JEE MAIN ANSWER KEY & SOLUTIONS

SUBJECT :- PHYSICS
CLASS :- 12th **PAPER CODE :- CWT-3**
CHAPTER :- CURRENT ELECTRICITY

ANSWER KEY

1.	(D)	**2.**	(A)	**3.**	(B)	**4.**	(C)	**5.**	(B)	**6.**	(A)	**7.**	(C)
8.	(C)	**9.**	(B)	**10.**	(B)	**11.**	(C)	**12.**	(D)	**13.**	(B)	**14.**	(D)
15.	(C)	**16.**	(A)	**17.**	(C)	**18.**	(C)	**19.**	(A)	**20.**	(B)	**21.**	5
22.	6	**23.**	3	**24.**	4	**25.**	3	**26.**	2	**27.**	400	**28.**	25
29.	0.1	**30.**	100										

SOLUTIONS

1. (D)

Sol. In the presence of an applied electric field ($\vec{E}$) in a metallic conductor. The electrons also move randomly but slowly drift in a direction opposite to $\vec{E}$.

2. (A)

Sol. $H_1 = \dfrac{V^2}{R}t$

$H_2 = \dfrac{V^2}{R/2}t$

$\therefore \quad \dfrac{H_2}{H_1} = 2 \quad \Rightarrow \quad H_2 = 2H_1$

3. (B)

Sol. Specific resistance depends only on the material of the wire.

4. (C)

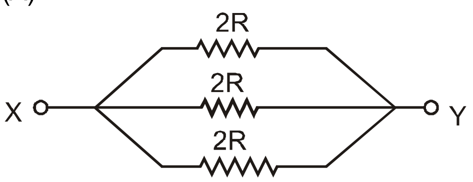
Sol. $R = \dfrac{\rho\ell}{A} = \dfrac{\rho \times 2\ell}{2A} = \dfrac{\rho\ell}{A}$ (unchanged)

5. (B)

Sol. $R = \dfrac{\rho\ell}{A} \Rightarrow 0.1 = \dfrac{3.14 \times 10^{-8} \times \ell}{\pi(1 \times 10^{-3})^2} \Rightarrow \ell = 10$ m

6. (A)

Sol.



$R_{eq.} = \dfrac{2R}{3}$

7. (C)

Sol. $\varepsilon_{eq} = 4 + \dfrac{\frac{4}{1} + \frac{4}{0.5}}{\frac{1}{1} + \frac{1}{0.5}}$

$= 4 + \dfrac{12}{3} = 8$ v.

8. (C)

Sol. Potential gradient $= \dfrac{V}{\ell}$

9. (B)

Sol. $r_{eq} = 10 + 20 = 30$, $I = \dfrac{3}{30} = \dfrac{1}{10}$, $V = \varepsilon - IR = 3 - \dfrac{1}{10} \times 10 = 2$

Potential gradient $= \dfrac{V}{\ell} = \dfrac{2}{10} = 0.2$

10. (B)

Sol. $R_1 = R_{01}(1 + \alpha_1 \Delta\theta) = 600(1 + 0.001 \times 30) = 618\ \Omega$

$R_2 = R_{02}(1 + \alpha_2 \Delta\theta) = 300(1 + 0.004 \times 30) = 336\ \Omega$

$R_{eq} = R_1 + R_2 = 618 + 336 = 954\ \Omega$

11. (C)

Sol. In semiconductor resistance decrease with increase in the temperature. Therefore resistivity also decrease. In conducting solid resistance increase with increase the temperature because the rate of collisions between free electron and ions increases with increase of temperature both the statements are true.

12. (D)

Sol. $X = \dfrac{\rho \times 4a}{a \times 2a} = 2\dfrac{\rho}{a}$

$Y = \dfrac{\rho \times a}{4a \times 2a} = \dfrac{1}{8}\dfrac{\rho}{a}$

$Z = \dfrac{\rho \times 2a}{4a \times a} = \dfrac{1}{2}\dfrac{\rho}{a}$

so, X > Z > Y

13. (B)

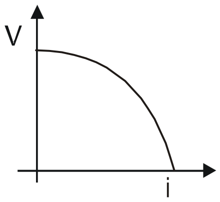
Sol. $\rho_{eq}\dfrac{2\ell}{A} = \rho_1\dfrac{\ell}{A} + \rho_2\dfrac{\ell}{A}$

$\rho_{eq} = 1/2\ (\rho_1 + \rho_2)$

14. (D)

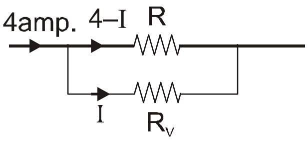
Sol. Given $r \propto i \Rightarrow r = ki$

$V = E - ir = E - i(ki)$ $\quad V = -i^2 k + E$



15. (C)

Sol.



$(4 - I) R = IR_V = 20 \qquad (4 - I) R = 20$

$4 - I$ is less than 4

So that, R is greater than 5Ω

16. (A)

Sol. $R_{eq} = 10 + \frac{480 \times 20}{480 + 20} = 10 + \frac{96}{5} = \frac{146}{5}$

current passes through the battery.

$I = \frac{20 \times 5}{146} = \frac{100}{146} = \frac{50}{73}$ amp.

17. (C)

Sol. From relation $\vec{J} = \sigma \vec{E}$, the current density $\vec{J}$ at any point in ohmic resistor is in direction of electric field $\vec{E}$ at that point. In space having non-uniform electric field, charges released from rest may not move along ELOF. Hence statement 1 is true while statement 2 is false.

