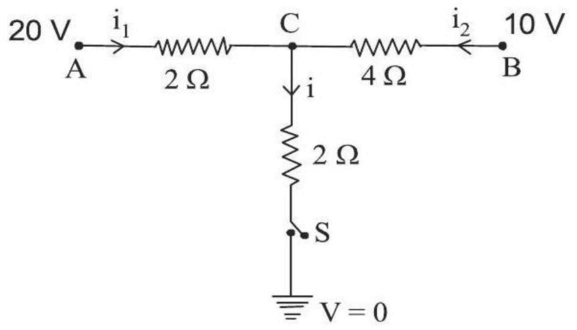
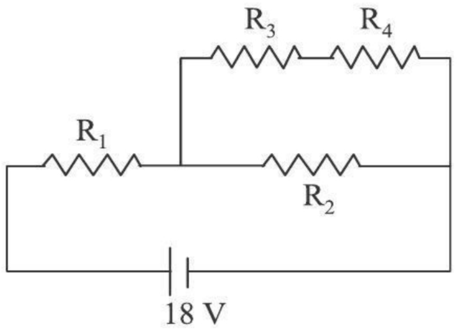
Current Electricity

1. When the switch S, in the circuit shown, is closed then the value of current i (in ampere) will be:



2. A copper wire is stretched to make it 0.5% longer. The percentage change in its electrical resistance if its volume remains unchanged is:

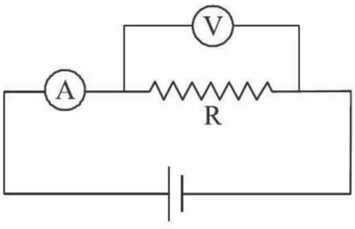
3. In the given circuit the internal resistance of the 18 V cell is negligible. If $R_1 = 400\Omega, R_3 = 100\Omega$ and $R_4 = 500\Omega$ and the reading of an ideal voltmeter across R_4 is 5 V, then the value of R_2 (in Ω) will be:



4. A uniform metallic wire has a resistance of 18Ω and is bent into an equilateral triangle. Then, the resistance (in Ω) between any two vertices of the triangle is:

5. A 2 W carbon resistor is color coded with green, black, red and brown respectively. The maximum current (in mA) which can be passed through this resistor is:

6. The actual value of resistance R, shown in the figure is 30Ω. This is measured in an experiment as shown using the standard formula $R = \frac{V}{I}$, where V and I are the reading of the voltmeter and ammeter, respectively. If the measured value of R is 5% less, then the internal resistance (in Ω) of the voltmeter is:



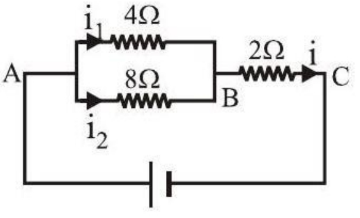
7. A current of 2 mA was passed through an unknown resistor which dissipated a power of 4.4 W. Dissipated power (in watt) when an ideal power supply of 11 V is connected across it is:

8. The amount of charge Q passed in time t through a crosssection of a wire is $Q = (5t^2 + 3t + 1)$ coulomb. The value of current (in ampere) at time $t = 5$ s is

9. A current of 1 mA flows through a copper wire. How many electrons will pass through a given point in each second?

10. At what temperature (in °C) will the resistance of a copper wire becomes three times its value at 0°C ? (Temperature coefficient of resistance of copper is $4 \times 10^{-3} /{}^{\circ}\mathrm{C}$)

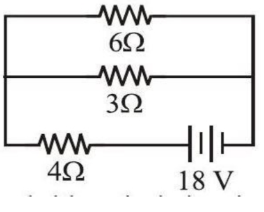
11. In the circuit shown in Fig, the current in 4Ω resistance is 1.2 A. What is the potential difference (in volt) between B and C ?



12. A current of 30 A is registered when the terminals of a dry cell of emf 1.5 V are connected through an ammeter. (Neglect the ammeter resistance). The amount of heat produced (in joule) in the battery in 20 s is

13. A 100 watt bulb working on 200 volt has resistance R and a 200 watt bulb working on 100 volt has resistance S. If the R/ S is $\frac{8}{x}$. Find the value of x.

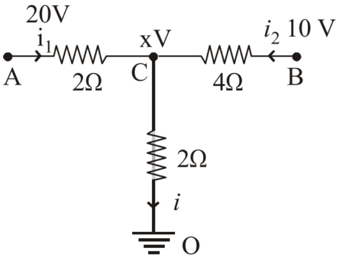
14. The total power dissipated in watts in the circuit shown here is



15. In an ideal metre-bridge, the balancing length from the left end when standard resistance of 1Ω is in right gap is found to be 20 cm. The value of unknown resistance (in Ω) is

SOLUTIONS

1. **(5)**



Let voltage at C = xV

From kirchhoff's current law,

KCL : $i_1 + i_2 = i$

$$\frac{20-x}{2} + \frac{10-x}{4} = \frac{x-0}{2} \Rightarrow x = 10$$

$$\therefore \quad i = \frac{V}{R} = \frac{X}{R} = \frac{10}{2} = 5A$$

2. **(1)** Resistance, $R = \frac{\rho\ell}{A}$

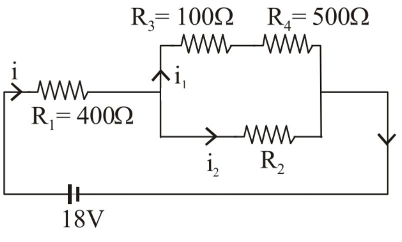
$$R = \rho\frac{\ell}{A} \times \frac{\ell}{\ell} = \frac{\rho\ell^2}{V} \quad [\because \text{Volume}(V) = A\ell.]$$

