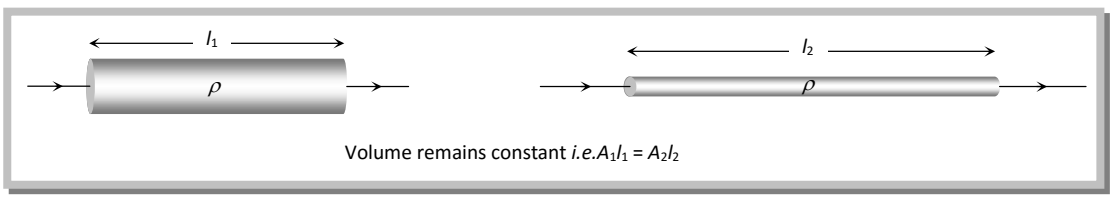
Stretching of Wire.

If a conducting wire stretches, its length increases, area of cross-section decreases so resistance increases but volume remain constant.

Suppose for a conducting wire before stretching its length = l1, area of cross-section = A1, radius = r1, diameter = d1, and resistance $R_1 = \rho \frac{l_1}{A_1}$

Before stretching after stretching



After stretching length = l2, area of cross-section = A2, radius = r2, diameter = d2 and resistance $= R_2 = \rho \frac{l_2}{A_2}$

Ratio of resistances $\frac{R_1}{R_2} = \frac{l_1}{l_2} \times \frac{A_2}{A_1} = \left(\frac{l_1}{l_2}\right)^2 = \left(\frac{A_2}{A_1}\right)^2 = \left(\frac{r_2}{r_1}\right)^4 = \left(\frac{d_2}{d_1}\right)^4$

(1) If length is given then $R \propto l^2 \Rightarrow \frac{R_1}{R_2} = \left(\frac{l_1}{l_2}\right)^2$

(2) If radius is given then $R \propto \frac{1}{r^4} \Rightarrow \frac{R_1}{R_2} = \left(\frac{r_2}{r_1}\right)^4$

Note: After stretching if length increases by n times then resistance will increase by n2 times i.e. $R_2 = n^2 R_1$. Similarly if radius be reduced to $\frac{1}{n}$ times then area of cross-section decreases $\frac{1}{n^2}$ times so the resistance becomes n4 times i.e. $R_2 = n^4 R_1$.

After stretching if length of a conductor increases by x% then resistance will increases by 2x % (valid only if x < 10%)