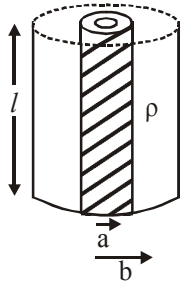
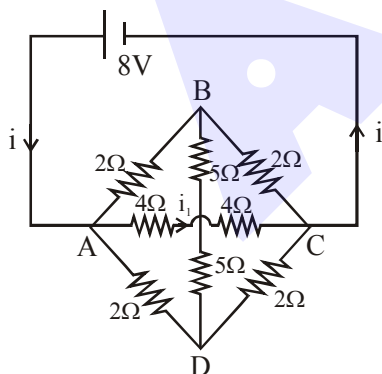


11. Model a torch battery of length l to be made up of a thin cylindrical bar of radius 'a' and a concentric thin cylindrical shell of radius 'b' filled in between with an electrolyte of resistivity ρ (see figure). If the battery is connected to a resistance of value R , the maximum Joule heating in R will take place for:-

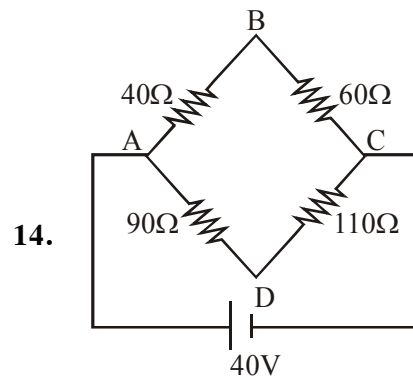


- (1) $R = \frac{2\rho}{\pi l} \ln\left(\frac{b}{a}\right)$ (2) $R = \frac{\rho}{\pi l} \ln\left(\frac{b}{a}\right)$
 (3) $R = \frac{\rho}{2\pi l} \left(\frac{b}{a}\right)$ (4) $R = \frac{\rho}{2\pi l} \ln\left(\frac{b}{a}\right)$

12. A battery of 3.0 V is connected to a resistor dissipating 0.5 W of power. If the terminal voltage of the battery is 2.5 V, the power dissipated within the internal resistance is :
- (1) 0.50 W (2) 0.125 W
 (3) 0.072 W (4) 0.10 W
13. The value of current i_1 flowing from A to C in the circuit diagram is :

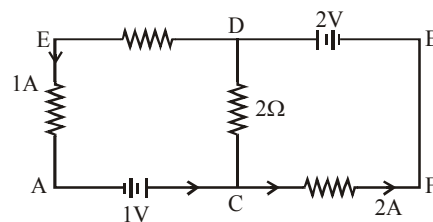


- (1) 5A (2) 2A (3) 4A (4) 1A



Four resistances 40Ω , 60Ω , 90Ω and 110Ω make the arms of a quadrilateral ABCD. Across AC is a battery of emf 40V and internal resistance negligible. The potential difference across BD is V is _____.

15. An electrical power line, having a total resistance of 2Ω , delivers 1 kW at 220 V. The efficiency of the transmission line is approximately:
 (1) 72% (2) 96% (3) 91% (4) 85%
16. A galvanometer of resistance G is converted into a voltmeter of range 0 – 1V by connecting a resistance R_1 in series with it. The additional resistance that should be connected in series with R_1 to increase the range of the voltmeter to 0 – 2V will be :
 (1) R_1 (2) $R_1 + G$
 (3) $R_1 - G$ (4) G
17. In the circuit, given in the figure currents in different branches and value of one resistor are shown. Then potential at point B with respect to the point A is :

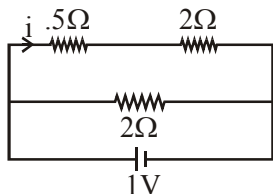


- (1) +1V (2) -1V (3) -2V (4) +2V
18. A galvanometer is used in laboratory for detecting the null point in electrical experiments. If, on passing a current of 6mA it produces a deflection of 2° , its figure of merit is close to :
 (1) 3×10^{-3} A/div. (2) 333° A/div.
 (3) 6×10^{-3} A/div. (4) 666° A/div.

