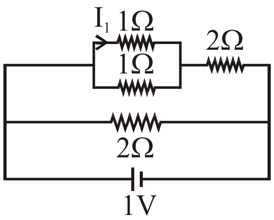
CURRENT ELECTRICITY

1. The current I_1 (in A) flowing through 1 Ω resistor in the following circuit is :



(1) 0.5 (2) 0.2 (3) 0.25 (4) 0.4

2. In a building there are 15 bulbs of 45 W, 15 bulbs of 100 W, 15 small fans of 10 W and 2 heaters of 1 kW. The voltage of electric main is 220 V. The minimum fuse capacity (rated value) of the building will be:

(1) 10 A (2) 25 A

(3) 15 A (4) 20 A

3. The balancing length for a cell is 560 cm in a potentiometer experiment. When an external resistance of 10 Ω is connected in parallel to the cell, the balancing length changes by 60cm. If the internal resistance of the cell is $\frac{N}{10}\Omega$, where N is an integer then value of N is____ .

4. The length of a potentiometer wire is 1200 cm and it carries a current of 60 mA. For a cell of emf 5V and internal resistance of 20Ω, the null point on it is found to be a 1000cm. The resistance of whole wire is :

(1) 120Ω (2) 60Ω

(3) 80Ω (4) 100Ω

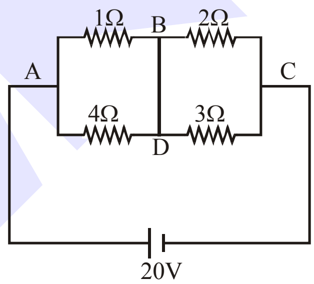
5. Four resistances of 15Ω, 12Ω, 4Ω and 10Ω respectively in cyclic order to form Wheatstone's network. The resistance that is to be connected in parallel with the resistance of 10Ω to balance the network is ________ Ω.

6. A galvanometer having a coil resistance 100 Ω gives a full scale deflection when a current of 1 mA is passed through it. What is the value of the resistance which can convert this galvanometer into a voltmeter giving full scale deflection for a potential difference of 10 V?

(1) 9.9 kΩ (2) 8.9 kΩ (3) 7.9 kΩ (4) 10 kΩ

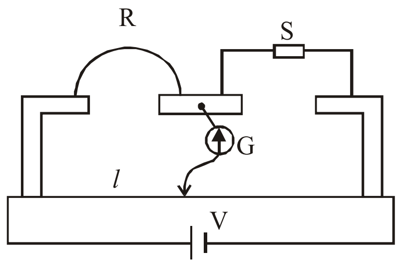
7. The series combination of two batteries, both of the same emf 10 V, but different internal resistance of 20Ω and 5Ω, is connected to the parallel combination of two resistors 30 Ω and R Ω. The voltage difference across the battery of internal resistance 20Ω is zero, the value of R (in Ω) is : _______

8. In the given circuit diagram, a wire is joining points B and D. The current in this wire is :



(1) 4A (2) 2A (3) 0.4A (4) Zero

9. In a meter bridge experiment S is a standard resistance. R is a resistance wire. It Is found that balancing length is l = 25 cm. If R is replaced by a wire of half length and half diameter that of R of same material, then the balancing distance l' (in cm) will now be________.

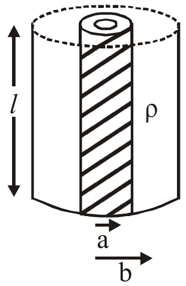


10. Consider four conducting materials copper, tungsten, mercury and aluminium with resistivity $\rho_C > \rho_T > \rho_M$ and ρ_A respectively. Then:

(1) $\rho_A > \rho_T > \rho_C$ (2) $\rho_C > \rho_A > \rho_T$

(3) $\rho_A > \rho_M > \rho_C$ (4) $\rho_M > \rho_A > \rho_C$

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) $R = \frac{\rho}{\pi l} ln\left(\frac{b}{a}\right)$

