D.N.R.COLLEGE(A)::BHIMAVARAM-534202

(A College with potential for excellence & Re-accredited at " B^{++} " level by NAAC)

Department of Physics

Capt.Dr. A.VEERAIAH M.Sc., M. Tech., Ph.D.

Assistant Professor, Principal Investigator, Research Director & NCC Officer

PHONE: +91-8143395467, avru@rediffmail.com

ELECTRIC POTENTIAL(విద్యుత్ పొటన్షియల్)

Definition(నిర్వచనం):

Electric potential at a point in an electric field is defined as the amount of work done by an external agent in carrying a unit positive charge from infinity to that point against the electric field.

Electric Potential difference(విద్యుత్ పొటన్షియల్ బేధం):

Electric Potential difference is defined as the ratio between the amount of work done in moving a test charge from one point to another point in an electric field to the magnitude of test charge between the two points.

The electric potential concept may be compared with liquid flow. Liquids travel from high level to low level. Similarly the electric charge flows from the point of high potential to the point of low potential

Let 'W' is the work done in moving a test charge q_0 from point B to point A, then the potential difference, V_A-V_B is mathematically expressed as

$$V_A - V_B = \frac{W}{q_0} \qquad \text{----------(1)}$$

If the point 'B' is taken as infinity, then the potential at 'B' may be taken as zero.

$$\therefore V_A = \frac{W}{q_0} \Longrightarrow V = \frac{W}{q_0}$$

MKS unit of potential difference is Volt. One Volt is defined as the difference in between two points so that one joule of work is done in carrying one coulomb of charge from one point to the other.

D.N.R.COLLEGE(A)::BHIMAVARAM-534202

(A College with potential for excellence & Re-accredited at " B^{++} " level by NAAC)

Department of Physics

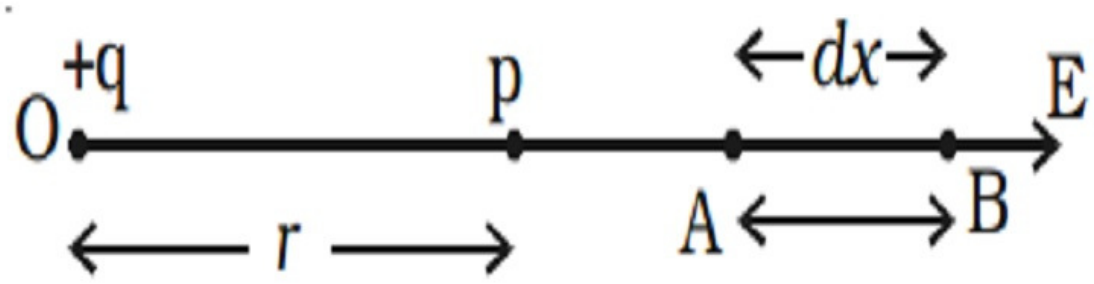
Capt.Dr. A.VEERAIAH M.Sc., M. Tech., Ph.D.

Assistant Professor, Principal Investigator, Research Director & NCC Officer

PHONE: +91-8143395467, avru@rediffmail.com

Potential due to a point charge(బిందు విద్యుదావేశం వల్ల విద్యుత్ పొటన్షియల్):

Point charge: An electric **charge** considered to exist at a single **point**, which doesn't have neither area nor volume. Point charges, such as electrons, are among the fundamental building blocks of matter.



Potential due to a point charge:

Consider a point charge +q as shown in the above figure. The electric field due to this charges is radially outward. Here, we derive an expression for electric potential at point 'B' at a distan ce of r_B from the charge. For this purpose, consider two points A and B as shown in the figure. Let, a test charge q_0 is moved from A to B along the radial line.

When the test charge is within the electric field, it experiences a force. The force exerted by the the teste charge is given by q_0E. Where, E is electric field. To move the test charge from A to B, a force $-q_0E$ must be applied. The work done by an external agent to move the test charge q_0 through a small distance dr is given by

$dW=q_0E.dr = q_0Edrcos180^{\circ}= - q_0E.dr$

As $E = \frac{1}{4\pi\varepsilon_0} \times \frac{q}{r^2}$, dW *is given by* $dW = -\frac{1}{4\pi\varepsilon_0} \times \frac{qq_0}{r^2}.dr$

Capt.Dr. A.VEERAIAH M.Sc., M. Tech., Ph.D.

Assistant Professor, Principal Investigator, Research Director & NCC Officer

PHONE: +91-8143395467, avru@rediffmail.com

The total work done in moving the test charge from A to B is given by

$$W_{AB} = \int_{r_A}^{r_B} -\frac{1}{4\pi\varepsilon_0} \times \frac{qq_0}{r^2}.dr = -\frac{qq_0}{4\pi\varepsilon_0}\left[-\frac{1}{r}\right]_{r_A}^{r_B} = \frac{qq_0}{4\pi\varepsilon_0}\left[\frac{1}{r_B} - \frac{1}{r_A}\right]$$

Therefore, the potential difference between two points will be

$$V_B - V_A = \frac{W_{AB}}{q_0} = \frac{q}{4\pi\varepsilon_0}\left[\frac{1}{r_B} - \frac{1}{r_A}\right]$$

To find the potential at point B, the reference point A is taken at infinity so that $V_A = 0$.

$$\therefore V_B = \frac{1}{4\pi\varepsilon_0} \times \frac{q}{r_B}$$

Therefore, the general expression for potential becomes $V = \frac{1}{4\pi\varepsilon_0} \times \frac{q}{r}$

model questions(మాదిరి ప్రశ్నలు)

1. Define Electric potential. What is point charge? Explain.
2. Derive an expression for potential due to a point charge.
3. Using the basic definition of electric potential, derive an expression for the potential due to a point charge.
4. Distinguish electric potential and Potential difference.

References

1. Unified Physics, Volume III, JAI PRAKASH NATH PUBLICATIONS, MEERUT

D.N.R.COLLEGE(A)::BHIMAVARAM-534202

(A College with potential for excellence & Re-accredited at " B^{++} " level by NAAC)

Department of Physics

Capt.Dr. A.VEERAIAH M.Sc., M. Tech., Ph.D.

Assistant Professor, Principal Investigator, Research Director & NCC Officer

PHONE: +91-8143395467, avru@rediffmail.com

*****