SOLUTION

1. NTA Ans. (2)

Sol. Equivalent resistance of upper branch of circuit
 $R = 2.5 \Omega$



Voltage across upper branch = 1 V

$$\Rightarrow i = \frac{1}{2.5} = .4 \text{ A}$$

$$\Rightarrow I_1 = 0.2 \text{ A}$$

2. NTA Ans. (4)

Sol. $220 I = P = 15 \times 45 + 15 \times 100 + 15 \times 10 + 2 \times 10^3$

$$I = \frac{4325}{220} = 19.66$$

$$I \approx 20 \text{ A}$$

3. NTA Ans. (12)

Sol. $r = R \left(\frac{x-x'}{x'} \right)$

$$= 10 \times \frac{60}{500} = 12$$

4. NTA Ans. (4)

Sol. $5 = \lambda \ell$

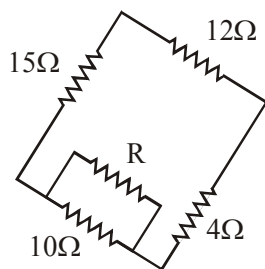
where λ is potential gradient & L is total length of wire.

$$5 = \frac{\Delta V}{L} \ell$$

$$\Delta V = \frac{5 \times L}{\ell} = 5 \times \frac{12}{10} = 6 \text{ V} = 60 \text{ mA} \times R$$

$$R = 100 \Omega$$

5. NTA Ans. (10.00)



Sol.

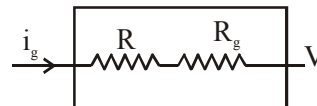
Let the resistance to be connected is R .
 For balanced wheatstone bridge,

$$15 \times 4 = 12 \times \frac{10R}{10+R}$$

$$\Rightarrow R = 10 \Omega$$

6. NTA Ans. (1)

Sol. $i_g = 1 \text{ mA}$, $R_g = 100 \Omega$

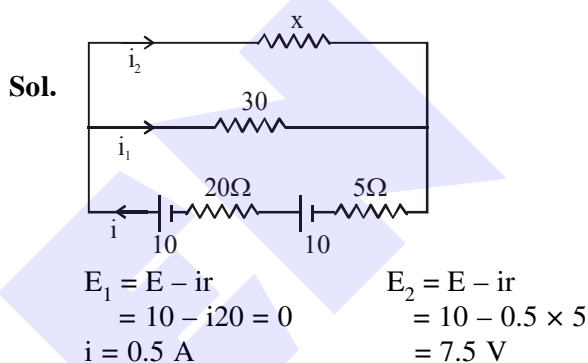


$$V = i_g (R + R_g)$$

$$10 = 1 \times 10^{-3} (R + 100)$$

$$R = 9.9 \text{ k}\Omega$$

7. NTA Ans. (30)



Sol.

$$E_1 = E - ir$$

$$= 10 - i20 = 0$$

$$i = 0.5 \text{ A}$$

$$E_2 = E - ir$$

$$= 10 - 0.5 \times 5$$

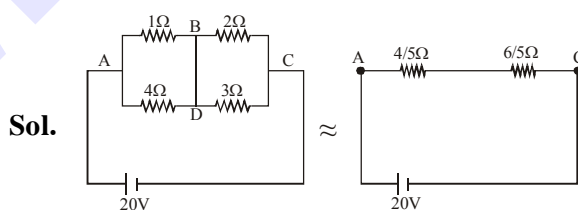
$$= 7.5 \text{ V}$$

$$E_{\text{net}} = E_1 + E_2 = 7.5 \text{ V}$$

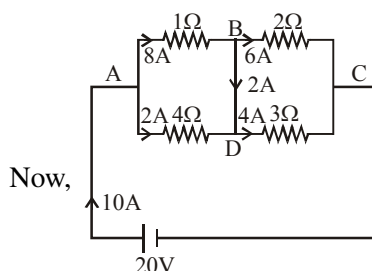
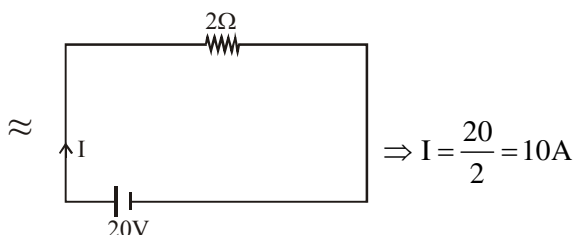
$$i = i_1 + i_2$$

$$0.5 = \frac{7.5}{x} + \frac{7.5}{30} \quad x = 30 \Omega$$

8. NTA Ans. (2)



Sol.



