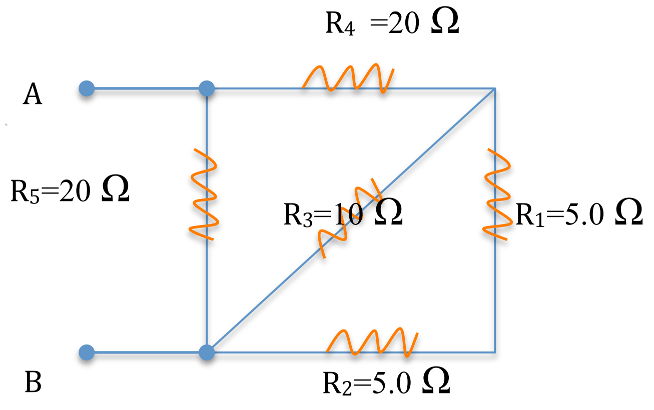
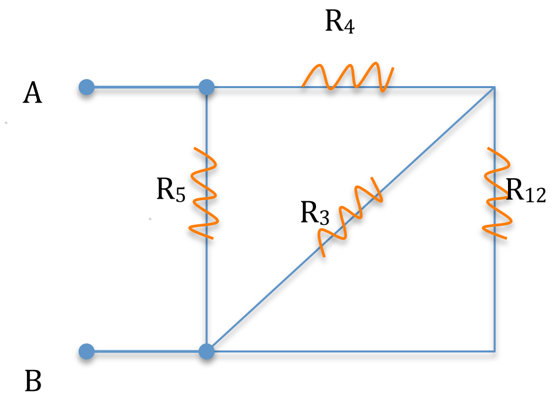
Assignment Solution 3

Questions:

1. Calculate the effective resistance between the points A and B in the figure below

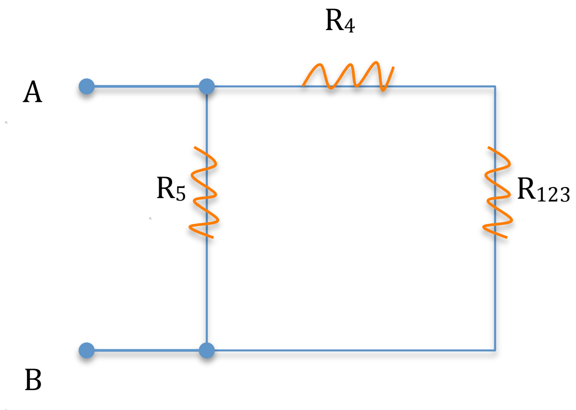


R_1=5Ω , R_2=5Ω, R_3=10Ω, R_4=20Ω. R_5=10Ω

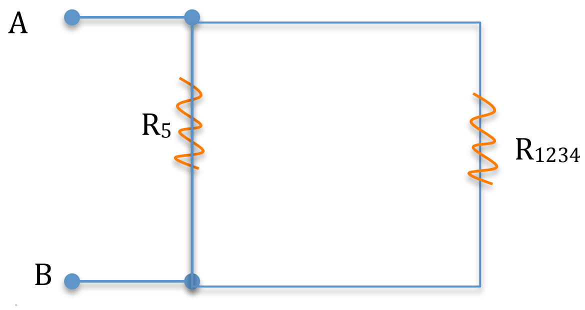


R_1 and R_2 are conncted in Series, Thus R_{12} is
$R_{12} = R_1 + R_2 = 10\Omega$
since R_{12} and R_3 are conncted in Parallel, Thus R_{123} is

$$\frac{1}{R_{123}} = \frac{1}{R_{12}} + \frac{1}{R_3} \Rightarrow \frac{1}{R_{123}} = \frac{1}{10} + \frac{1}{10}$$
$$R_{123} = 5\Omega$$

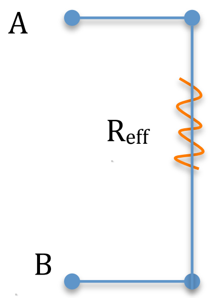


R_{123} and R_4 are conncted in Series, Thus R_{1234} is
$R_{1234} = R_{123} + R_4 = 5+20 = 25\Omega$



R_{eff}

since R_{1234} and R_5 are conncted in Parallel, Therefore the effective resisterse R_{eff} is given by



$$\frac{1}{R_{eff}} = \frac{1}{\mathrm{R}_{1234}} + \frac{1}{\mathrm{R}_5} \Rightarrow \frac{1}{R_{123}} = \frac{1}{25} + \frac{1}{10}$$
$$R_{12345} = 7.14\Omega$$

2. A copper wire has a resistance of 25 mΩ at 20 ° C. When the wire is carrying a current, heat produced by the current causes the temperature of the wire to increase by 27 ° C
(a). Calculate the change in the wire's resistance.
(b). If its original current was 10.0 mA and the potential difference across wire remains constant, what is its final current? (Given the temperature coefficient of resistivity for copper is 6.80x10 -3 ° C -1).

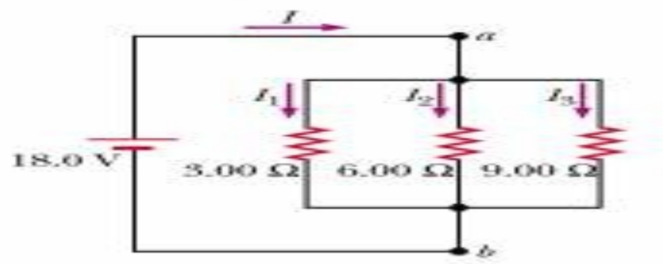
(a) $R_0 = 25m\Omega$
$\mathrm{T}_0 = 20^0 C \qquad \Delta\mathrm{T} = 27^0 C$
$\propto = 6.80\times10^{-3} C^{-1}$
By using the equation for R_{123} temperature variation of resistance thus
$R = R_0(1+\propto \Delta T) \Rightarrow R - R_0 = R_0 \propto \Delta T$
$\Rightarrow \Delta R = R_0 \propto \Delta T = 25\times10^{-3}\times6.80\times10^{-3}\times(27-20) = 1.19\times10^{-3}\Omega$

R_{123}

(b) $I_0 = 10mA$

$V \; is \; constant$

By using equation for equation for temperature variation of resistance



$R = R_0(1+\propto \Delta T) \quad where \;\; R = \frac{V}{I}$

$\Rightarrow \frac{V}{I} = \frac{V}{I_0}(1+\propto \Delta T)$ but

$V \; is \; constant$

$\Rightarrow \frac{1}{I} = \frac{1}{I_0}(1+\propto \Delta T)$

$\Rightarrow \frac{1}{I} = \frac{1}{10\times10^{-3}}(1 + 6.80\times10^{-3}\times7)$

$\Rightarrow I = 9.54 \times10^{-3}A$

3. Three resistors are connected in parallel as shown in the figure below, A potential difference of 18.0V is maintained between points a and b.

(a). Find the current in each resistor.

(b). Calculate the power delivered to each resistor.

(a) V=18V R_1=3Ω , R_2=6Ω, R_3=9Ω,

$$I_1 = \frac{V}{R_1} = \frac{18}{3} = 6A$$

$$I_2 = \frac{V}{R_2} = \frac{18}{6} = 3A$$

$$I_3 = \frac{V}{R_3} = \frac{18}{9} = 2A$$

(b)

$$P_1 = I_1^2 R_1 = (6)^2(3) = 108\Omega$$

$$P_2 = I_2^2 R_2 = (3)^2(6) = 54\Omega$$

$$P_3 = I_3^2 R_3 = (2)^2(9) = 36\Omega$$