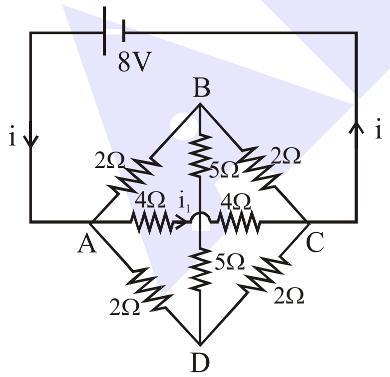
(3) $R = \frac{\rho}{2\pi l}\left(\frac{b}{a}\right)$ (4) $R = \frac{\rho}{2\pi l} ln\left(\frac{b}{a}\right)$

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

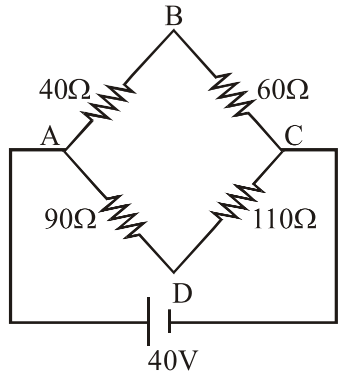
(3) 0.072 W (4) 0.10 W

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

14.



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:

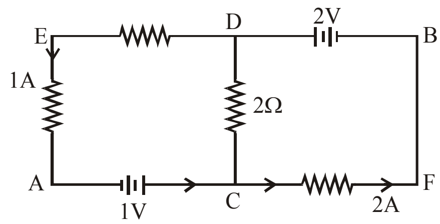
(1) 72% (2) 96% (3) 91% (4) 85%

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.

19. A circuit to verify Ohm's law uses ammeter and voltmeter in series or parallel connected correctly to the resistor. In the circuit :

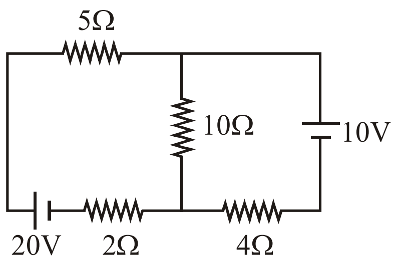
(1) ammeter is always connected series and voltmeter in parallel.

(2) Both, ammeter and voltmeter mast be connected in series.

(3) Both ammeter and voltmeter must be connected in parallel.

(4) ammeter is always used in parallel and voltmeter is series.

20. In the figure shown, the current in the 10 V battery is close to :



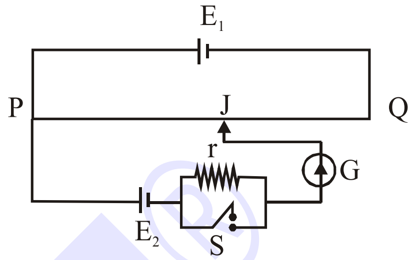
(1) 0.36 A from negative to positive terminal.

(2) 0.71 A from positive to negative terminal.

(3) 0.21 A from positive to negative terminal.

(4) 0.42 A from positive to negative terminal.

21. A potentiometer wire PQ of 1 m length is connected to a standard cell E_1. Another cell E_2 of emf 1.02 V is connected with a resistance 'r' and switch S (as shown in figure). With switch S open, the null position is obtained at a distance of 49 cm from Q. The potential gradient in the potentiometer wire is :



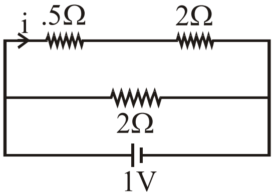
(1) 0.02 V/cm (2) 0.04 V/cm

(3) 0.01 V/cm (4) 0.03 V/cm

SOLUTION

1. NTA Ans. (2)

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



Voltage across upper branch = 1 V

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

$\Rightarrow\ I_1 = 0.2\ A$

2. NTA Ans. (4)

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

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

$I \simeq 20\ A$

3. NTA Ans. (12)

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

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

4. NTA Ans. (4)

Sol. $5 = \lambda\ell$

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

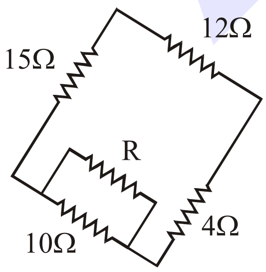
$5 = \dfrac{\Delta V}{L}\ell$

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

$R = 100\Omega$

5. NTA Ans. (10.00)

Sol.



