PH170

LAB ASSIGNMENT 2

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AIM:

Visualize Electric field lines and equipotential surfaces.

A. Plot the electrical field lines and equipotential surfaces by estimation for,

- Single positive charge (+1Q).
- Single negative charge (-2 Q).
- Single dipole (one positive charge and one negative charge).
- One charge with +2Q and one charge with –Q.
- Quadruple arrangement.

B. Determine the variables that affect the strength and direction of the electric field for a static arrangement of charges.

C. Investigate the variables that affect the strength of the electrostatic potential (voltage).

D. Describe and draw models for common static electricity concepts (transfer of charge, induction, attraction, repulsion, and grounding).

THEORY:

Electric Field lines in never intersect each other. They are perpendicular to the surface of the charge. The magnitude of charge and the number of field lines, both are proportional to each other. The start point of the field lines is at the positive charge and end at the negative charge. For the field lines to either start or end at infinity, a single charge must be used.

Equipotential surfaces are the surfaces where 0 work is done to move a charge over it.

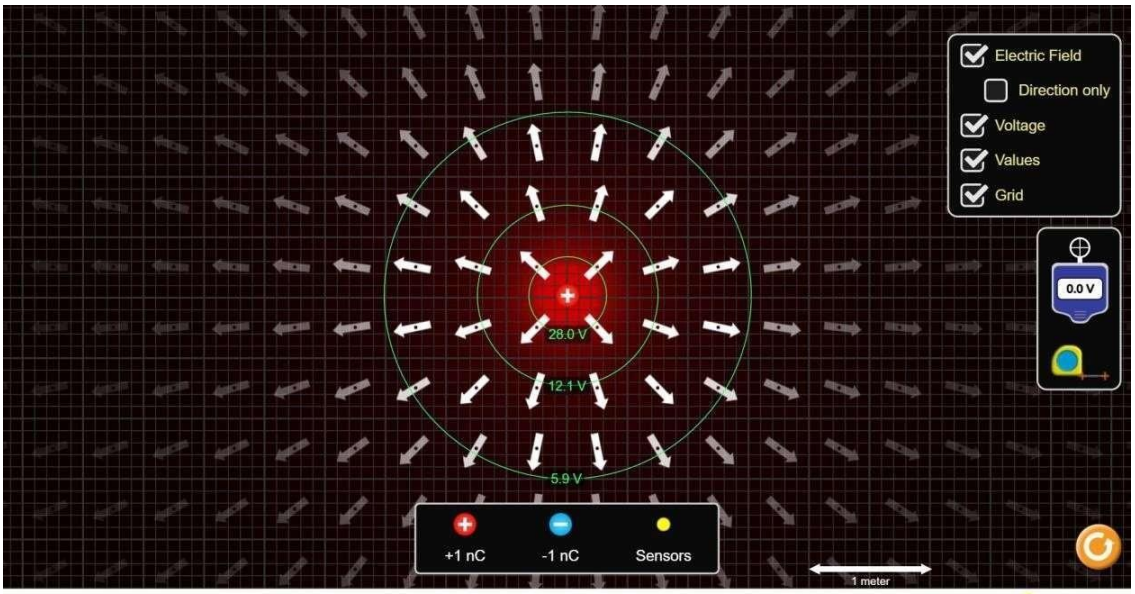
Theoretically, the strength of electric field lines decrease with the increase in the square of the distance.

Static electricity is an imbalance of electric charges within or on the surface of a material. The charge remains until it is able to move away by means of an electric current or electrical discharge.

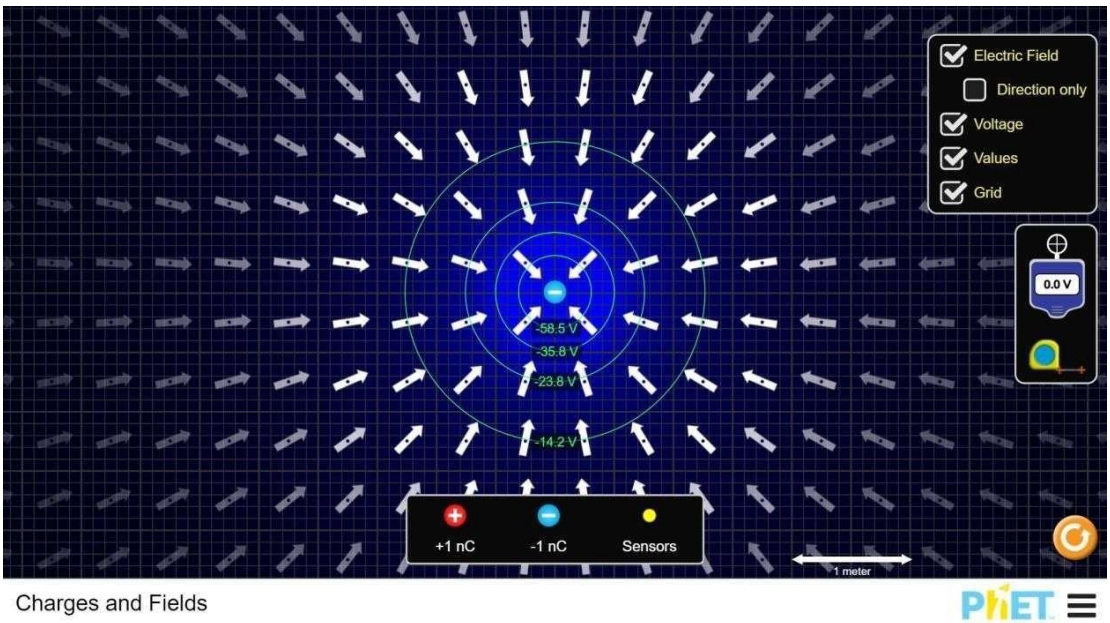
OBSERVATION TABLES AND RESULTS:

