PHYSICS

Current Electricity

Speed TEST 17

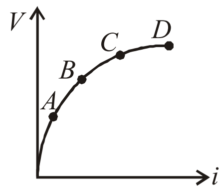
Chapter-wise

No. of Questions	Maximum Marks	Time
30	120	1 Hour

GENERAL INSTRUCTIONS

- This test contains 30 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 solutions provided at the end of this book.
- 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.
- 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.

1. 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



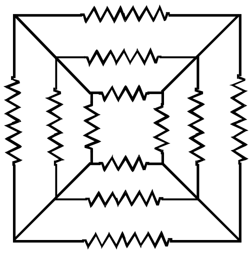
(a) $R_C = R_D$

(b) $R_B > R_A$

(c) $R_C > R_B$

(d) $R_A > R_B$

2. Twelve resistors each of resistance $16\,\Omega$ are connected in the circuit as shown. The net resistance between AB is



(a) $1\,\Omega$

(b) $2\,\Omega$

(c) $3\,\Omega$

(d) $4\,\Omega$

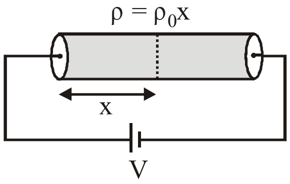
3. The masses of the three wires of copper are in the ratio of 1 : 3 : 5 and their lengths are in the ratio of 5 : 3 : 1. The ratio of their electrical resistance is

(a) 1 : 3 : 5 (b) 5 : 3 : 1

(c) 1 : 25 : 125 (d) 125 : 25 : 1

RESPONSE GRID 1. ⓐⓑⓒⓓ 2. ⓐⓑⓒⓓ 3. ⓐⓑⓒⓓ

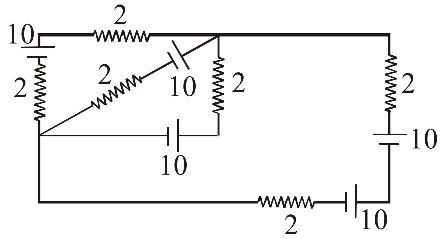
4. A cylindrical solid of length L and radius a is having varying resistivity given by $\rho = \rho_0 x$, where ρ_0 is a positive constant and x is measured from left end of solid. The cell shown in the figure is having emf V and negligible internal resistance. The electric field as a function of x is best described by



(a) $\frac{2V}{L^2}x$ (b) $\frac{2V}{\rho_0 L^2}x$

(c) $\frac{V}{L^2}x$ (d) None of these

5. All batteries are having emf 10 volt and internal resistance negligible. All resistors are in ohms. Calculate the current in the right most 2Ω resistor.



(a) $\frac{25}{12}$A (b) $\frac{25}{6}$A (c) $\frac{12}{25}$A (d) $\frac{6}{25}$A

6. 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) $1/n$

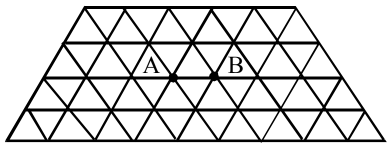
7. A battery is charged at a potential of 15V for 8 hours when the current flowing is 10A. The battery on discharge supplies a current of 5A for 15 hours. The mean terminal voltage during discharge is 14V. The "watt-hour" efficiency of the battery is

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

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

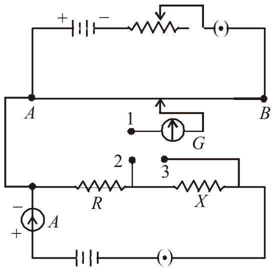
(a) When the coil is connected to the battery directly
(b) When the coil is divided into two equal parts and both the parts are connected to the battery in parallel
(c) When the coil is divided into four equal parts and all the four parts are connected to the battery in parallel
(d) When only half the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

9. There is an infinite wire grid with cells in the form of equilateral triangles. The resistance of each wire between neighbouring joint connections is R_0. The net resistance of the whole grid between the points A and B as shown is



