Nouf
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C104. part 1.

Resistance / Resistor

Resistance of material

$$R = \frac{\rho \times L}{A}$$

R => Resistor Ω

ρ => Resistivity of material in circular mil ohms per foot

L => its length in feet

A => Area in circular mils

Resistor and wire sizing

$$\frac{R_1}{\frac{L_1}{A_1}} = \frac{R_2}{\frac{L_2}{A_1}}$$

Example: A conductor that is 1 m long with cross section area of 1 mm², has R of 0.017 Ω, what is the resistance of 50 m of wire from the same material but with cross section area of 0.25 mm²?

1
$L_1 = 1\ m$
$R_1 = 0.017\ \Omega$
$A_1 = 1\ mm^2$

2
$R_2 = ??$
$L_2 = 50\ m$

3 $\frac{R_1 A_1}{L_1} = \frac{R_2 A_2}{L_2}$

$A_2 = 0.25\,mm^2$

$$\frac{R_1}{L_1} \cdot \frac{A_1}{1} = \frac{R_2}{L_2} \cdot \frac{A_2}{1}$$

$$\frac{R_1 \cdot A_1}{L_1} = \frac{R_2 A_2}{L_2}$$

$$R_2 \frac{A_2 L_1}{A_2 L_1} = \frac{R_1 A_1 L_2}{A_2 L_1}$$

$$R_2 = \frac{R_1 A_1 L_2}{A_2 L_1}$$

$$= \frac{0.017 \cdot 1 \cdot 50}{0.25 \cdot 1}$$

$$\boxed{= 3.4\,\Omega}$$

Specific Resistance

$$\rho = \frac{RA}{L}$$

ρ => "rho" specific resistance

R => resistance Ω

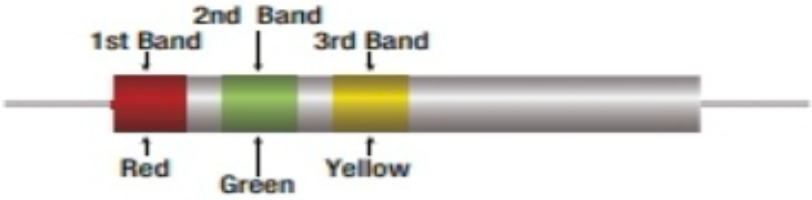
A => cross sectional area (must be uniform)

L => length

Resistor color code

how to find resistor colour code ??

Examples:-



Color	Numerical Value	Significance
1st Band — Red	2	1st Digit
2nd Band — Green	5	2nd Digit
3rd Band — Yellow	4	No. of Zeroes to Add

Figure 7-8. End to center band marking.

Resistor Color Code		
Color	Number	Tolerance
Black	0	—
Brown	1	1%
Red	2	2%
Orange	3	3%
Yellow	4	4%
Green	5	5%
Blue	6	6%
Violet	7	7%
Gray	8	8%
White	9	9%
Gold	—	5%
Silver	—	10%
No color	—	20%

Figurer 7-9. Resistor color code.

Note : we must momorize these colors code

first band

second band

add zeros

1 86000 (1)

* 86000 × 0.10
  = 8600 Ω
* max: 86000 + 8600
  = 94600 Ω
* mini: 86000 − 8600
  = 77400 Ω

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2 960 (2)

* 960 × 0.05
  = 48 Ω
* max: 960 + 48
  = 1008 Ω
* mini: 960 − 48
  = 912 Ω

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3 2500 (3)

* 2500 × 0.02
  = 50 Ω
* max: 2500 + 50
  = 2550 Ω
* mini: 2500 − 50 =
  = 2450 Ω

(1)

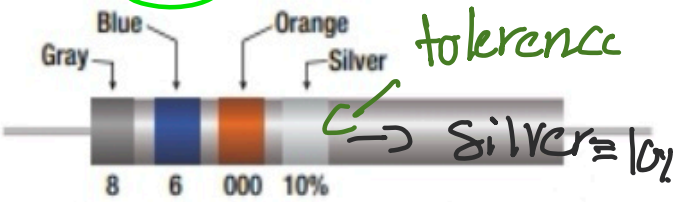


Figure 7-10. Resistor color code example.

