r_2}$$

Potential difference through capacitor

$$V_c = \frac{Q}{C} = E - ir = E - \left(\frac{E}{r + r_2}\right) r$$

$$\therefore \quad Q = CE \frac{r_2}{r + r_2}$$

34. (c) $i = neAV_d$ and $V_d \propto \sqrt{E}$ (Given)

or, $i \propto \sqrt{E}$

$i^2 \propto E$

$i^2 \propto V$

Hence graph (c) correctly dipicts the *V-I* graph for a wire made of such type of material.

35. (b) Current, $I = (2.9 \times 10^{18} + 1.2 \times 10^{18}) \times 1.6 \times 10^{-19}$

$= 0.66$A towards right.

36. (a) Copper rod and iron rod are joined in series.

$$\therefore R = R_{Cu} + R_{Fe} = (\rho_1 + \rho_2) \frac{\ell}{A}$$

$$\left(\because R = \rho \frac{\ell}{A}\right)$$

From ohm's law $V = RI$

$= (1.7 \times 10^{-6} \times 10^{-2} + 10^{-5} \times 10^{-2}) \div 0.01 \times 10^{-4}$ volt

$= 0.117$ volt ($\because I = 1$A)

37. (d) $I = \frac{E}{R + r}$, Internal resistance (r) is zero, $I = \frac{E}{R}$ = constant.

38. (b) $R_t = R_0(1 + \alpha t)$

Initially, $R_0(1 + 30\alpha) = 10\,\Omega$

Finally, $R_0(1 + \alpha t) = 11\,\Omega$

$$\therefore \frac{11}{10} = \frac{1 + \alpha t}{1 + 30\alpha}$$

or, $10 + (10 \times 0.002 \times t) = 11 + 330 \times 0.002$

or, $0.02t = 1 + 0.66 = 1.066$ or $t = \frac{1.66}{0.02} = 83°C$.

39. (b) As $P = I^2 R$, so $P_1 = (1.01\ I)^2 R = 1.02 I^2 R = 1.02 P$.

It means % increase in power

$$= \left(\frac{P_1}{P} - 1\right) \times 100 = 2\%.$$

40. (b) Let I_1 be the current throug 5 Ω resistance, I_2 through (6 + 9) Ω resistance. Then as per question,

$I_1^2 \times 5 = 20$ or, $I_1 = 2$A.

Potential difference across C and D = 2 × 5 = 10V

Current $I_2 = \frac{10}{6+9} = \frac{2}{3}$A.

Heat produced per second in 2 Ω

$$= I^2 R \left(\frac{8}{3}\right)^2 \times 2 = 14.2 \text{ cal/s}.$$

41. (b) $\frac{P}{Q} = \frac{R}{S}$ where $S = \frac{S_1 S_2}{S_1 + S_2}$

42. (c) $R = \frac{\rho \ell_1}{A_1}$, now $\ell_2 = 2\ell_1$

$A_2 = \pi(r_2)^2 = \pi(2r_1)^2 = 4\pi r_1^2 = 4A_1$

$$\therefore \quad R_2 = \frac{\rho(2\ell_1)}{4A_1} = \frac{\rho \ell_1}{2A_1} = \frac{R}{2}$$

∴ Resistance is halved, but specific resistance remains the same.

43. (d) $E = V + Ir$

$V = 12 - 3 = 9$ volt

44. (c) $I = neAV_d$

$$V_d = \frac{I}{neA} = 5 \times 10^{-3} \text{ m/sec}$$

45. (d) Since due to wrong connection of each cell the total emf reduced to 2ε then for wrong connection of three cells the total emf will reduced to ($n\varepsilon - 6\varepsilon$) whereas the total or equivalent resistance of cell combination will be *nr*.