AIM 1 –

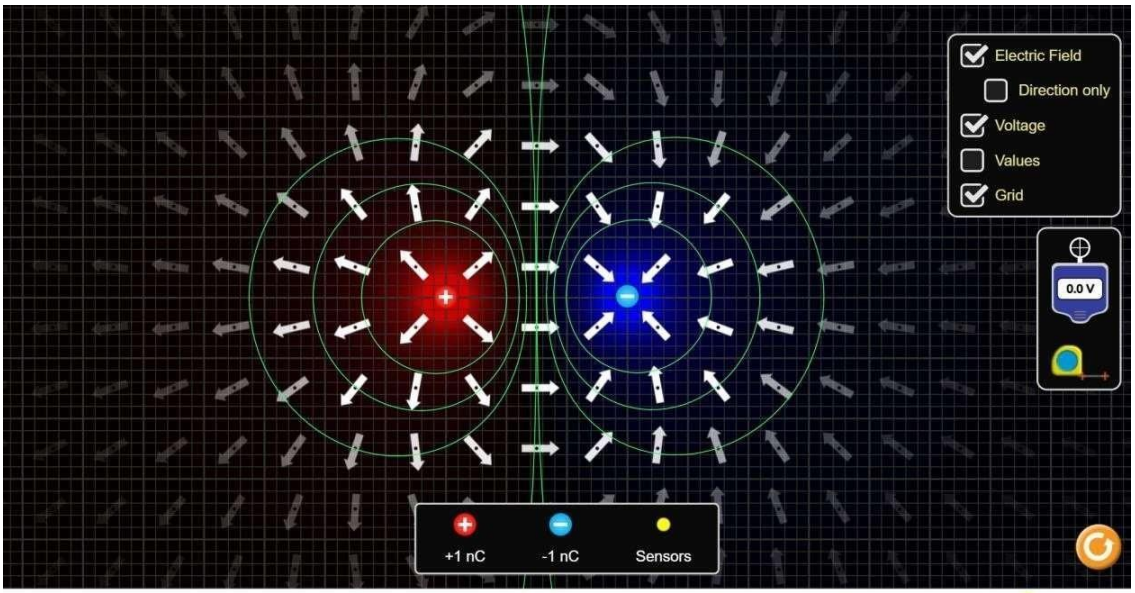
Objective 1



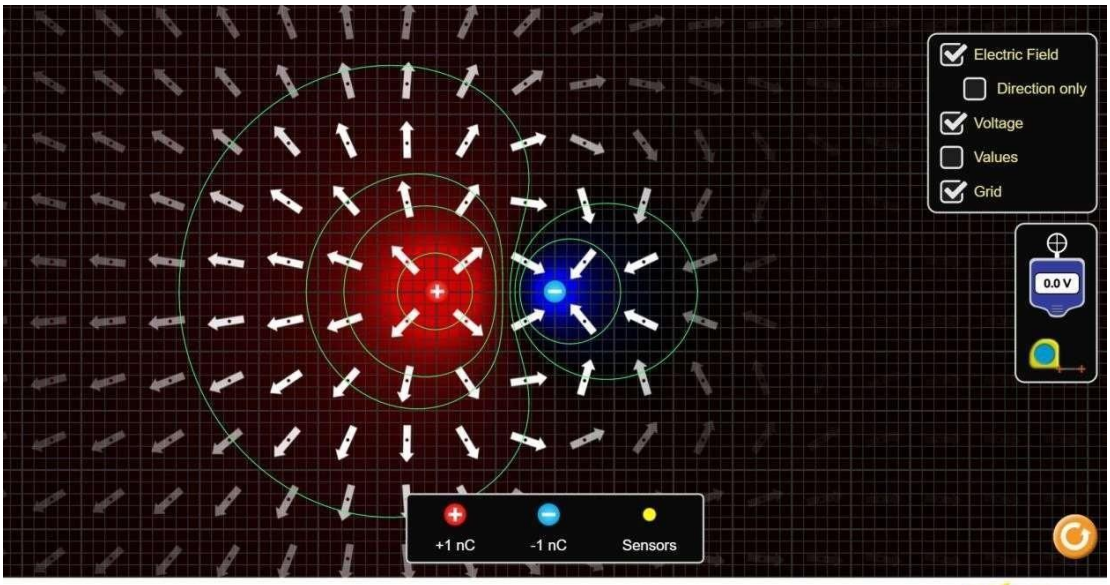
Objective 2



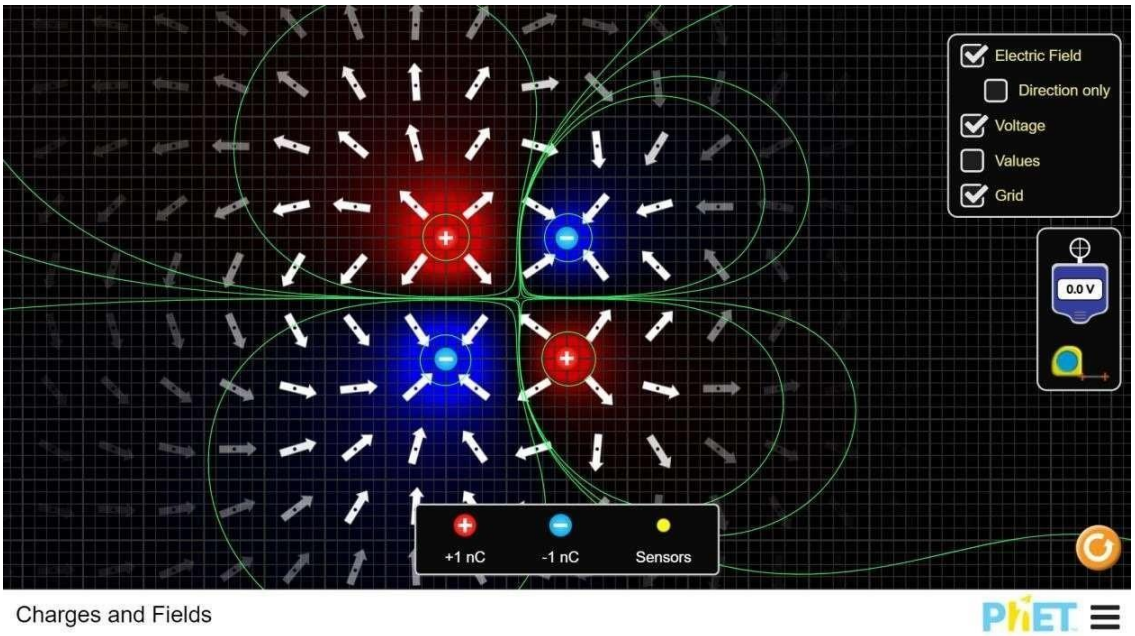
Objective 3



Objective 4

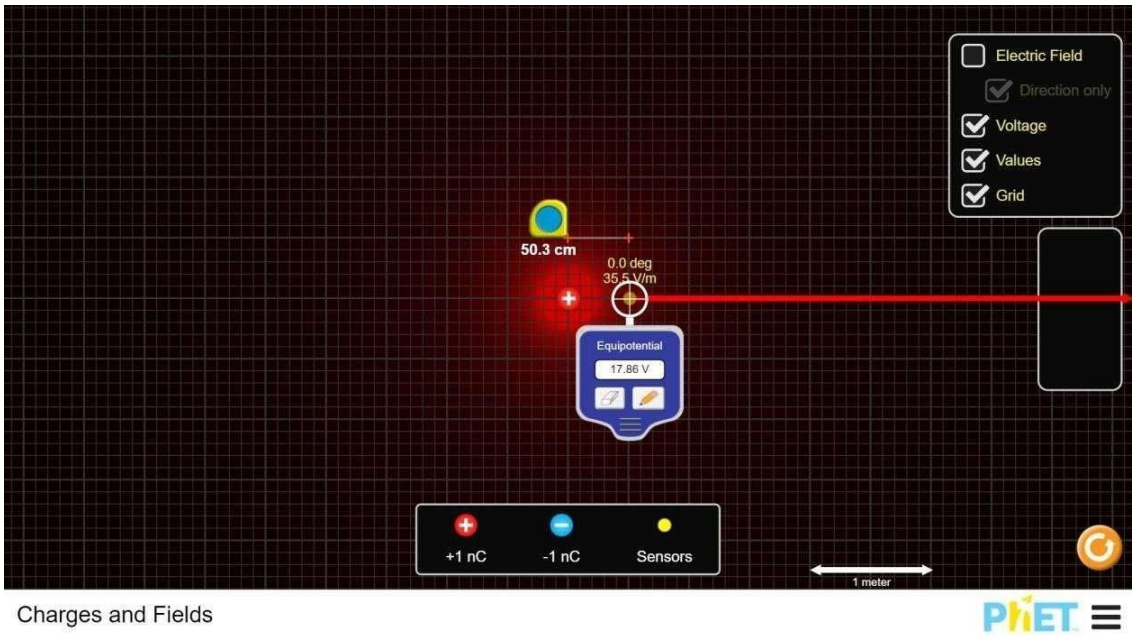


Objective 5



AIM 2 –

Figure 1:



For all the objectives in aim 1, the electric strength was calculated in the way shown in figure 1. For consistency, sensor was taken at the right side of the charge(s) in all cases and the distance was measure from the centre of any charge setup.