(2)

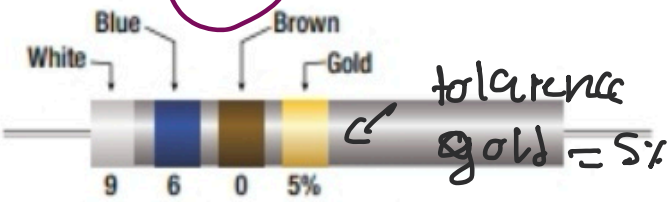


Figure 7-11. Resistor color code example.

(3)

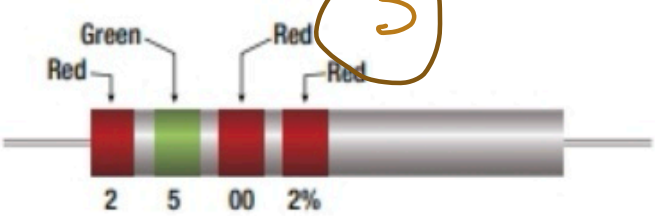


Figure 7-12. Resistor with two percent tolerance.

(4)

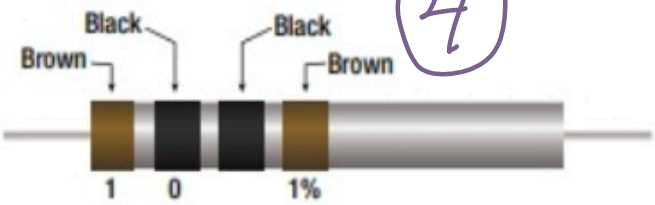


Figure 7-13. Resistor with black third color band.

(5)

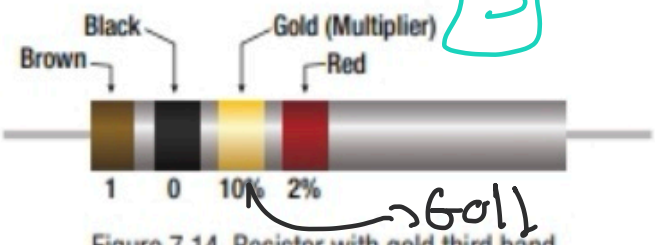


Figure 7-14. Resistor with gold third band.

(6)

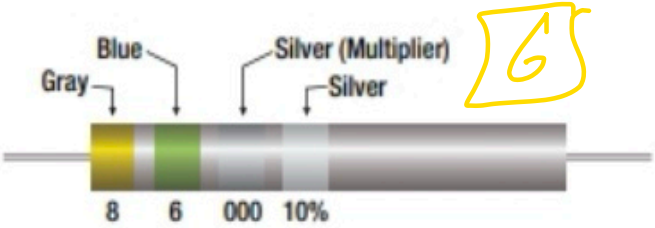


Figure 7-15. Resistor with a silver third band.

