Explanations

1. (c) Semiconductor has negative temperature coefficient of resistivity which means that their resistance decreases with rise in temperature.

2. (a) Given, $V = 200$ V, $R = 100\Omega$ and $t = 1$s

By Ohm's law $V = IR$

$$\Rightarrow \quad I = \frac{V}{R} = \frac{200}{100} = 2\text{A}$$

$$\therefore \quad I = \frac{q}{t} = \frac{ne}{t}$$

$$\Rightarrow \quad n = \frac{It}{e} = \frac{2\times1}{1.6\times10^{-19}} = 1.25\times10^{19}$$

3. (b) The resistance of a wire of length l and cross-sectional area A is

$$R = \rho \frac{l}{A} = \frac{l}{\sigma A}$$

where, σ = conductivity $= \frac{ne^2\tau}{m}$

$$\therefore \quad R = \frac{l}{(ne^2\tau / m)A} = \frac{ml}{ne^2\tau A}$$

4. (d) Kirchhoff's first rule, $\Sigma I = 0$ and second rule, $\Sigma IR = \Sigma E$ respectively are based on conservation of charge and conservation of energy.

5. (c)In a DC circuit the direction of current inside the battery is from negative to positive terminal, while that outside the battery is from positive to negative terminal of the battery.

6. (a) Given, $V = 12\text{V}$, $U = 7.2 \times 10^5$ J

The energy stored in a battery , $U = QV$

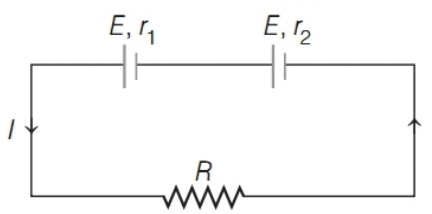
$$\Rightarrow \quad Q = \frac{U}{V} = \frac{7.2 \times 10^5}{12} = 6 \times 10^4 \text{C}$$

7. (b) Since, sources are in series

$\therefore$ Net emf, $E_{\text{net}} = E + E = 2E$

$\therefore$ Net resistance, $R_{\text{net}} = R + r_1 + r_2$

$\therefore$ Current in the circuit, $I = \frac{E_{\text{net}}}{R_{\text{net}}} = \frac{2E}{R + r_1 + r_2}$



Since, potential difference across the source of resistance r_1 is zero.

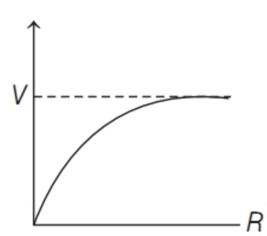
$$\therefore \quad E - Ir_2 = 0$$

$$\Rightarrow E - \frac{2Er_2}{R + r_1 + r_2} = 0 \Rightarrow R + r_1 - r_2 = 0$$

or $\quad R = r_2 - r_1$

8. (b) The graphical relationship between voltage V and the resistance R is given below

$$\left[\because V = \frac{E}{1 + r/R}\right]$$



9. (a) Given, power of bulb, $P = 100$ W

Voltage rating of bulb, $V_R = 220$ V

$\therefore$ Resistance of bulb, $R = \frac{V_R^2}{P} = \frac{(220)^2}{100} = 484\Omega$

When, $V = 110$ V, then power consumed,

$$P = \frac{V^2}{R} = \frac{(110)^2}{484} = 25\text{W}$$

10. (b) As, mobility $= \frac{\text{drift velocity}}{\text{electric field}}$

$$\Rightarrow \quad \mu = \frac{v_d}{E} = \frac{v_d}{\frac{V}{d}} = \frac{v_d\, d}{\left(\frac{W}{q}\right)}$$

$$= \frac{v_d\, dq}{W} = \frac{[\text{LT}^{-1}\text{LAT}]}{[\text{ML}^2\text{T}^{-2}]}$$

$$= [\text{M}^{-1}\text{AT}^2]$$

11. (a) The temperature coefficient of resistance of an alloy used for making resistors is small and positive.