Objective table 1 (For A1 Ob1)

Sr. No	Potential (V)	Distance (cm)	Strength (V/m)
1	17.86	50.3	35.5
2	9.06	100.0	9.12
3	6.01	150.4	4.01

Objective table 2 (For A1 Ob2)

Sr. No	Potential (V)	Distance (r)	Strength (V/m)
1	-18.37	50.4	37.5
2	-9.06	100.0	8.99
3	-6.01	150.4	4.01

Objective table 3 (For A1 Ob3)

Sr. No	Potential (V)	Distance (r)	Strength (V/m)
1	-13.38	124.9	33.2
2	-5.45	174.6	7.67
3	-3.01	224.9	3.02

Objective table 4 (For A1 Ob4)

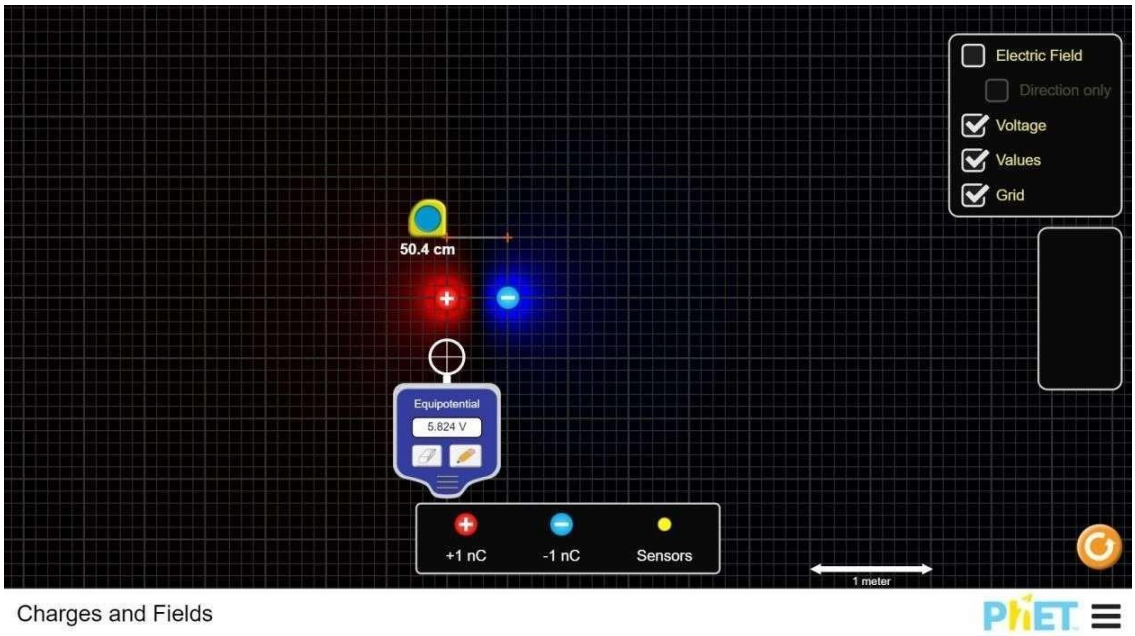
Sr. No	Potential (V)	Distance (r)	Strength (V/m)
1	-6.03	100.0	29.4

2	0.031	149.7	4.4
3	1.19	200.1	1.13

Objective table 5 (For A1 Ob5)

Sr. No	Potential (V)	Distance (r)	Strength (V/m)
1	-0.07	100.0	20.8
2	-0.04	149.7	4.48
3	-0.02	199.4	1.18

AIM 3 –

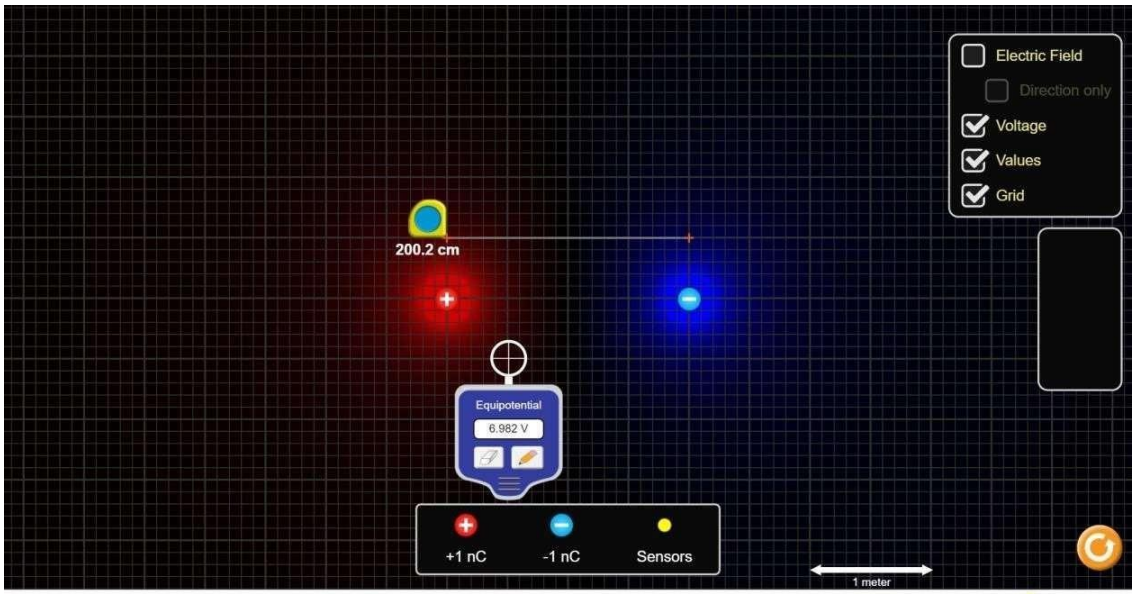


Here we have a point at some distance and we keep that point constant. Then we increase distance between the two charges to get the other readings.