Now,

$$v_B - v_D = \frac{1}{5}(90) - \frac{4}{10} \times 40$$

$$v_B - v_D = 18 - 16 = 2$$

15. Official Ans. by NTA (2)

Sol. $v_i = 10^3$

$$i = \frac{1000}{220}$$

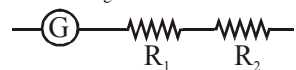
$$\text{loss} = i^2 R = \left(\frac{50}{11}\right)^2 \times 2$$

$$\text{efficiency} = \frac{1000}{1000 + i^2 R} \times 100 = 96\%$$

16. Official Ans. by NTA (2)



$$\Rightarrow 1 = i_g(G + R_1) \quad \dots (1)$$



$$\Rightarrow 2 = i_g(R_1 + R_2 + G) \quad \dots (2)$$

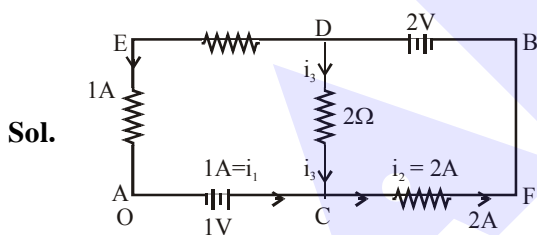
$$(1) \% (2)$$

$$\Rightarrow \frac{1}{2} = \frac{G + R_1}{G + R_1 + R_2}$$

$$G + R_1 + R_2 = 2G + 2R_1$$

$$(R_2 = G + R_1)$$

17. Official Ans. by NTA (1)



Let us assume the potential at A = $V_A = 0$

Now at junction C, According to KCL

$$i_1 + i_3 = i_2$$

$$1A + i_3 = 2A$$

$$i_3 = 2A$$

Now Analyse potential along ACDB

$$v_A + 1 + i_3(2) - 2 = v_B$$

$$0 + 1 + 2(1) - 2 = v_B$$

$$v_B = 3 - 2$$

$$v_B = 1 \text{ Amp}$$

18. Official Ans. by NTA (1)

Sol. Figure of Merit = $C = \frac{i}{\theta}$

$$= C = \frac{6 \times 10^{-3}}{2} = 3 \times 10^{-3} \text{ Am}^2$$

19. Official Ans. by NTA (1)

Sol. Conceptual

Option (1) is correct

Ammeter :- In series connection, the same current flows through all the components. It aims at measuring the current flowing through the circuit and hence, it is connected in series.
Voltmeter :- A voltmeter measures voltage change between two points in a circuit, So we have to place the voltmeter in parallel with the circuit component.

20. Official Ans. by NTA (3)

Sol. $E_{eq} = \frac{20 \times 10}{17} = \frac{200}{17}$

$$\text{and } R_{eq} = \frac{7 \times 10}{17} = \frac{70}{17}$$

21. Official Ans. by NTA (1)

Sol. Balancing length is measured from P.

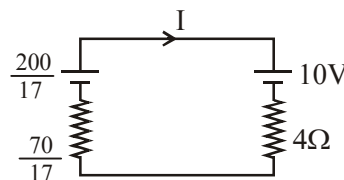
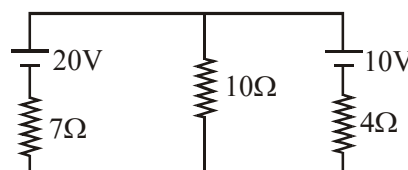
$$\text{So } 100 - 49 = 51 \text{ cm}$$

$$E_2 = \phi \times 51$$

Where ϕ = Potential gradient

$$1.02 = \phi \times 51$$

$$\phi = 0.02 \text{ V/cm}$$



$$\therefore I = \frac{\frac{20}{17} - 10}{4 + \frac{70}{17}} = 0.21 \text{ A}$$

from +ve to -ve terminal