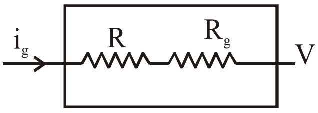
Let the resistance to be connected is R.
For balanced wheatstone bridge,

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

$\Rightarrow R = 10\Omega$

6. NTA Ans. (1)

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



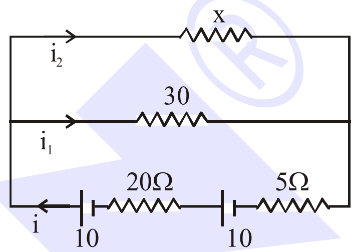
$V = i_g(R + R_g)$

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

$R = 9.9\ k\Omega$

7. NTA Ans. (30)

Sol.



$E_1 = E - ir$
$= 10 - i20 = 0$
$i = 0.5\ A$

$E_2 = E - ir$
$= 10 - 0.5\times 5$
$= 7.5\ V$

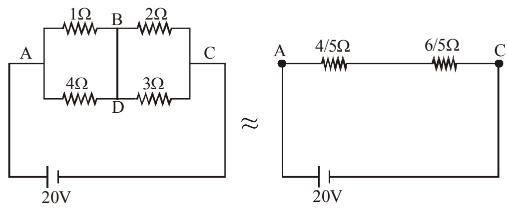
$E_{net} = E_1 + E_2 = 7.5V$

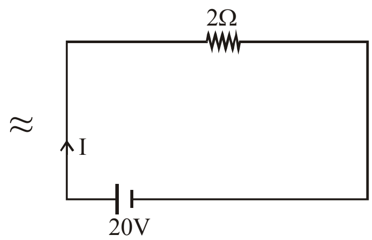
$i = i_1 + i_2$

$0.5 = \dfrac{7.5}{x} + \dfrac{7.5}{30}$ $x = 30\ \Omega$

8. NTA Ans. (2)

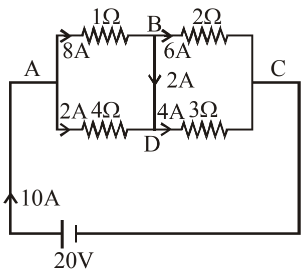
Sol.





$\Rightarrow I = \dfrac{20}{2} = 10A$

Now,



9. **NTA Ans. (40.00)**

Sol. In balancing

$$\frac{R}{S}=\frac{25}{75}$$

New resistance $R'=\frac{\rho\ell}{A}$

$$=\frac{\rho\times\frac{\ell}{2}}{\frac{A}{4}}=\frac{\rho\ell}{2}\times 4A$$

R' = 2R

$$\frac{2R}{S}=\frac{\ell'}{100-\ell'}$$

$$2\times\frac{1}{3}=\frac{\ell'}{100-\ell'}=3\ell'=200-2\ell'$$

$$5\ell'=200$$

$$\ell'=40$$

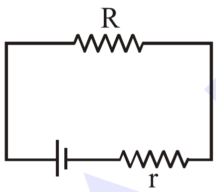
$\therefore$ Correct answer 40

10. **Official Ans. by NTA (4)**

Sol. $\rho_M>\rho_A>\rho_C$

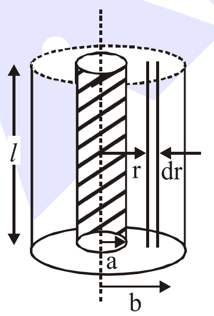
11. **Official Ans. by NTA (4)**

Sol. Maximum power in external resistance is generated when it is equal to internal resistance of battery.



$$P_R=\left(\frac{\in}{r+R}\right)^2 R$$

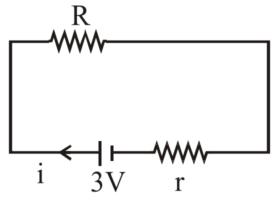
P_R is max. when r = R



$$\int dr=\int_a^b\frac{\rho dr}{2\pi rl}\Rightarrow r=\frac{\rho}{2\pi l}ln\frac{b}{a}$$

12. **Official Ans. by NTA (4)**

Sol.



