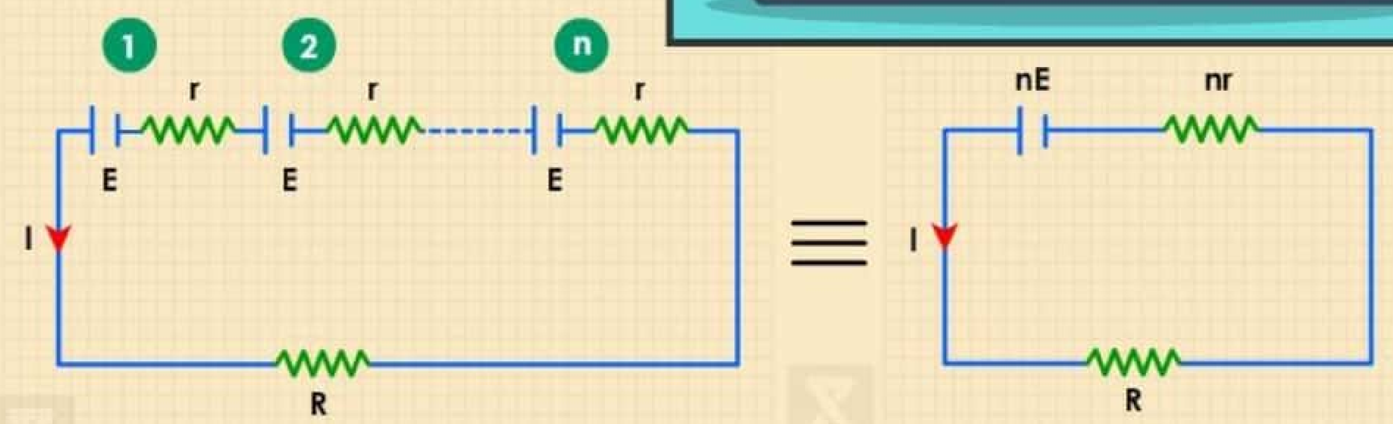
Part I

CELLS AND ELECTRIC POWER

COMBINATIONS OF CELLS

1 CELL IN SERIES



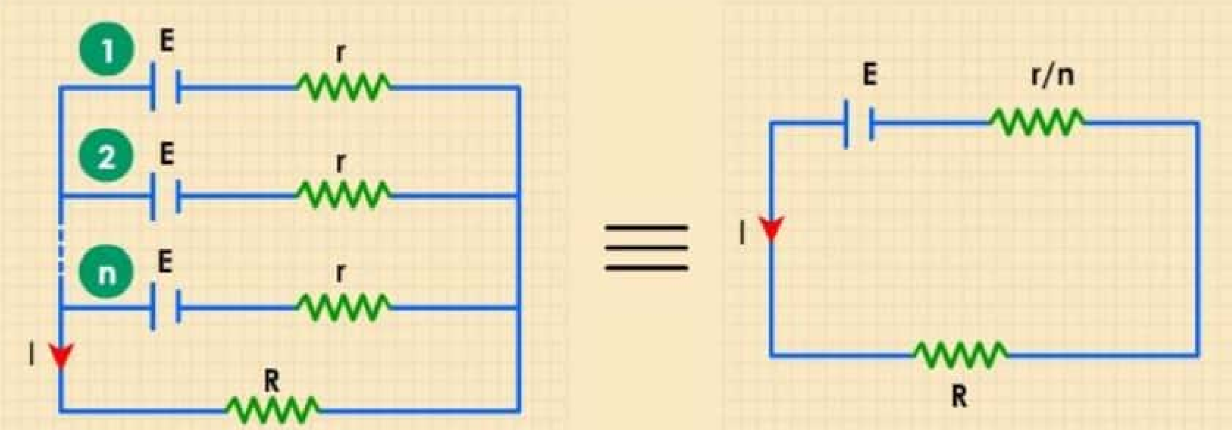
- Net EMF of the cells = nE,
- Total internal resistance = nr,
- Hence total resistance of the circuit = nr + R,

$$I = \frac{\text{net EMF}}{\text{Total Resistance}} = \frac{nE}{nr + R}$$

Case I If nr < < R, then $I \cong nE/R$ i.e. current obtained from the cells is approximately equal to n times the current obtained from a single cell.

