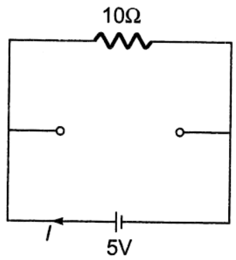
PHYSICS

11. (1)

12. (2)

$$I = \frac{5}{10} = 0.5\ A$$



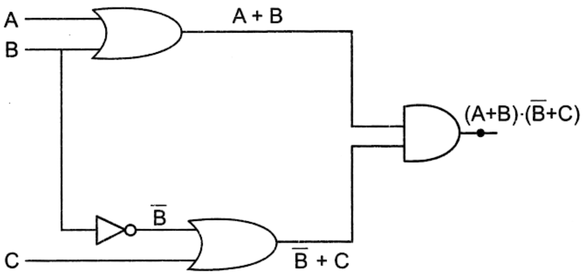
13. (2)

Since diode is in forward bias

$$i = \frac{\Delta V}{R} = \frac{4-(-6)}{1\times 10^3} = \frac{10}{10^3} = 10^{-2}\ A$$

14. (2)

15. (2)



16. (4)

A bulb is essentially a resistance, $R = \frac{V^2}{P}$

where P denotes the power of the bulb.

$\therefore$ Resistance of $B_1 (R_1) = \frac{V^2}{100}$

Resistance of $B_2 (R_2) = \frac{V^2}{60}$

Resistance of $B_3 (R_3) = \frac{V^2}{60}$

$\therefore I_1 = \text{Current in } B_1 = \frac{250}{(R_1 + R_2)}$

$= \frac{250 \times 300}{8V^2}$

$I_2 = \text{Current in } B_2 = \frac{250}{(R_1 + R_2)}$

$= \frac{250 \times 300}{8V^2}$

$I_3 = \text{Current in } B_3 = \frac{250}{R_3} = \frac{250 \times 60}{V^2}$

$\therefore W_1$ = output power of $B_1 = I_1^2 R_1$

$$\therefore W_1 = \left(\frac{250 \times 300}{8V^2}\right)^2 \times \frac{V^2}{100}$$

$$W_2 = I_2^2 R_2 \text{ or } W_2 = \left(\frac{250 \times 300}{8V^2}\right)^2 \times \frac{V^2}{60}$$

$$W_3 = I_3^2 R_3 \text{ or } W_3 = \left(\frac{250 \times 60}{V^2}\right) \times \frac{V^2}{60}$$

$\therefore W_1 : W_2 : W_3 = 15 : 25 : 64$

or $W_1 < W_2 < W_3$

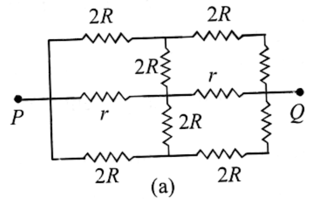
17. (1)

Consider upper segment above PQ.

It is a balanced Wheatstone bridge.

The central resistance 2R becomes ineffective.

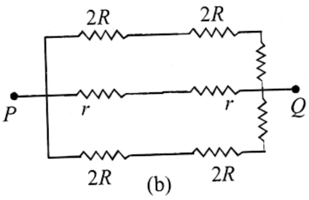
Similarly in the lower segment, the central resistance 2R becomes ineffective. The equivalent circuit is shown in the figure.



$$\therefore \frac{1}{R_{PQ}} = \frac{1}{4R} + \frac{1}{2r} + \frac{1}{4R}$$

$$\text{or } \frac{1}{R_{PQ}} = \frac{r + 2R + r}{4Rr}$$

$$R_{PQ} = \frac{4Rr}{2(R+r)} = \frac{2Rr}{R+r}$$



$$\therefore R_{PQ} = \frac{2Rr}{R+r}$$

18. (4)

Copper is a metal. Its resistance decreases when temperature falls.

Germanium is a semiconductor. Its resistance increases when temperature falls.

19. (4)

R_0 = Resistance at 0 °C

$1\ \Omega = R_0 (1 + 27\alpha)$ and $2\ \Omega = R_0 (1 + T\alpha)$

$$\frac{2}{1}=\frac{1+T\alpha}{1+27\alpha} \text{ or } T=854\,°C=127\text{ K}$$

20. (1)

Current flowing though copper rod is given by

$I = neAv_d = \rho A v_d \ (\because \ \rho = ne)$

$$v_d=\frac{I}{\rho A}$$

Time taken by charges to travel distance d,

$$t=\frac{d}{v_d}=\frac{d}{\left(\frac{I}{\rho A}\right)}=\frac{\rho A d}{I}$$