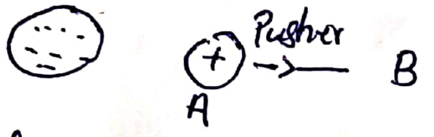
Name: SHAFIQ ID: 14859 Page # 1

State the relationship between electric potential difference with example

Electric Potential and Potential difference:-

a negative charge picked in space and positive charge nearby negative attract the positive

(−) → It produce electric field around it
negative



if we have to point B

if we push exert force through distance so the work done

work = F × X

"we expend energy"

So the energy goes to potential energy.

if we purpose surface of earth.

Electric Potential:

$$V = K \frac{Q}{r}$$

Q → Single charge

Q → $\xrightarrow[\text{distance}]{r}$ · P

Name SHAFIQ ID 14859 Page 2

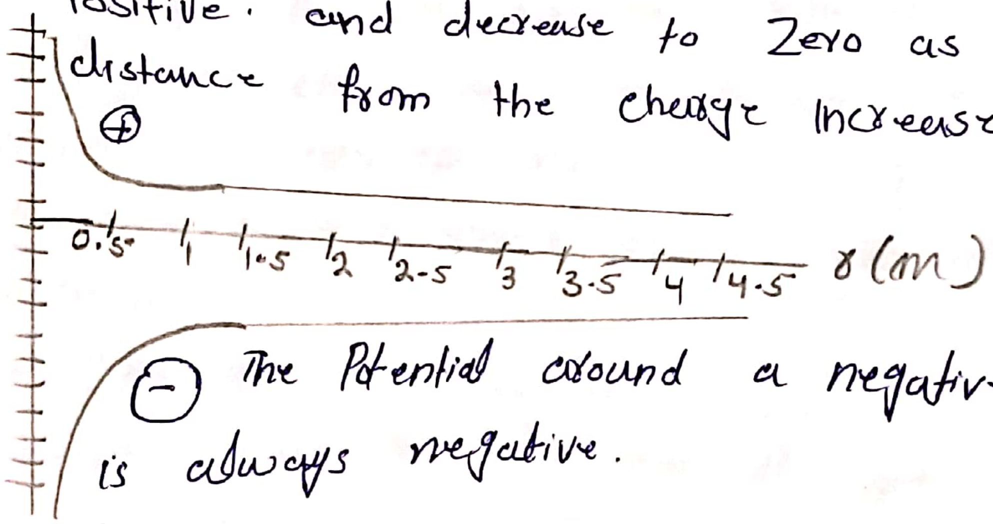
Electric Potential energy Per unit of charge.

V = Potential , $U_e \rightarrow$ Potential energy

$$V = \frac{U_e}{q} = \frac{J}{C} = \text{Volts}$$

$$V = \frac{K Q \cancel{q} / r}{\cancel{q}} \qquad V = K\frac{Q}{r}$$

The Potential around Positive charge is always Positive. and decrease to Zero as the distance from the charge increase.



The Potential around a negative charge is always negative.

And Increase to Zero as the distance from the charge Increase.

Electric Potential Difference: The electrical Potential difference is defined as the amount of work done to carrying a unit charge from one Point to another in an electric field in other words the Potential difference is defind as the difference in in the electric Potential of the two charged ~~ts~~ bodies.

<u>Unit</u>: The unit of Potential difference is Volt.

Q2. State the difference and similarity b/w gradient and divergence Providing relevent examples?

Ans. The gradient is the directional rate of change of a scalar function in RnRn whereas the divergence measures the amount of output vs input for a unit volume of a vector valued flow in RnRn

The gradient has the magnitude of the rate of change in the direction of that change

The gradient is what you get when you multiply Del by a Scaler function Grad (f)= Note that the result of the gradient is a vector field. we can Say that the gradient operation turns a Scalar field into a vector field.

The divergense is an operator which takes in the vector valued function defining this

Vector field and outputs a Scalar valued function measuring the change in density of the fluid at each Point.

For Example:- The gradient of the distance from a given Point is a vector field of unit length vector Pointing away from the given Point.

whereas the divergence is the measure of the amount of flow out of a given volume minus the amount of flow into a given Volume.