Objective table 7 (Aim 3, T1)

Sr. No	Nature of the charge	Distance between charges (cm)	Electrostatic potential (V)
1	+q, -q	50.4	5.824
2	+q, -q	100.1	10.55
3	+q, -q	150.5	12.92

For the other table we change the nature of charge, keep the distance between charges constant and vary the nature of charges.



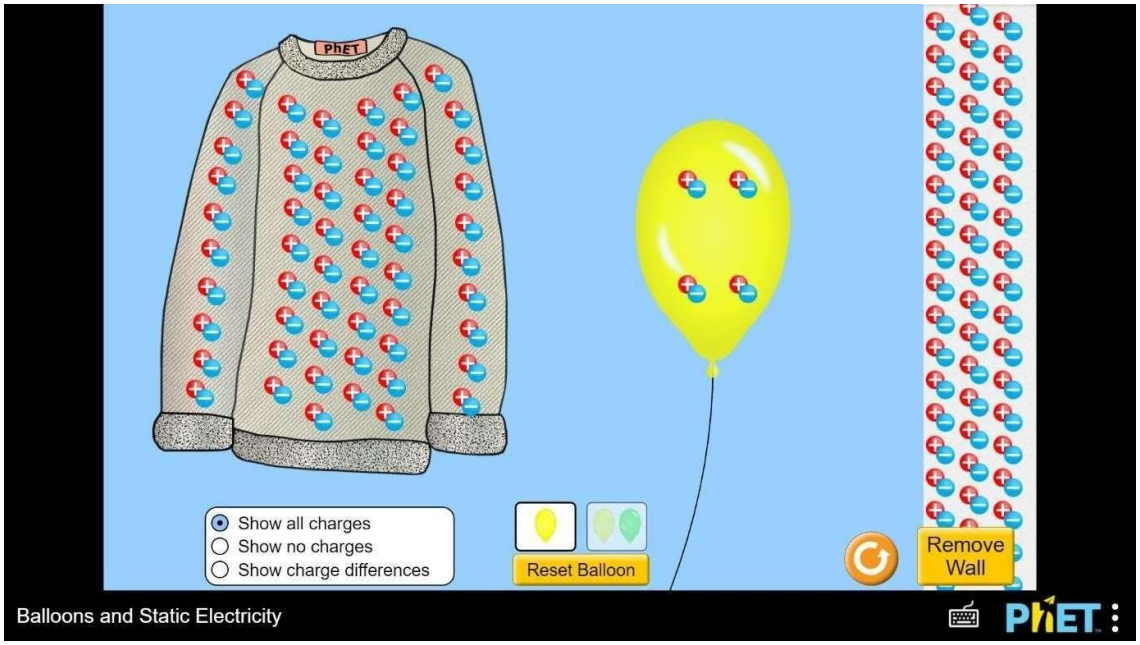
Objective table 8 (Aim 3, T2)

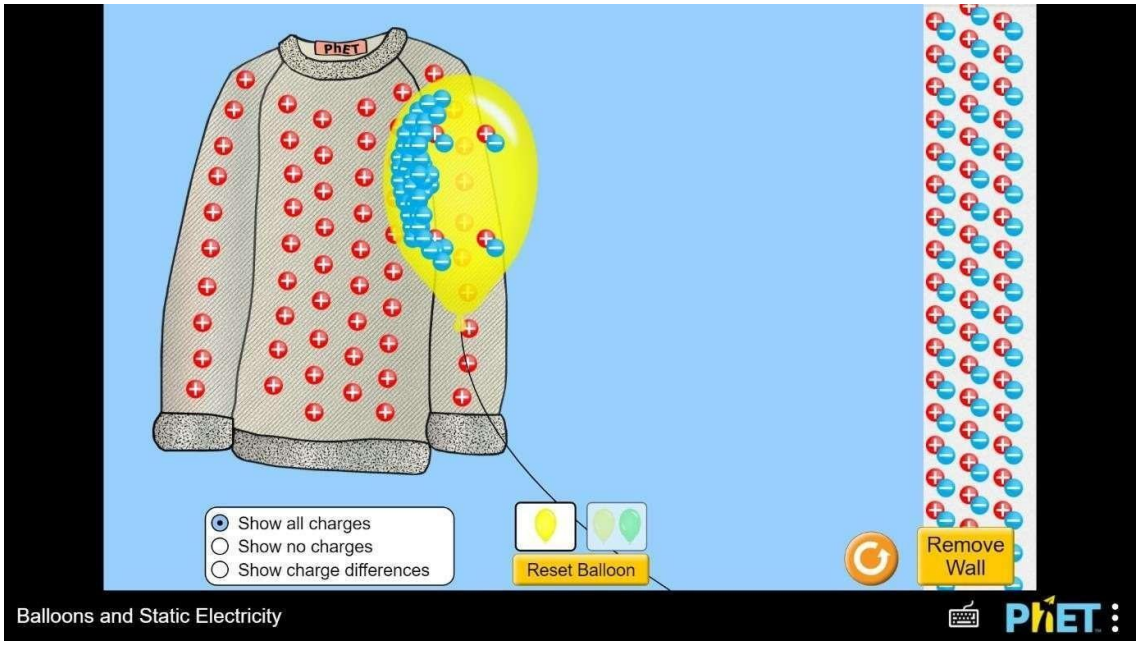
Sr. No	Nature of the charge	Distance between charges (cm)	Electrostatic potential (V)
1	+q, -q	200.2	6.982
2	+q, +q	200.2	18.45
3	-q, -q	200.2	-18.46