Since resistivity and volume remains constant therefore

% change in resistance

$$\frac{\Delta R}{R} = \frac{2\Delta\ell}{\ell} = 2 \times (0.5) = 1\%$$

3. **(300)**



Across R_4 reading of voltmeter, $V_4 = 5V$

Current, $i_4 = \frac{V_4}{R_4} = 0.01A$

$V_3 = i_1 R_3 = 1V$

$V_3 + V_4 = 6V = V_2$

$V_1 + V_3 + V_4 = 18V$

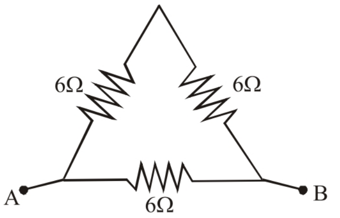
$\Rightarrow V_1 = 12V$

$$i = \frac{V_1}{R_1} = 0.03A$$

$i = i_1 + i_2 \Rightarrow i_2 = i - i_1 = 0.03 - 0.01A = 0.02A$

$$\therefore R_2 = \frac{V_2}{i_2} = \frac{6}{0.02} = 300\Omega$$

4. **(4)**



Resistance, $R \propto l$ so resistance of each side of the equilateral triangle = $6\,\Omega$

Resistance R_{eq} between any two vertices

$$\frac{1}{R_{eq}} = \frac{1}{12} + \frac{1}{6} \Rightarrow R_{eq.} = 4\Omega$$

5. **(20)** Colour code for carbon resistor

Bl,	Br,	R,	O,	Y,	G,	Blue,	V,	Gr,	W
0	1	2	3	4	5	6	7	8	9

Resistance, $R = AB \times C \pm D$

$\therefore$ Resistance, $R = 50 \times 10^2\,\Omega$

Now using formula, Power, $P = i^2R$

$$\therefore \quad i = \sqrt{\frac{P}{R}} = \sqrt{\frac{2}{50 \times 10^2}} = 20\text{mA}$$

6. **(570)** using, $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$

$0.95\,R = \frac{R R_\upsilon}{R + R_\upsilon}$ (measured value 5% less then internal resistance of voltmeter)

or, $0.95 \times 30 = 0.05\,R_\upsilon$

$\therefore\ R_\upsilon = 19 \times 30 = 570\,\Omega$

7. **(11×10^{-5})** Power, $P = I^2R$

$4.4 = 4 \times 10^{-6} \times R$

$\Rightarrow R = 1.1 \times 10^6\Omega$

When supply of 11 v is connected

$$\text{Power, } P' = \frac{v^2}{R} = \frac{11^2}{1.1} \times \frac{11^2}{1.1} \times 10^{-6} = 11 \times 10^{-5}\,\text{W}$$

8. **(53)** $I = \frac{dQ}{dt} = 10t + 3 = 10 \times 5 + 3 = 53\,\text{A}$

9. **(6.25×10^{15})** Current, $I = \frac{\text{Charge}}{\text{Time}}$;

as charge $q = n \times 1.6 \times 10^{-19}$

$$10^{-3}\,\text{amp} = \frac{n \times 1.6 \times 10^{-19}}{1\text{ sec}} \quad \Rightarrow \quad n = 6.25 \times 10^{15}$$

10. **(500)** $R_t = R_0(1+\alpha t)$ at t°C $R_t = 3R_0$

$\alpha = 4\times10^{-3}$ /°C

$3R_0 = R_0(1+4\times10^{-3}\times t)$

$\therefore\quad 3-1 = 4\times10^{-3}t$

$$\therefore\quad t = \frac{2}{4\times10^{-3}} = 500°C$$

11. **(3.6)** The potential difference across 4Ω resistance is given by $V = 4\times i_1 = 4\times1.2 = 4.8$ volt

So, the potential across 8Ω resistance is also 4.8 volt.

$$\text{Current } i_2 = \frac{V}{8} = \frac{4.8}{8} = 0.6 \text{ amp}$$

Current in 2Ω resistance $i = i_1 + i_2$

$\therefore i = 1.2 + 0.6 = 1.8$ amp

Potential difference across 2Ω resistance

$V_{BC} = 1.8\times2 = 3.6$ volts

12. **(900)** $i = \frac{E}{r} \Rightarrow 30 = \frac{1.5}{r}$

$r = 0.05\,\Omega \Rightarrow H = i^2rt = (30)^2\times0.05\times20 = 900$ J

13. **(1)** $P = V^2/R$

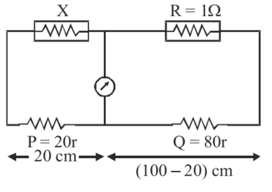
$\Rightarrow\quad R = V^2/P\times10^4/100 = 400\ \Omega$

$S = 10^4/200 = 0.5\times10^2 = 50\ \Omega$

$R/S = 8$

14. **(54)** Power dissipated $= P = \frac{V^2}{R} = \frac{(18)^2}{6} = 54$ W

15. **(0.25)** Let unknown resistance be X. Then condition of Wheatstone's bridge gives $\frac{X}{R} = \frac{20r}{80r}$, where r is resistance of wire per cm.



$$\therefore\quad X = \frac{20}{80}\times R = \frac{1}{4}\times1 = 0.25\,\Omega$$