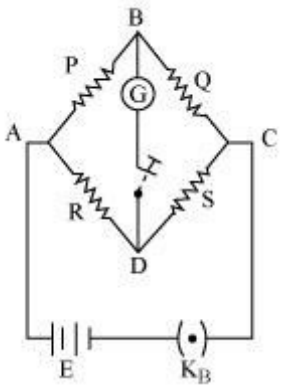
12. Current Electricity

Kirchhoff's laws:

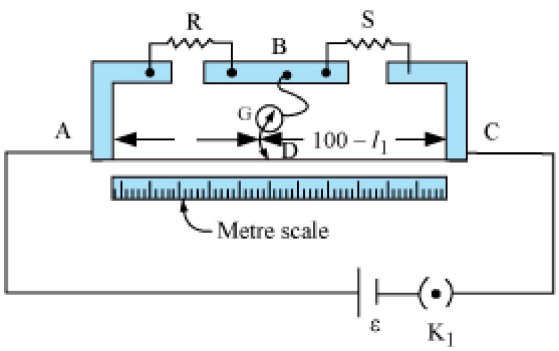
- First law: In any electrical network, the algebraic sum of the currents, sum for blank of I, meeting at a junction is always zero.
- Second law: The algebraic sum of all the potential drops and emfs along any closed path in a network is zero.

Wheatstone bridge:



P over Q equals R over S

Metre Bridge:



Here comma space R over S equals fraction numerator R subscript c m end subscript l subscript 1 over denominator R subscript c m end subscript left parenthesis 100 minus l subscript 1 right parenthesis end fraction therefore R equals fraction numerator S l subscript 1 over denominator 100 minus l subscript 1 end fraction

- **Causes of probable errors while using a metre bridge:**
  - Uneven thickness of the wire used in the metre bridge
  - Contact resistances developed at the ends of the wire of the metre bridge
  - Ends of the wire not coinciding with the 0 and 100 cm marks of a metre scale

- We can minimise the errors in a metre bridge by using wire of uniform thickness and repeating the experiment by changing the position of the unknown resistance.
- In Kelvin's method, the resistance of galvanometer is given by

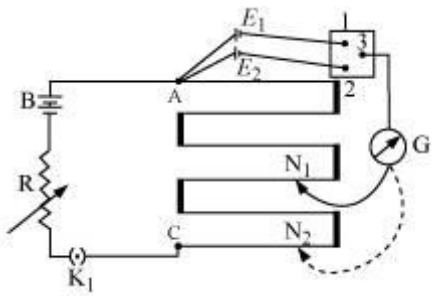
G space equals space R cross times open parentheses fraction numerator l subscript g over denominator 100 minus l subscript g end fraction close parentheses
, where R is the resistance and l_g is the point where the galvanometer shows the same deflection as shown while the jockey was not touching the wire.

- **Potentiometer**

It works on the principle that on passing a constant current, the potential drop across any portion of the wire is directly proportional to the length of that portion.
i.e., V α l

- **Applications of a Potentiometer**

Comparison of emfs of two cells

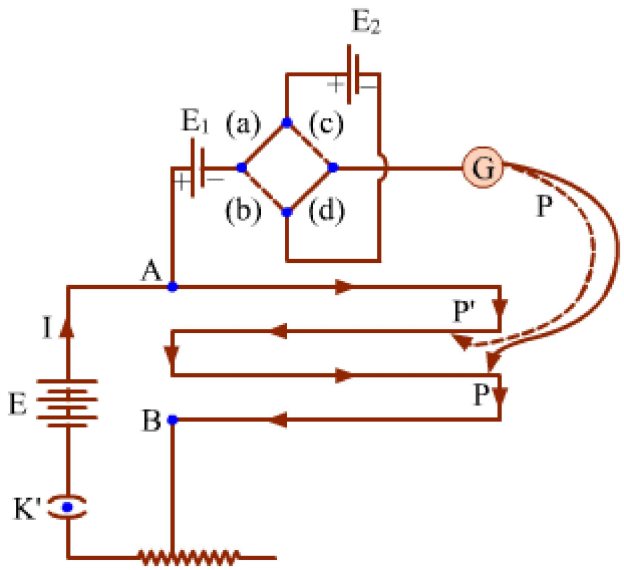


E1E2=l1l2

Measurement of internal resistance of a cell

r=Rl1l2-1

Comparison of emfs using the sum and difference method



E1E2 =L1 + L2L1 - L2

- **Sensitivity of Potentiometer**
The smallest ptential difference that can be measured with a potentiometer is known as its sensitivity. The sensitivity of a potentiometer can be increased by decreasing its potential gradient (E/l). The potential gradient can be decreased by following ways:
  - Increasing the length of potentiometer

    - Decreasing the current in the potentiometer wire circuit if the wire is of fixed length
- **Precautions to be taken while using a potentiometer**
    - The potentiometer wire must be uniform.
    - The resistance of potentiometer wire should be high.
    - The emf of the battery must be greater then the emfs that are to be compared.
- **Advantages of a potentiometer**
    - It can measure the terminal potential difference as well as the emf of a cell.
    - Its accuracy can also be increased by increasing the length of the wire.
- **Disadvantages of a potentiometer**
    - It cannot directly indicate the value of the potential difference.
    - It is not portable.