AIM 4 –

Objective 1:

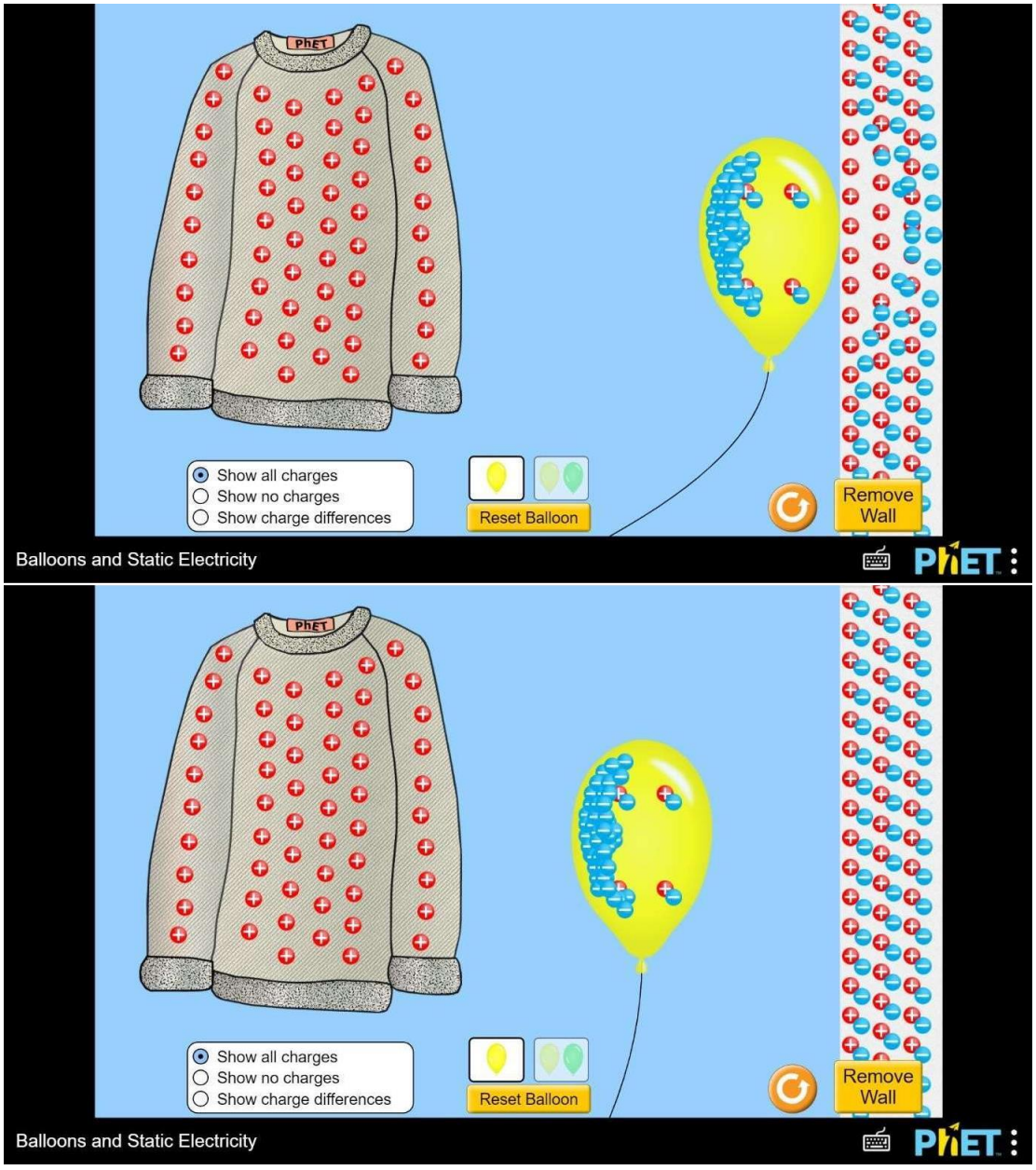
At first both T-shirt & balloon, have charges equally distributed. When the balloon is moved across the area of the T-shirt, the negative charges are transferred to the balloon. (Transfer of charge)





