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Electrostatic Force Can Give You Extra Work Done?

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Abstract: Using test charge (at rest) we bring another positive charge near to test charge in which we have to do the some work done thus, its potential energy is increases finally releasing it this charge give you kinetic energy(electrostatic force is conservative force).I try to develop group of system in which there is no work done is required or less, further releasing it will gain kinetic energy so that this system doing work done without or less work done

***Index Terms* – Electrostatic Force, Conservative Force , Non-Conservative Force**

I. Introduction

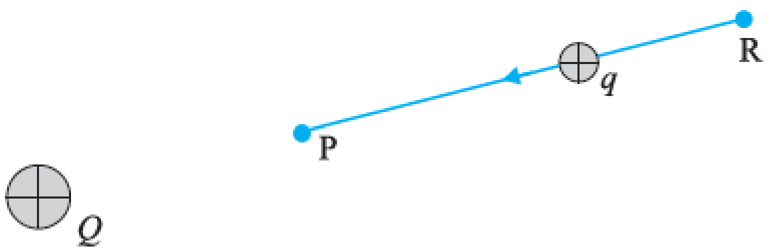
As we know that charges flow only in one condition – due to electric potential difference =Work done/q, e.g. V_2-V_1=W/q, if there is difference then current will flow from higher to lower

Question is that what electric potential and electric potential difference is

Electric potential (V)

$$V(r) = \frac{Q}{4\pi\varepsilon_0 r}$$

From infinity to 'r' position from test charge,

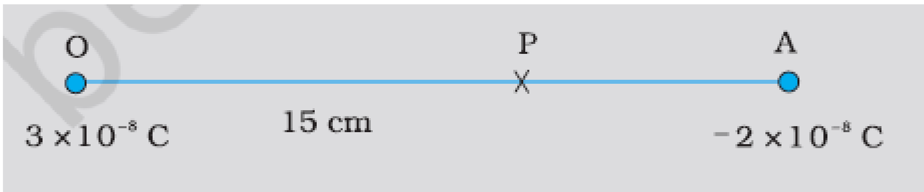


Electrostatic force is a conservative force. Work done by an external force (equal and opposite to the electrostatic force) in bringing a charge *q* from a point R to a point P is q(V_P–V_R), which is the difference in potential energy of charge *q* between the final and initial points.

Electric potential difference [**V_p-$V_{R]}$ = k [Q/r(OP) –Q/r(OR)]= work done(W)/q**

And it is path independent, means it
Let's take example, OA=15 cm

If we take test charge +3Q (positive and at rest at origin O) and another charge is that located at infinity.



OP= 9 cm, PA=6 cm, AZ=30 cm[extended towards right of A(not shown above)]
And OZ = 45 cm ,Z to infinity towards right side

Q=10^{-8} C, let's take initial charge Q(at infinity) in absence of charge(-2Q) point at A
So, **Vop –Vo infinity= k*3Q/OP**

, V=3*10^3 =3000 V,

Work done=V*Q=3*10^{-5} J (we seen that this work done in absence of -2Q charge. (1)

So point P is the releasing point later to obtain kinetic energy in Absence of charge -2Q

Now, we try to introduce the -2Q charge at point A [only test charge is present](it can be produce by friction Force or **triboelectric energy generation**, textile cloths and van de graff generator
That you will get the work done because of attractive nature(opposite charges),From infinity to point A, so remove the charge from point P, only 2 charges left. At points O and A

work done=k*3Q*(-2Q)/R(OA)= -3.6*10^{-5} J (2)

We found that 2 points along X-axis were have zero electric potentials

Let P be the required point on the x-axis where the potential is zero. If x is the x-coordinate of P, obviously x must be positive. (There is no possibility of potentials due to the two charges adding up to zero for $x < 0$.) If x lies between O and A, we have

$$\frac{1}{4\pi\varepsilon_0}\left[\frac{3\times10^{-8}}{x\times10^{-2}} - \frac{2\times10^{-8}}{(15-x)\times10^{-2}}\right] = 0$$

where x is in cm. That is,

$$\frac{3}{x} - \frac{2}{15-x} = 0$$

which gives x = 9 cm.

If x lies on the extended line OA, the required condition is

$$\frac{3}{x} - \frac{2}{x-15} = 0$$

which gives

x = 45 cm

Thus, electric potential is zero at 9 cm and 45 cm away from the positive charge on the side of the negative charge. Note that the formula for potential used in the calculation required choosing potential to be zero at infinity.

So that $V_{9cm}-V_{45cm}=$ work done/q= 0 joule

So work done on charge is zero because its depends upon initial and final Position(it is conservative force)

Input=out put (energy)=equation (1)= $3*10^{-5}$ J this energy we get only when if we remove the charge at A (-2Q)by grounding or earthing,so we get potential energy converted to Kinetic energy on releasing

Coficient of performance =output/input
= ($3.6*10^{-5}$ J +$3*10^{-5}$ J)/ small work done nearly zero= very large or infinity

IV. RESULTS AND DISCUSSION

We conclude that if we introduce the negative charge (-2q). It will stabilized the system and there will be 2 points at which

Potential will be zero and its difference of two points also zero along X-axis therefore,work done by us

Is very small or negligible. It's happen because we move from infinity to Z to P all these points have zero potential and finally zero potential difference => Work done is zero

Finally we can say that **Coefficient Of Performance** =very large,

REFERENCES

[1] NCERT- chapter 2-class 12th

[2] Measurements of Electric Static Charge Generated From Sliding of Cotton Against Clothes Textile, **Solid State Technology ISSN: 0038-111X Vol. 63, No. 4, (202)**