12. (a) As, $\quad V = IR \quad \Rightarrow \quad I = \frac{V}{R} = \frac{220}{100 \times 10^3}$

$$\Rightarrow \quad I = 2.2 \times 10^{-3} \text{ A} = 2.2 \text{ mA}$$

13. (d) The current $= \frac{\text{net emf}}{\text{net resistance}}$

$$\Rightarrow \quad I = \frac{2 + 2 + 2}{1 + 1 + 1 + 2} = \frac{6}{5} = 1.2 \text{ A}$$

14. (a) From Kirchhoff's first law, in an electric circuit, the algebraic sum of the currents meeting at any junction is zero.

i.e. $\quad \Sigma i = 0$

Taking inward direction of current as positive and outward as negative, we have

$$1 \text{ A} - 3 \text{ A} - 2 \text{ A} + I = 0$$

$$\Rightarrow \quad I = 4 \text{ A}$$

15. (a) With increase in temperature, average speed of the electrons, which acts as the carriers of current increases, resulting in more frequent collisions.

Thus, the average time of collisions τ decreases with increasing temperature.

16. (a) Charge carriers do not move with acceleration but can move with a steady drift velocity.

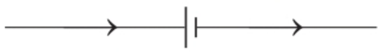
This is because of the collisions with ions and atoms during transit.

17. (d) During charging of battery,

$$V = E + iR$$

i.e. $\quad V > E$

18. (d) Current through a resistance wire flows from higher potential to lower potential. But inside cell it flows from lower to higher potential.



Further, during charging of a battery, current flows in the direction shown in above figure.

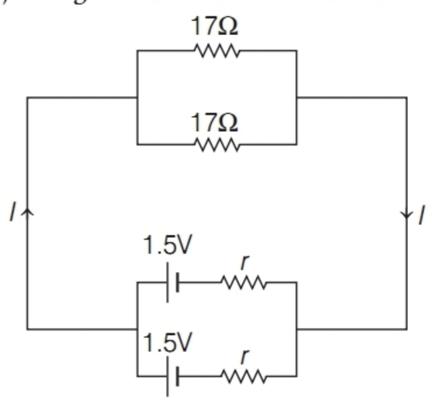
19. (a) $R = \rho \frac{l}{A}$ or $R \propto \frac{1}{A}$

Area of cross-section of first wire is less, hence its resistance is more.

and in series, $H = iRt$

$$H \propto R$$

20. (i) (c) The given situation is as shown below.



Resistance of external circuit = Total resistance of two resistances of 17 Ω connected in parallel

$$\therefore \quad R = \frac{R_1 R_2}{R_1 + R_2} = \frac{17 \times 17}{17 + 17} = 8.5\,\Omega$$

(ii) (b) Let r be the internal resistance of the two cells, then

$$r' = R\left(\frac{E - V}{V}\right) = 8.5\left(\frac{1.5 - 1.4}{1.4}\right) = 0.6\,\Omega$$

(iii) (c) As, the two cells of internal resistance r Ω each have been connected in parallel, therefore.

$$\frac{1}{r'} = \frac{1}{r} + \frac{1}{r}$$

or $$\frac{1}{0.6} = \frac{2}{r}$$

or $$r = 0.6 \times 2 = 1.2\,\Omega$$

(iv) (a) A source can transfer maximum power, if its internal resistance is equal to external resistance of the circuit.

i.e. $r = 17\,\Omega$

(v) (d) Total resistance of the circuit,

$$R' = R_1 \,||\, R_2 + r \,||\, r$$
$$= \frac{R_1 R_2}{R_1 + R_2} + \frac{r \cdot r}{r + r}$$
$$= \frac{17 \times 17}{17 + 17} + \frac{1.2 \times 1.2}{1.2 + 1.2}$$
$$= 8.5 + 0.6$$
$$= 9.1\,\Omega$$