To find internal resistance of a cell :

The experimental arrangement to determine the internal resistance of a cell is shown in given figure.
Here, we have to find the internal resistance (r) of a test cell With Emf E.

During experiment, we slide a jockey over the potentiometer wire in order to obtain null deflection in the galvanometer. (Like meter bridge, the potentiometer also works under balanced condition).

Step 1: When K_1 is close and K_2 is open:

If C be the balanced point, then

Emf: $E = V_{AC}$

From principle of potentiometer,

$V_{AC} \propto l_1$

Thus, $E \propto l_1$

or, $E = kl_1$ …….. (1)

Step 2: **When K_1 is open and K_2 is close**:

If C' be the balanced point, then

TPD: $V = V_{AC'}$

From principle of potentiometer,

$V_{AC'} \propto l_2$

Thus, $V \propto l_2$

or, $V = kl_2$ …….. (2)

From equation (1) and (2),

$$\frac{E}{V} = \frac{l_1}{l_2}$$

or, $$\frac{Ir+IR}{IR} = \frac{l_1}{l_2}$$

or, $$\frac{r}{R} + 1 = \frac{l_1}{l_2}$$

or, $$r = \left[\frac{l_1}{l_2} - 1\right] \times R$$

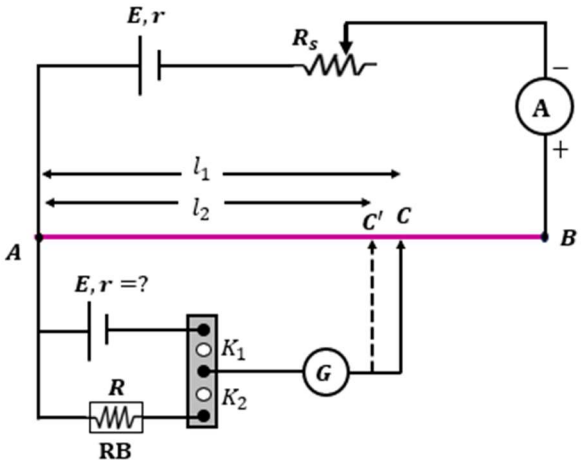
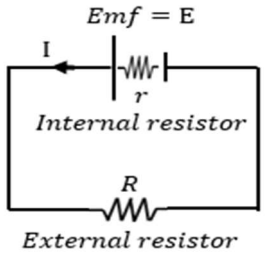


Figure: Determination of internal resistance (r) by using *Potentiometer*



$E = Ir + V$ and $V = IR$

By knowing values of l_1 *and* l_2 and R, the internal resistance (**r**) of the test cell can be calculated.

Working formula:

- ✓ For the comparison of emf of two cells:

  If, l_1 is balanced length in open circuit

  l_2 is balanced length in close circuit

  R is the resistance shunted across the test cell (Connected across the test cell)

  Then, $$r = \left[\frac{l_1}{l_2} - 1\right] \times R$$