(a) R_0 (b) $\frac{R_0}{2}$ (c) $\frac{R_0}{3}$ (d) $\frac{R_0}{4}$

10. A potentiometer circuit is set up as shown. The potential gradient, across the potentiometer wire, is k volt/cm and the ammeter, present in the circuit, reads 1.0 A when two way key is switched off. The balance points, when the key between the terminals (i) 1 and 2 (ii) 1 and 3, is plugged in, are found to be at lengths l_1 cm and l_2 cm respectively. The magnitudes, of the resistors R and X, in ohms, are then, equal, respectively, to



(a) $k(l_2 - l_1)$ and $k l_2$
(b) $k l_1$ and $k(l_2 - l_1)$
(c) $k(l_2 - l_1)$ and $k l_1$
(d) $k l_1$ and $k l_2$

11. 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%

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

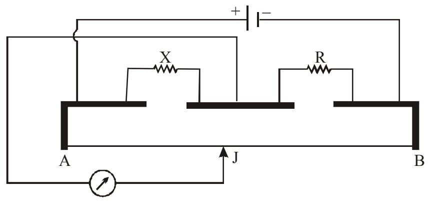
(a) $\frac{R}{n}$ (b) $\frac{R}{n-1}$ (c) $\frac{R}{n+1}$ (d) nR

13. 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

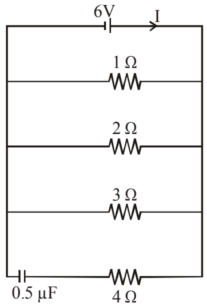
RESPONSE GRID					
	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ
	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ

14. The figure shows a meter-bridge circuit, $X = 12\Omega$ and $R = 18\Omega$. The jockey J is at the null point. If R is made 8Ω, through the jockey J have to be moved by $4 \times A$ cm to obtain null point again then find the value of A.



(a) 2 (b) 5 (c) 8 (d) 6

15. In the given circuit diagram the current through the battery and the charge on the capacitor respectively in steady state are



(a) 1 A and 3 μC

(b) 17 A and 0 μC

(c) $\frac{6}{7}$ A and $\frac{12}{7}$ μC

(d) 11A and 3 μC

16. 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%

17. Drift velocity V_d varies with the intensity of electric field as per the relation

(a) $V_d \propto E$ (b) $V_d \propto \frac{1}{E}$

(c) V_d = constant (d) $V_d \propto E^2$

18. Product of conductivity and resistivity of a metallic conductor depends on

(a) Area of cross-section (b) Temperature

(c) Pressure (d) None of these

19. 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

20 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) $\frac{30E}{100.5}$ (b) $\frac{30E}{(100-0.5)}$

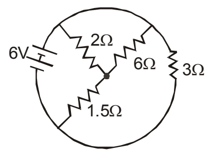
(c) $\frac{30(E-0.5i)}{100}$ (d) $\frac{30E}{100}$

where i is the current in the potentiometer wire.

21. If current flowing in a conductor changes by 1% then power consumed will change by

(a) 10% (b) 2% (c) 1% (d) 100%

22. The total current supplied to the circuit by the battery is



(a) 4 A

(b) 2 A

(c) 1 A

(d) 6 A

23. The e.m.f. developed in a thermo-couple is given by

$$E = \alpha T + \frac{1}{2}\beta T^2$$

where T is the temperature of hot junction, cold junction being at 0ºC. The thermo electric power of the couple is

(a) $\alpha + \frac{\beta}{2}T$ (b) $\alpha + \beta T$

(c) $\frac{\alpha T^2}{2} + \frac{\beta T^3}{6}$ (d) $\alpha / 2\beta$

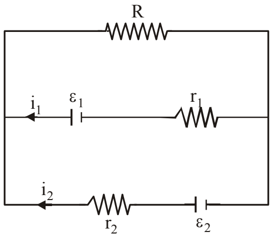
24. To get maximum current in a resistance of 3 ohms, one can use n rows of m cells (connected in series) connected in parallel. If the total number of cells is 24 and the internal resistance of a cell is 0.5 ohms then