18. (C)

Sol. Let time taken in boiling the water by the heater is t sec. Then

$Q = ms\Delta T \Rightarrow \frac{Pt}{J} = ms\Delta T$

$\frac{836}{4.2} t = 1 \times 1000\,(40^\circ - 10^\circ)$

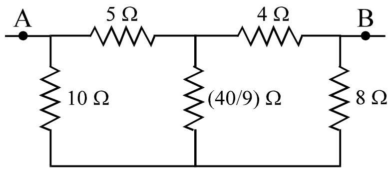
$\frac{836}{4.2} t = 1000 \times 30$

$t = \frac{1000 \times 30 \times 4.2}{836}$

$= 150$ second **Ans.**

19. (A)

Sol. The given circuit is equivalent to



As 10 × 4 = 5 × 8 this is balanced Wheatstone network

Therefore $R = \frac{(5+4) \times (10+8)}{9+18} = 6$ ohm

20. (B)

Sol. For balnaced bridge, P/Q = R/S

power dissipation in resistance R with voltage V is V^2/R.

$\therefore \frac{P_{P+Q}}{P_{R+S}} = \frac{R+S}{P+Q} = \frac{R}{P}$.

21. 5

Sol. Using the formula $P = \frac{V^2}{R}$ ...(i)

Where R is resistance of wire, V is voltage across wire and P is power dissipation in wire

and $R = \frac{\rho \ell}{A}$ ...(ii)

From Eqs. (i) and (ii)

$P_1 = \frac{V^2}{\rho \ell / A} = \frac{V^2}{\rho \ell} . A$

$P_1 = \frac{V^2}{\rho \ell} . A$ ...(iii)

In 2nd case

Let R_2 is net resistance.

$R_2 = \frac{R \times R}{R + R} = \frac{R}{2}$

Where, R is the resistance of half wire.

$\therefore \quad R_2 = \frac{\rho . \left(\frac{\ell}{2}\right)}{A.2} = \frac{\rho \ell}{4A}$

$\therefore \quad P_2 = \frac{V^2}{\rho \ell} . 4A$ ... (iv)

Hence, from Eqs. (iii) and (iv)

$\frac{P_1}{P_2} = \frac{1}{4} \Rightarrow \frac{P_2}{P_1} = \frac{4}{1}$ x+y = 4+1 = 5

22. 6

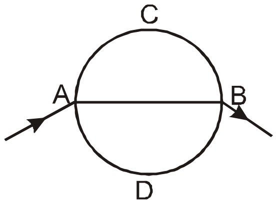
Sol. $\frac{15^2}{R_{eq}} = 150$ .....(i)

$R_{eq} = \frac{2R}{2+R}$ .....(ii)

Solving (i) and (ii), $R = 6\ \Omega$ **Ans.**

23. 3

Sol.



$$\frac{1}{R_{eq.}} = \frac{1}{R_{ACB}} + \frac{1}{R_{ADB}}$$

$2\pi r = L$

$ACB = \pi r$

$$\pi r = \frac{L}{2} = \frac{12}{2} = 6$$

$$\frac{1}{R_{eq.}} = \frac{1}{6} + \frac{1}{6}$$

$R_{eq} = 3$

24. 4

Sol. $\therefore$ 2Ω and 6Ω are in parallel

$$\Rightarrow R_{eq} = \frac{3\times(1.5+1.5)}{3+(1.5+1.5)} = \frac{3}{2}\Omega$$

$i = \frac{6}{R_{eq}} = 4A$ **Ans.**

25. 3

Sol. ρ : same

In parallel $\Rightarrow i_1 R_1 = i_2 R_2$

$$\Rightarrow \frac{i_1}{i_2} = \frac{R_2}{R_1} = \frac{\rho\ell_2/A_2}{\rho\ell_1/A_1} = \frac{\ell_2}{\ell_1}\times\frac{r_1^2}{r_2^2}$$

$$\therefore \frac{\ell_1}{\ell_2} = \frac{4}{3} \text{ and } \frac{r_1}{r_2} = \frac{2}{3}$$

$\Rightarrow \frac{i_1}{i_2} = \frac{1}{3}$ $\frac{P}{Q} = \frac{1}{3} = Q = 3$ **Ans.**

26. 2

Sol. The internal resistance of the cell .

$$r = \left(\frac{\ell_1-\ell_2}{\ell_2}\right)R$$

$= \frac{240-120}{120} \times 2 = 2\Omega$ **Ans.**

27. 400

Sol. Let resistance of bulb filament is R_0 at 0ºC, then from expression

$R = R_0(1 + \alpha\Delta T)$

$\therefore$ $100 = R_0(1 + 0.005 \times 100)$

$200 = R_0(1 + 0.005 \times x)$

where x is temperature in ºC at which resistance become 200 Ω.

Dividing the above two equation

$$\frac{200}{100} = \frac{1+0.005x}{1+0.005\times100} \Rightarrow x = 400\ ºC$$

28. 25

Sol. $P = V^2/R$, putting values we get $R = (22)^2$ ohm

When operated at 110 V, $P' = (110)^2/R = 25$ watt

29. 0.1

Sol. $x = \frac{V}{\ell} = \frac{IR}{\ell} = \frac{IR}{\ell}\left(\frac{\rho\ell}{A}\right) = \frac{I\rho}{A}$

$$x = \frac{0.2\times4\times10^{-7}}{8\times10^{-7}} = \frac{0.8}{8} = 0.1\ V/m.$$

30. 100

Sol. $V \propto \ell$

$\ell \propto R$

$$\frac{\ell_1}{\ell_2} = \frac{R_1}{R_2} \Rightarrow \frac{50}{\ell} = \frac{\frac{4\times4}{4+4}}{4}$$

$\ell = 100$ cm