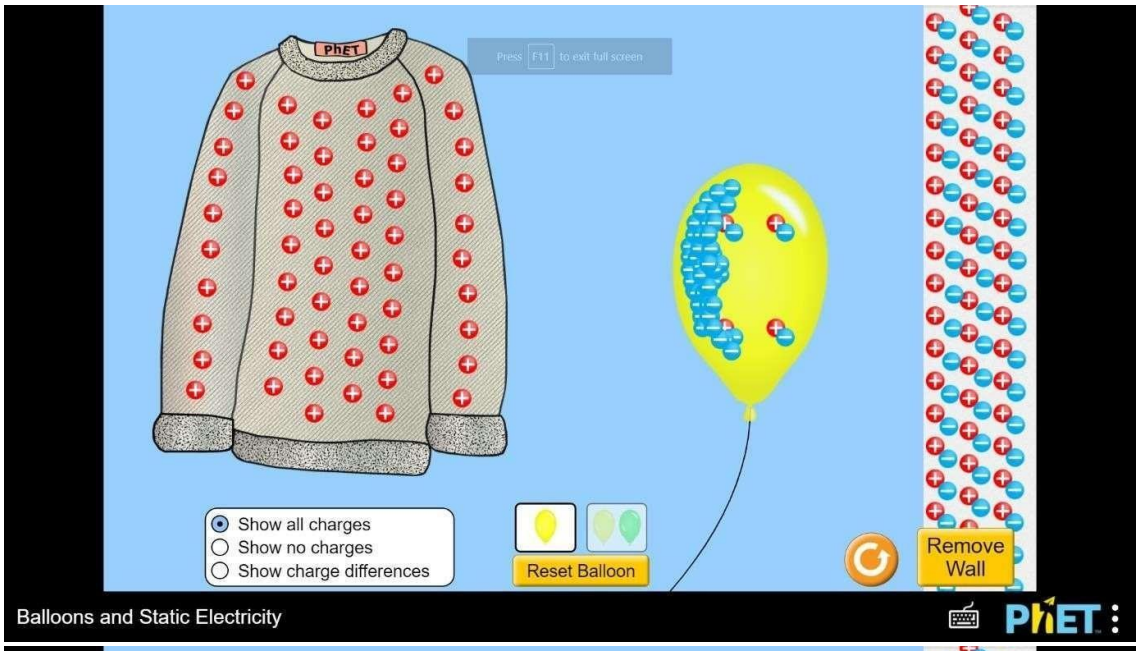
Objective 2:

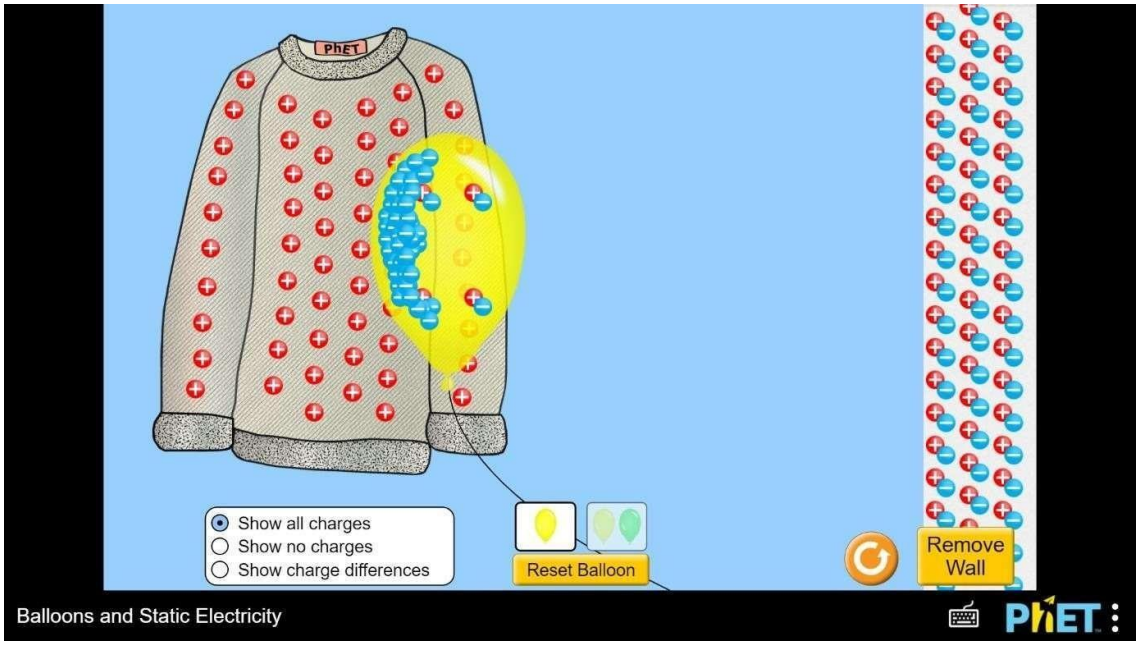
Once the charged object was moved towards the walls, the negative charges were displaced, but later when the balloon was moved away, the charges were back to their initial position. (Induction)