P_R = 0.5W

$\Rightarrow$ i^2R = 0.5W

Also, V = E – ir

2.5 = 3 – ir

$\Rightarrow$ ir = 0.5

Power dissipated across 'r' : $P_r = i^2r$

Now iR = 2.5

ir = 0.5

On dividing : $\frac{R}{r}=5$

Now $\frac{P_R}{P_r}=\frac{i^2R}{i^2r}\Rightarrow\frac{P_R}{P_r}=\frac{R}{r}\Rightarrow\frac{P_R}{P_r}=5$

$\Rightarrow P_r=\frac{P_R}{5}$

$\Rightarrow P_r=\frac{0.50}{5}\Rightarrow P_r=0.10$ W

option (4) is correct.

13. **Official Ans. by NTA (4)**

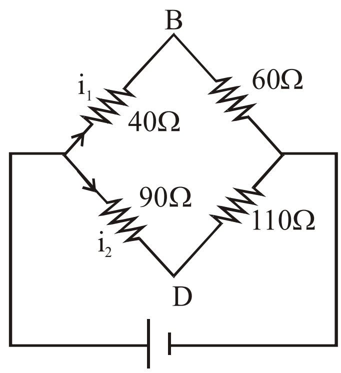
Sol. Voltage across AC = 8V

R_{AC} = 4 + 4 = 8Ω

$$i_1=\frac{V}{R_{AC}}=\frac{8}{8}=1\text{ A}$$

14. **Official Ans. by NTA (2)**

Sol.



$$i_1=\frac{40}{40+60}=0.4$$

$$i_2=\frac{40}{90+110}=\frac{1}{5}$$

$v_B + i_1(40) - i_2(90) = v_D$

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

$v_B - v_D = 18 - 16 = 2$

15. Official Ans. by NTA (2)

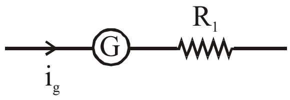
Sol. $vi = 10^3$

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

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

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

16. Official Ans. by NTA (2)

Sol. 

$\Rightarrow 1 = i_g(G + R_1)$ ... (1)

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

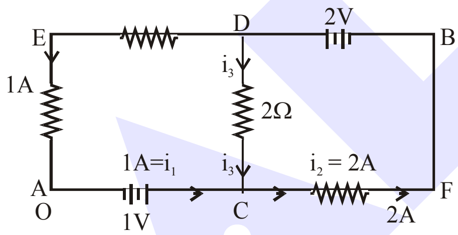
(1) % (2)

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

$G + R_1 + R_2 = 2G + 2h_1$

$(R_2 = G + R_1)$

17. Official Ans. by NTA (1)

Sol. 

Let us asssume 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

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

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

$v_B = 3 - 2$

$v_B = 1$ Amp

18. Official Ans. by NTA (1)

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

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

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 curent 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 parallal with the circuit component.

20. Official Ans. by NTA (3)

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

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

21. Official Ans. by NTA (1)

Sol. Balancing length is measured from P.

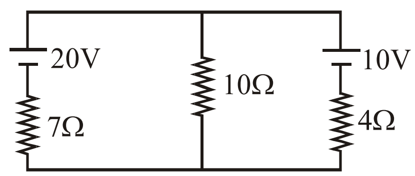
So 100 – 49 = 51 cm

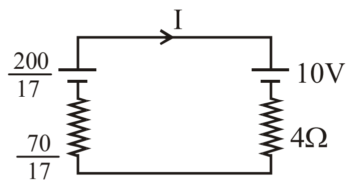
$E_2 = \phi \times 51$

Where ϕ = Potential gradient

$1.02 = \phi \times 51$

$\phi = 0.02$ V/cm





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

from +ve to –ve terminal