Q. 05   Suppose there is a circuit consisting of only resistances and batteries. Suppose one is to double (or increase it to n-times) all voltages and all. resistances. Show that currents are unaltered. Do this for circuit of Examples 3, 7 in the NCERT Text Book for Class XII.

Solution:

Let us first assume the equivalent internal resistance of the battery is R_{eff}, the equivalent external resistance R and the equivalent voltage of the battery is V_{eff}
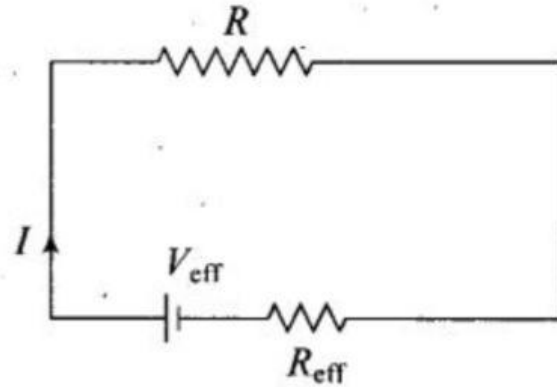
Now by applying Ohm's law,
Then current through R is given by

$$I = \frac{V_{\text{eff}}}{R_{\text{eff}} + R}$$

Now according to the question if all the resistances and the effective voltage are increased n-times, then we have

$$V_{\text{eff}}^{\text{new}} = nV_{\text{eff}}, R_{\text{eff}}^{\text{new}} = nR_{\text{eff}}$$

and $R^{\text{new}} = nR$

Then, the new current is given by

$$I' = \frac{nV_{\text{eff}}}{nR_{\text{eff}} + nR} = \frac{n(V_{\text{eff}})}{n(R_{\text{eff}} + R)} = \frac{(V_{\text{eff}})}{(R_{\text{eff}} + R)} = I$$

The last result of two equations is same, so we can say that current remains the same.