(a) m = 12, n = 2 (b) m = 8, n = 3

(c) m = 2, n = 12 (d) m = 6, n = 4

RESPONSE GRID					
	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ
	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ
	24. ⓐⓑⓒⓓ				

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

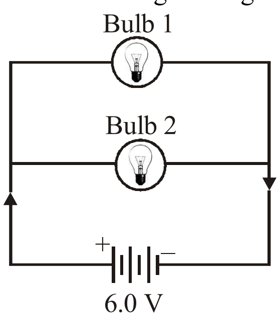


(a) $\varepsilon_2 - i_2 r_2 - \varepsilon_1 - i_1 r_1 = 0$
(b) $-\varepsilon_2 - (i_1 + i_2)R + i_2 r_2 = 0$
(c) $\varepsilon_1 - (i_1 + i_2)R + i_1 r_1 = 0$
(d) $\varepsilon_1 - (i_1 + i_2)R - i_1 r_1 = 0$

26. 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

27. A 6.0 volt battery is connected to two light bulbs as shown in figure. Light bulb 1 has resistance 3 ohm while light bulb 2 has resistance 6 ohm. Battery has negligible internal resistance. Which bulb will glow brighter?

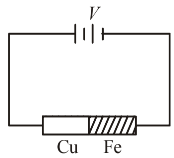


(a) Bulb 1 will glow more first and then its brightness will become less than bulb 2
(b) Bulb 1
(c) Bulb 2
(d) Both glow equally

28. 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\

29. 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

30. 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) $R = R_1 R_2/(R_2 - R_1)$
(d) $R = R_1 R_2/(R_1 - R_2)$

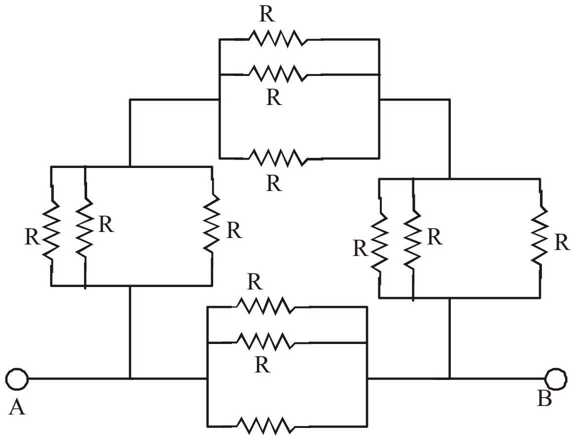
RESPONSE GRID	**25.** ⓐⓑⓒⓓ **26.** ⓐⓑⓒⓓ **27.** ⓐⓑⓒⓓ **28.** ⓐⓑⓒⓓ **29.** ⓐⓑⓒⓓ **30.** ⓐⓑⓒⓓ

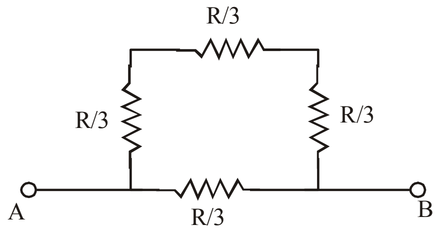
PHYSICS CHAPTERWISE SPEED TEST-17			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	40	Qualifying Score	50
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Speed Test-17

1. **(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
$R_A > R_B > R_C > R_D$

2. **(d)**





$$R_{net} \text{ between AB} = \frac{\frac{3R}{3} \times \frac{R}{3}}{\frac{3R}{3} + \frac{R}{3}} = \frac{R^2}{4R} = 4\Omega$$

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

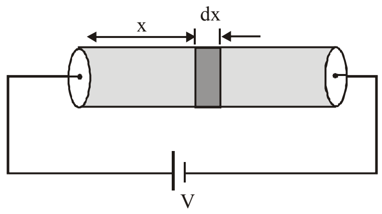
$$\therefore R = \frac{\rho l^2 d}{m}, \; R_1 = \frac{\rho l_1^2 d}{m_1}, \; R_2 = \frac{\rho l_2^2 d}{m_2}$$