4

4 10

* 10×0.01
$= 0.1\Omega$

* max : $10 + 0.1$
$= 10.1\Omega$

* mini : $10 - 0.1$
$= 9.9\Omega$

5

5 10

* 10×0.10
$= 1$

* $1 + 0.02 =$
1.02

* $1 - 0.02 =$
0.98

6

6 86000

* 86000×0.10
$= 8600$

* max : $86000 + 8600$
$= 94600\Omega$

mini : $86000 - 8600$
$= 77400\Omega$

The Resistance in series / parallel circuit

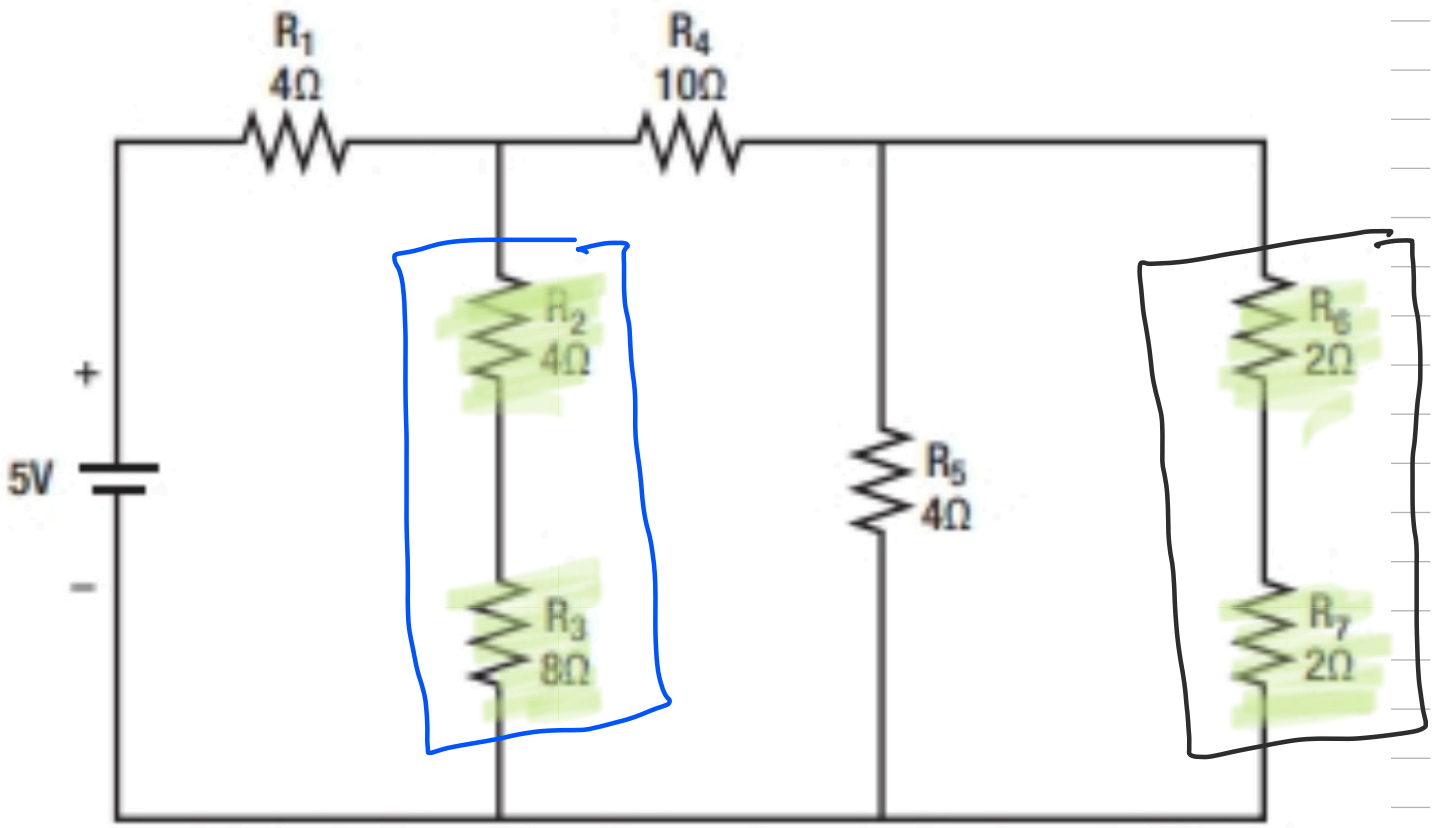


Figure 7-18. Calculations of resistance in circuits containing combinations of series and parallel paths.

