

Potentiometer | Determination of Unknown emf

A very simple instrument that can measure and compare [potential differences](#) accurately without drawing any [electric current](#) from the circuits is called a potentiometer.

Topic Related video:

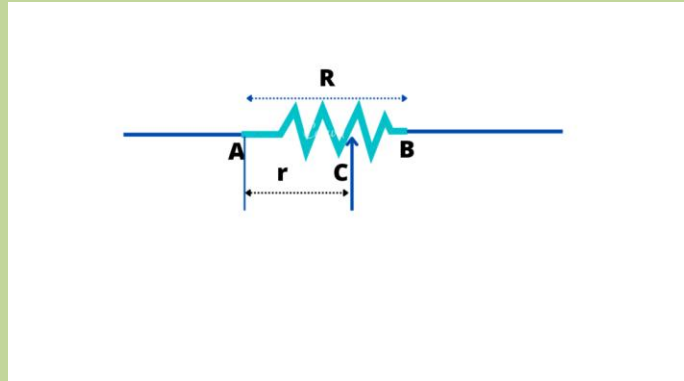
[what is Potentiometer?](#)

Principle of Potentiometer:

The potential difference across any length of a wire of uniform cross-section area is directly proportional to its length when a constant current passes through it.

Construction of potentiometer:

It consists of a [resistor](#) R in the form of a wire connected between points A and B.



A terminal C can slide on it. The resistance between A and C can be varied from 0 to R on the sliding contact C is moved from A to B.

When a battery of emf E is connected across R, the current following through it is given by:

$$E=IR$$

Or

$$I=E/R$$

Let r be the resistance between points A and C Then the potential drop between these points is given by:

$$V_{ac}=E/R \times r$$

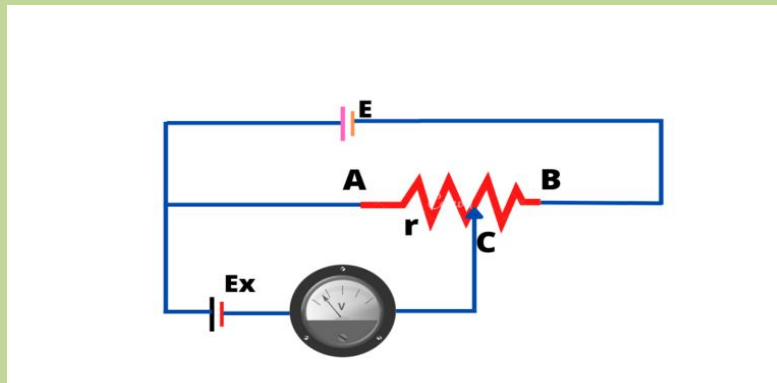
What is a Potential divider?

As 'C' moves from A to B. varies from 0 to R and potential drop changes from 0 to E. Such an arrangement is known as a "Potential Divider".

Determination of unknown emf:

Consider a cell of emf “Ex” which is to be determined. It is connected between A and sliding contact C through a galvanometer.

The positive terminal of Ex and potential divider are commonly connected at point A.



In the loop AGCA, if the point C and the negative terminal of Ex are at the same potential, then the potential and no current will flow through the galvanometer.

Thus to measure the potential Ex the position of C is so adjusted that the galvanometer shows no deflection. In such a case emf Ex of the cell is equal to the potential difference between A and C

$$Ex = E \times r / R$$

But resistances are proportional to their respective lengths.

$$r \propto l$$

$$R \propto L$$

$$Ex = E \times l / L$$

Where L is the total length of the wire AB and l is the length from A to C. The unknown emf Ex should not exceed E otherwise null condition

will not be satisfied. Thus potentiometer is the most accurate method for measuring potent

Comparison of the emf's of two cells:

The method for measuring the emf of a cell can be used to compare the emf's E_1 and E_2 of two cells.

The balancing lengths l_1 and l_2 are determined separately for the two cells

For the first cell

$$E_1 = Exl_1/L$$

For the second cell

$$E_2 = Exl_2/L$$

Dividing the two equations

$$E_1/E_2 = l_1/l_2$$

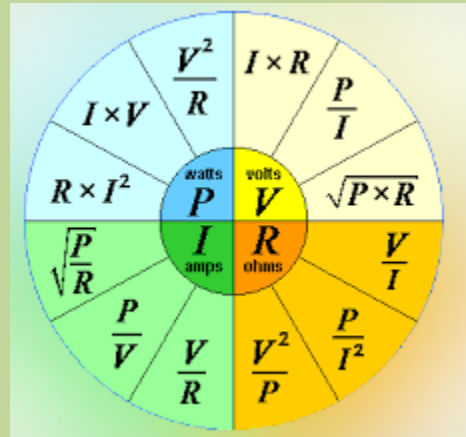
Thus the ratio of the EMFs is equal to the ratio of their balancing lengths

Why we use potentiometer:

Potential difference is usually measured by an instrument known as a voltmeter.

A voltmeter measures the P.D correctly only when its resistance is very large than the resistance of the circuit so that no current is passing through it. An ideal voltmeter has infinite resistance.

Some other potential measuring instruments are digital voltmeter and cathode-ray oscilloscope. They have large resistance and draw no current from the circuit. But these instruments are very expensive and are difficult to use.



Edu input
Education for everyone