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

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

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

4. **(a)**



Resistance of this elemental part is,

$$dR = \frac{\rho dx}{\pi a^2} = \frac{\rho_0 x dx}{\pi a^2}$$

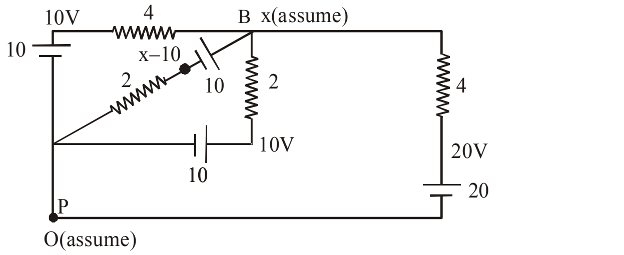
$$R = \int dR = \int_0^L \frac{\rho_0 x dx}{\pi a^2} = \frac{\rho_0 L^2}{2\pi a^2}$$

Current through cylinder is, $I = \frac{V}{R} = \frac{V \times 2\pi a^2}{\rho_0 L^2}$

Potential drop across element is, $dV = I\,dR = \frac{2V}{L^2} x\,dx$

$$E(x) = \frac{dV}{dx} = \frac{2V}{L^2} x$$

5. **(a)** The simplified circuit is



We have to find I.
Let potential of point P be 0. Potential at other points are shown in the figure apply Kirchoff's current law at B where potential is assume to be x volt.

$$\frac{x-10}{4} + \frac{x-10}{2} + \frac{x-20}{4} + \frac{(x-10)-0}{2} = 0$$
$$\Rightarrow x - 10 + 2x - 20 + x - 20 + 2x - 20 = 0$$

$$\Rightarrow 6x = 70 \Rightarrow x = \frac{35}{3} \text{ volt}$$

$$\therefore \; I = \frac{20 - \frac{35}{3}}{4} = \frac{25}{12} A$$

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

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

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

$= \frac{5 \times 15 \times 14}{10 \times 8 \times 15} = 0.875 \text{ or } 87.5\,\%$

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

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

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

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

9. **(c)** By principle of symmetry and superposition,

$2 \times \frac{I}{6} \times R_0 = I\, R_{eq.} \Rightarrow R_{eq.} = \frac{R_0}{3}$

(Current $\frac{I}{6}$ in AB is due to division in current entering at A and current $\frac{I}{6}$ is due to current returning from infinity of grid).

10. **(b)** (i) When key between the terminals 1 and 2 is plugged in,

P.D. across $R = IR = k\,l_1$

$\Rightarrow R = k\,l_1$ as $I = 1A$

(ii) When key between terminals 1 and 3 is plugged in,

P.D. across $(X + R) = I(X + R) = k\,l_2$

$\Rightarrow X + R = k\,l_2$

$\therefore X = k\,(l_2 - l_1)$

$\therefore R = kl_1$ and $X = k\,(l_2 - l_1)$

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

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

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

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

13. **(c)** $I = neAV_d$

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

14. **(b)** If ℓ_1 = length from one end then $\frac{\ell_1}{1 - \ell_1} = \frac{X}{R} = \frac{12}{18}$

$\ell_1 = \frac{12}{30}\text{m} = 40\text{cm}.$

and ℓ'_1 = length from one end in second case

$\frac{\ell'_1}{1 - \ell'_1} = \frac{X}{R'} = \frac{12}{8}$

$\ell'_1 = \frac{12}{20}\text{m} =$

15. **(d)** In steady state capacitor is fully charged and no current flows through it.