$\boxed{1}$ $R_2 + R_3$

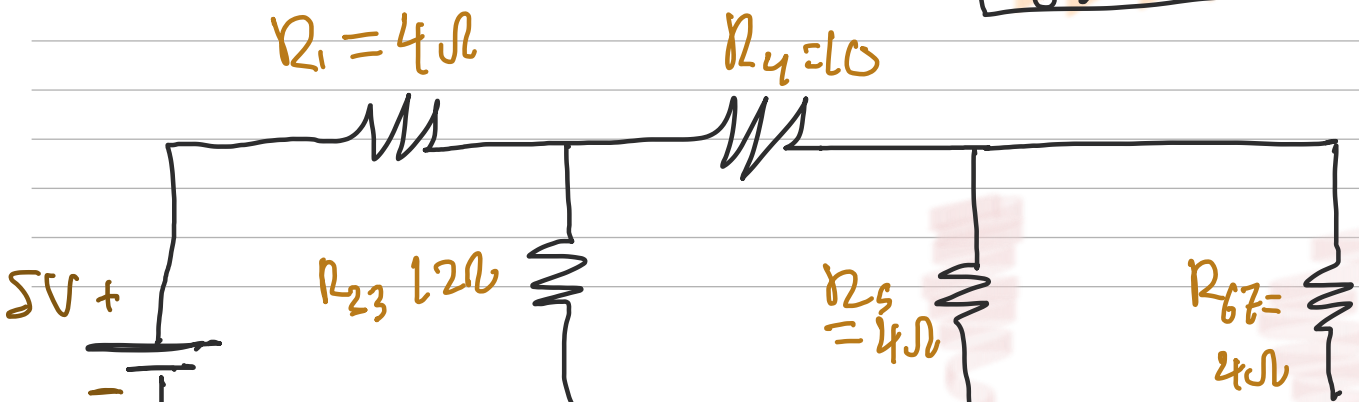
$R_{23} = 4 + 8$

$\boxed{R_{23} = 12\Omega}$

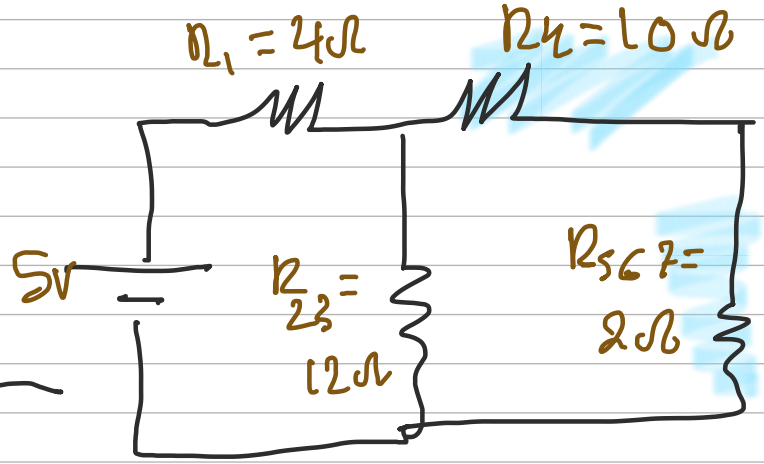
$\boxed{2}$ $R_5 + R_7$

$R_{67} = 2 + 2$

$\boxed{R_{67} = 4\Omega}$



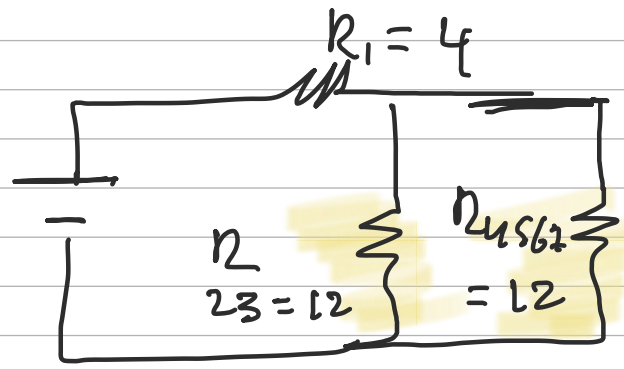
$\boxed{3}$ R_5 and R_{67} parallel



$$R_{567} = \frac{1}{\frac{1}{4} + \frac{1}{4}}$$

$$\boxed{R_{567} = 2\Omega}$$

$\boxed{4}$ R_4 and R_{567} series