Case II If nr > > R, then $I \cong nE/nr = E/r$ i.e. current obtained from the combination of n cells is nearly the same as obtained from a single cell.

2 CELL IN PARALLEL



When E.M.F's and internal resistance of all the cells are equal

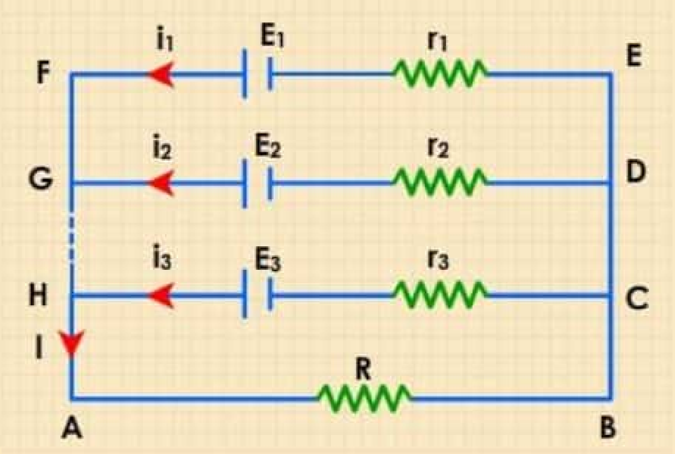
- E.M.F of battery = E.
- Total internal resistance of the combination of n cells = r/n
- Total resistance of the circuit = (r/n) + R

$$I = \frac{\text{net E.M.F}}{\text{Total Resistance}} = \frac{E}{(r/n)+R} = \frac{nE}{r+nR}$$

Case I If $r << R$, the $I \cong nE/nR = E/R$; then total current obtained from combination is approximately equal to current given by one cells only.

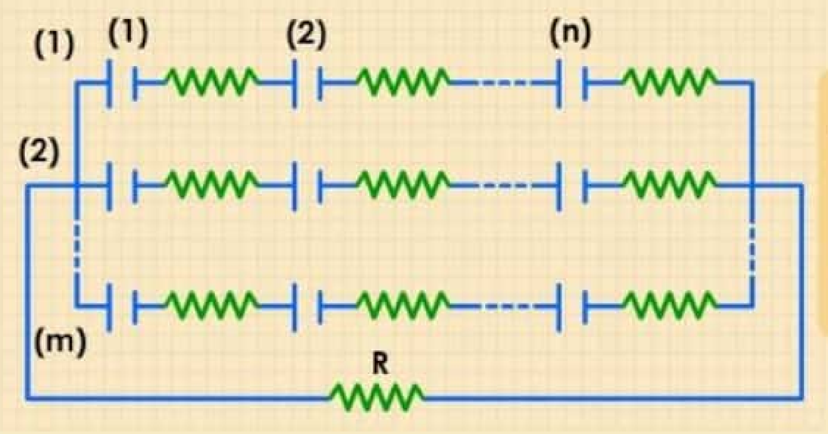
Case II If $r >> R$, then $I \cong nE/r$; then total current is approximately equal to n times the current given by one cell.

When E.M.F's and internal resistance of all the cells connected in parallel are different



$$I = \frac{\sum_{i=0}^{n} \frac{E_i}{r_i}}{1+R\sum_{i} \frac{1}{r_i}} \text{ and } E_{eq.} = \frac{\sum \frac{E_i}{r_i}}{\sum \frac{1}{r_i}},\ r_{eq.} = \frac{1}{\sum \frac{1}{r_i}}$$

3 CELL IN MIXED GROUPING



Total resistance of the circuit $= \left[\left(\frac{nr}{m}\right) + R\right]$

$$I = \frac{\text{net E.M.F}}{\text{Total Resistance}} = \frac{nE}{(nr/m)+R} = \frac{nmE}{nr+mR}$$

ELECTRICAL POWER

The energy liberated per second in a device is called its power. The electrical power P delivered by an electrical device is given by

$$P = \frac{dq}{dt}V \quad P = VI \quad P = I^2R \quad P = \frac{V^2}{R} \text{ watt}$$