$\frac{1}{R_{eq}} = \frac{1}{1} + \frac{1}{2} + \frac{1}{3} = \frac{6+3+2}{6} = \frac{11}{6} \Rightarrow R_{eq} = \frac{6}{11}\Omega$

Current through battery $= \frac{6 \times 11}{6} = 11\text{A}$

$Q = CV = 0.5 \times 10^{-6} \times 6 = 3.0 \times 10^{-6}\,C = 3\mu C$

16. **(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

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

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

$= 300\%$

17. **(a)** $V_d = \frac{e}{m} \times \frac{V}{\ell}\tau$ or, $V_d = \frac{e}{m} . \frac{E\ell}{\ell}\tau$ $[\because V = E\,\ell]$

$\therefore V_d \propto E$

18. **(d)** $\rho \times \sigma = 1$ = constant

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

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

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

$\therefore$ Resistance is halved, but specific resistance remains the same.

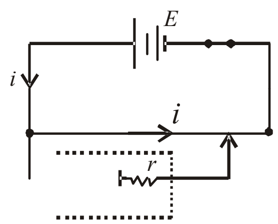
20. **(d)** From the principle of potentiometer, $V \propto l$

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

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

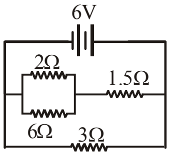
L = length of potentiometer wire

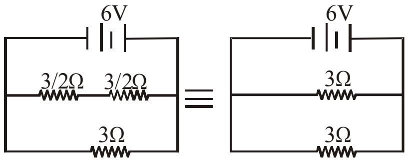
$V = \frac{El}{L} = \frac{30E}{100}$



21. **(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
$$= \left(\frac{P_1}{P} - 1\right) \times 100 = 2\%.$$

22. **(a)**





hence $R_{eq} = 3/2$; $\therefore I = \dfrac{6}{3/2} = 4A$

23. **(b)** Thermo-electric power $S = \dfrac{dE}{dT} = \alpha + \beta T$

24. **(a)** Let, we connect 24 cells in n rows of m cells, then if I is the current in external circuit then

$$I = \frac{mE}{mr/n + R} \qquad ...(1)$$

For I to be maximum, (mr + nR) should be minimum.

It is minimum for $R = \dfrac{mr}{n}$ ...(2)

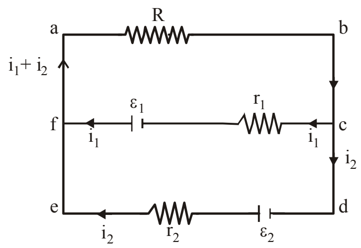
So maximum current in external circuit is

$$I = \frac{mE}{2R} \qquad ...(3)$$

here R = 3, r = 0.5 so equation (2) become $\dfrac{m}{n} = 6$

so n = 2, m = 12

25. **(d)**



Applying Kirchhoff 's rule in loop **abcfa**
$\varepsilon_1 - (i_1 + i_2) R - i_1 r_1 = 0.$

26. **(b)** Current, $I = (2.9 \times 10^{18} + 1.2 \times 10^{18}) \times 1.6 \times 10^{-19}$
= 0.66A towards right.

27. **(b)** Total resistance $= \dfrac{6 \times 3}{6+3} = 2\Omega$

Current in circuit $= \dfrac{6}{2} = 3A$

Therefore current through bulb 1 is $2A$ and bulb 2 is $1A$. So bulb 1 will glow more

28. **(d)** $E = V + Ir$
$V = 12 - 3 = 9$ volt

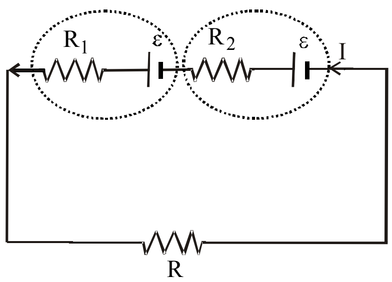
29. **(a)** Copper rod and iron rod are joined in series.

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

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

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 $(\because I = 1A)$

30. **(a)**



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

Potential difference across second cell
$= V = \varepsilon - iR_2 = 0$

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

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

$$R + R_1 - R_2 = 0$$

$$\therefore R = R_2 - R_1$$