$$R_4 + R_{567}$$

$$10 + 2$$

$$\boxed{R_{4567} = 12\Omega}$$

$\boxed{5}$ R_{23} and R_{4567} are parallel

$$R_{23456 7} = \frac{1}{\frac{1}{12} + \frac{1}{12}}$$

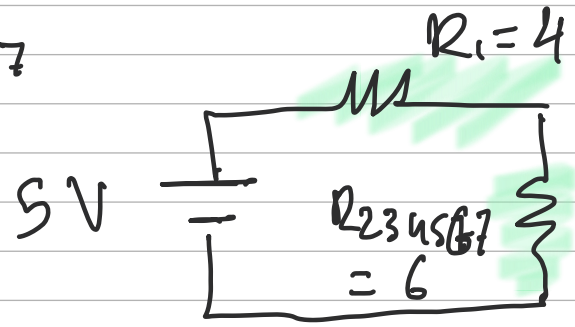
$$\boxed{R_{23456 7} = 6\Omega}$$

[6] R_1 and $R_{23456\,7}$ are series

$R_{123456\,7} = R_1 + R_{23456\,7}$

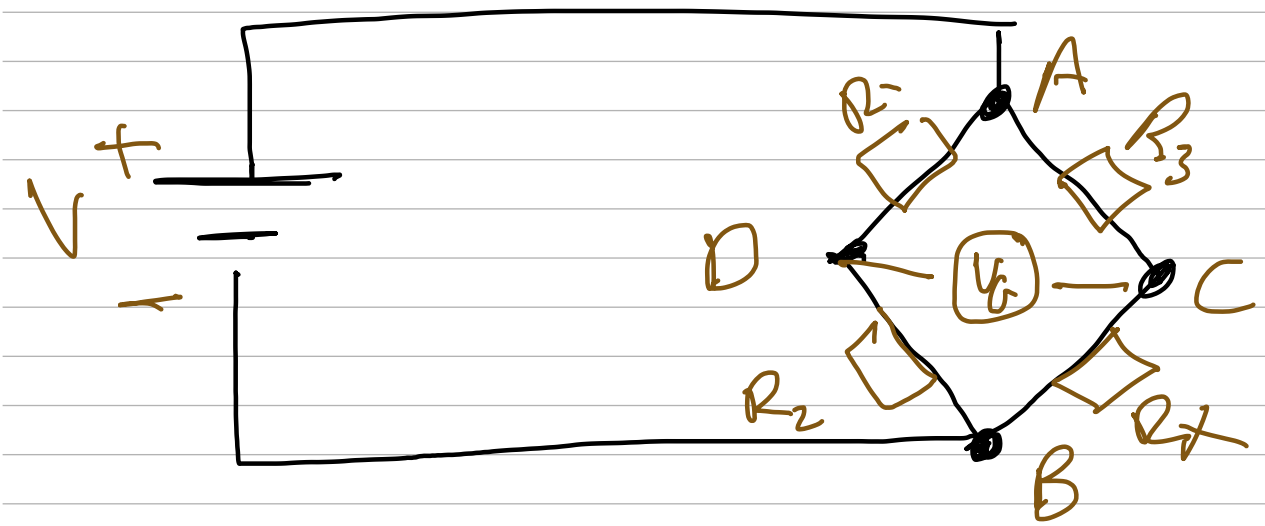
$R_{123456\,7} = 4 + 6$