For Example: The divergence of a flow with no Source or Sink is 0. if there is a net Source the divergence is Positive and if there is a net Sink the divergence is negative.

Compute $\text{div}\vec{F}$ and $\text{Curl}\vec{F}$ for $\vec{F} = x^2y\vec{i} - (z^3 - 3x)\vec{j} + 4y^2\vec{k}$

'Lets Compute the divergence first and there isn't much to do other than run through the formula

$$\text{div}\vec{F} = \nabla\cdot\vec{F} = \frac{\partial}{\partial x}(x^2y) + \frac{\partial}{\partial y}(3x - z^3) + \frac{\partial}{\partial z}(4y^2)$$

$$= \boxed{2xy}$$

Name SHAFIQ ID 14859 Page 5

Be Carefull to watch for minus Signs in front of any of the vector Components (2nd Component in this Case) it is easy to get in a hurry and miss them.

The Curl is a little more work but Still Just formula work So here is the Curl

$$Curl\vec{F} = \nabla \times \vec{F} = \begin{vmatrix} \vec{i} & \vec{i} & \vec{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ x^2y & 3x-z^3 & 4y^2 \end{vmatrix}$$

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$$= \frac{\partial}{\partial y}(4y^2)\vec{i} + \frac{\partial}{\partial z}(x^2y)\vec{j} + \frac{\partial}{\partial x}(3x-z^3)\vec{k} - \frac{\partial}{\partial y}(x^2y)\vec{k} - \frac{\partial}{\partial x}(4y^2)\vec{j} - \frac{\partial}{\partial z}(3x-$$

$$= 8y\vec{i} + 3\vec{k} - x^2\vec{k} + 3z^2\vec{i}$$

$$\boxed{(8y+3z^2)\vec{i} + (3-x^2)\vec{k}}$$

Name SHAFIQ ID 14859 Page 6

Find gradient of function F at Point (1, 1, 2) for $F = x^3 + y^3 z$.

Solutions. Point (1, 1, 2)

$$F = x^3 + y^3 z$$

$$\vec{\nabla} F = \frac{\partial F}{\partial x} i + \frac{\partial F}{\partial y} j = \frac{\partial F}{\partial z} k$$

$$\vec{\nabla} F = \frac{\partial (x^3 + y^3 z)}{\partial x} i + \frac{\partial (x^2 + y^3 z)}{\partial y} j \frac{(x^2 + y^2 z)}{\partial z} k$$

$$\text{Grad}(F) = \vec{\nabla} F = 3y^2 z i + 3x^2 z j + 3y^2 z k$$

At Point (1, 1, 2)

$$\text{Grad } F = \vec{\nabla} F = 6i + 6j + 6k$$

Find the Expression for moving a Point Charge Q from one Position to another by using line Integrals?

The Integral expression for the work done is moving a Point charge Q from one Position to another. In a example of a line Integral which in vector analysis notation always takes form of the Integral along some Prescribed Path of the dot

Product of a vector field using vector
Path length dL. without
we should be write.

$$w = -Q\int_{init}^{final} E_L \, dL$$

where E_L = Component of E along dL.

A line Integral is like many other Integrals which appear in advanced analysis including the Surface Integral appearing in Gauss's law in that it is essentially ~~de-Sen~~ descriptive. we like to look at it much more than we like to work it out. it tells us to chose a Path break it up into a large number of very Small Segments multiply the Component of the Segments This is a Summation of Course and the Integral is obtained exactly only when the number of Segments becomes Infinite.

This ~~Pro~~ Procedure is Indicated in figure 4.) where a Path has been chosen from an initial Position B to a final Position A and a uniform electric field selected for Simplicity The Path is divided into Six Segments.
$\Delta L_1 - \Delta L_2 \ldots\ldots \Delta L_6$ and the Components of E along each Segment are denoted by

denoted by $E_{L1} \cdot E_{L2} \cdots E_{L6}$ The work involved in moving a charge Q from B to A is then approximately.

$$W = -Q(E_{L1}\Delta L_1 + E_{L2}\Delta L_2 + \cdots + E_{L6}\Delta L_6)$$

or using vector notation.

$$W = -Q(E_1 \cdot \Delta L_1 + E_2 \cdot \Delta L_2 + \cdots + E_6 \cdot \Delta L_6)$$