**Chapter 29: Electric Potential**

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## 29.1 Electric Potential

Electric potential difference is the work done in moving a point charge from one point to another.

The electric potential at a point is the work done in bringing a point charge from infinity to that point in the electric field.

Electric potential is path independent as only the work done along the electric field is to be considered.

A locus of points that have the same electric potential is called an equipotential surface. No work is done in moving a point charge along an equipotential surface.

## 29.2 Potential and Field Strength

Electric Potential difference is also equal to the electric field strength acting on a charge times the distance the charge is moved against that force.

## 29.3 Potential Due to a Point Charge

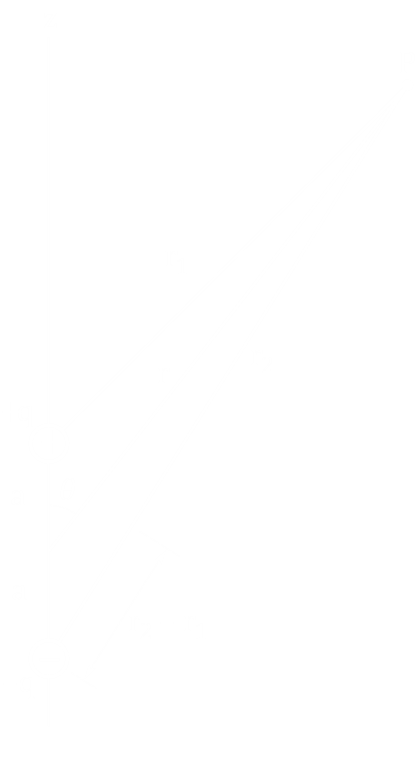
For a point charge, the electric potential changes with the distance of the test charge from the centre of the point charge.

## 29.4 A Group of Point Charges

The potential at any point due to a group of point charges is the algebraic sum of the potential due to each individual charge. On occasion, integrals may need to be used to find this sum (as was done with Gauss’s Law).

## 29.5 Potential Due to a Dipole

Two equal charges of opposite sign, separated by a distance create an electric dipole. The dipole moment is given by .



Considering only points where ,

and

Here , meaning the value depends on the product of and but not on their individual values.

The equation shows that no work is done in bringing a point charge in from infinity along the perpendicular bisector of the dipole. has its greatest positive value when and its greatest negative value when .

## 29.6 Electric Potential Energy

The electric potential energy of a system is the work required to assemble this system of charges by bringing them in from an infinite distance.

29.7 Calculating from

is the negative of the rate of change in .

## 29.8 An Insulated Conductor

Gauss’s Law has already proven that after a steady state has been reached, any excess charge placed on an insulated conductor will remain on its outer surface. The charge will also distribute itself such that all points on the conductor, both on the surface and inside, have the same potential. If this were not true, there would be a flow of current which contradicts the statement that a steady state has been reached. The charge will thus move until all points are brought to the same potential.

So, inside the sphere, is zero and is constant, while outside, both decreases exponentially, as though the charge of the conductor where concentrated at its centre.

It should also be noted that charge density tends to be higher at sharper surfaces than on plainer ones.

=========================== Skipping Section 29.9 ============================