$\boxed{R_{123456\,7} = 10\Omega}$



Balanced

C= Wheatstone Bridge



When $V_G = 0$

* $R_1 R_x = R_2 R_3$

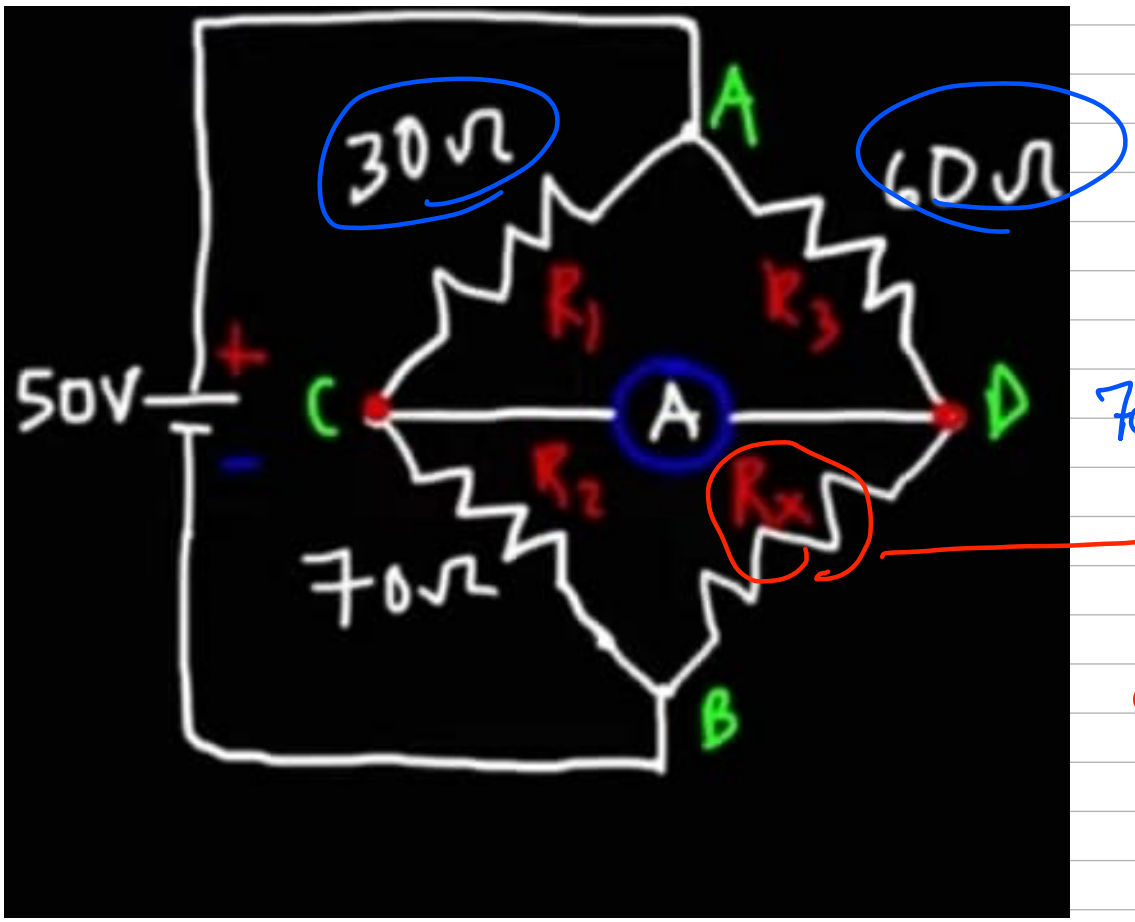
$R_2 = R_{pot}$

* $R_1 = R_3$

$R_x = R_{pot}$

Examples:-

$\frac{30}{60} = \frac{1}{2}$



$\frac{70}{??} = \frac{1}{2}$

$70 \times 2 = 140$

→ unknown

find Rx

??

$$R_1 R_x = R_2 R_3$$

$$\frac{30}{30} \cdot R_x = \frac{70 \times 60}{30}$$

$$\boxed{R_x = 140\,\Omega}$$