Objective 3,

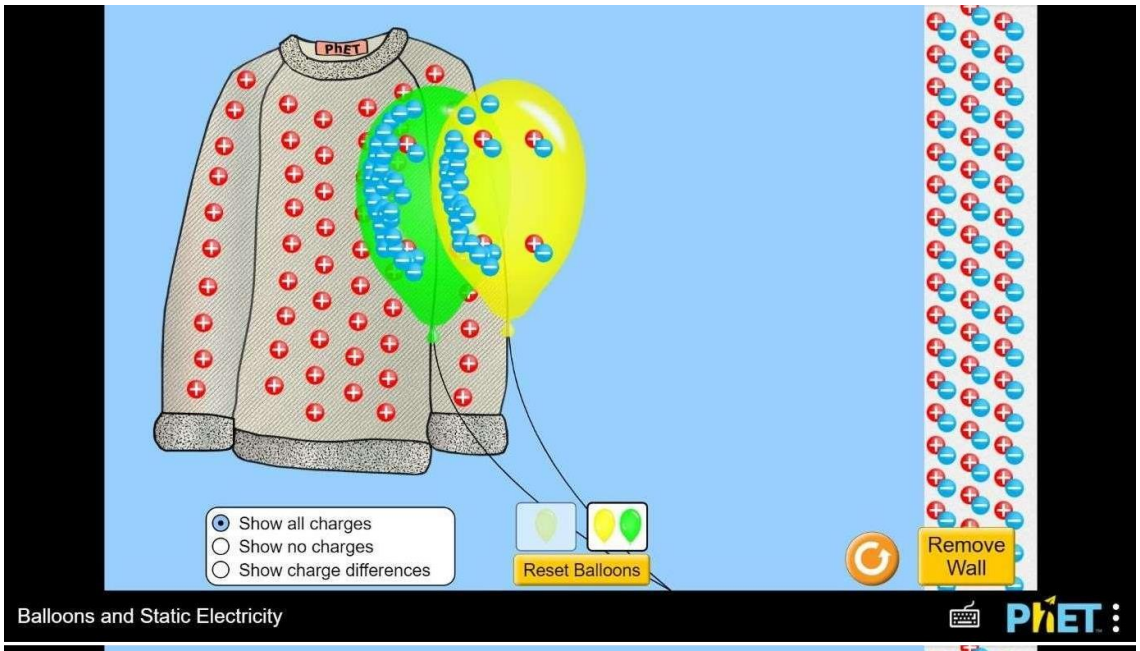
When the balloon was taken away from the t-shirt, and left on its own, it instantly went towards the t-shirt as they have a (+ve) charge. (Attraction)

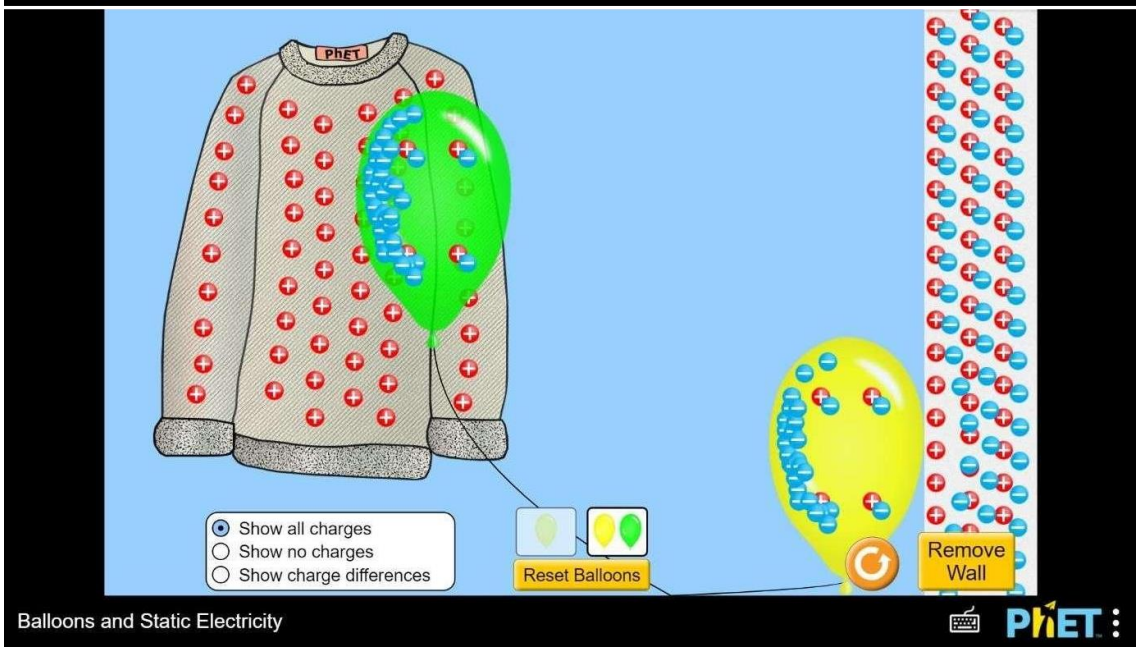




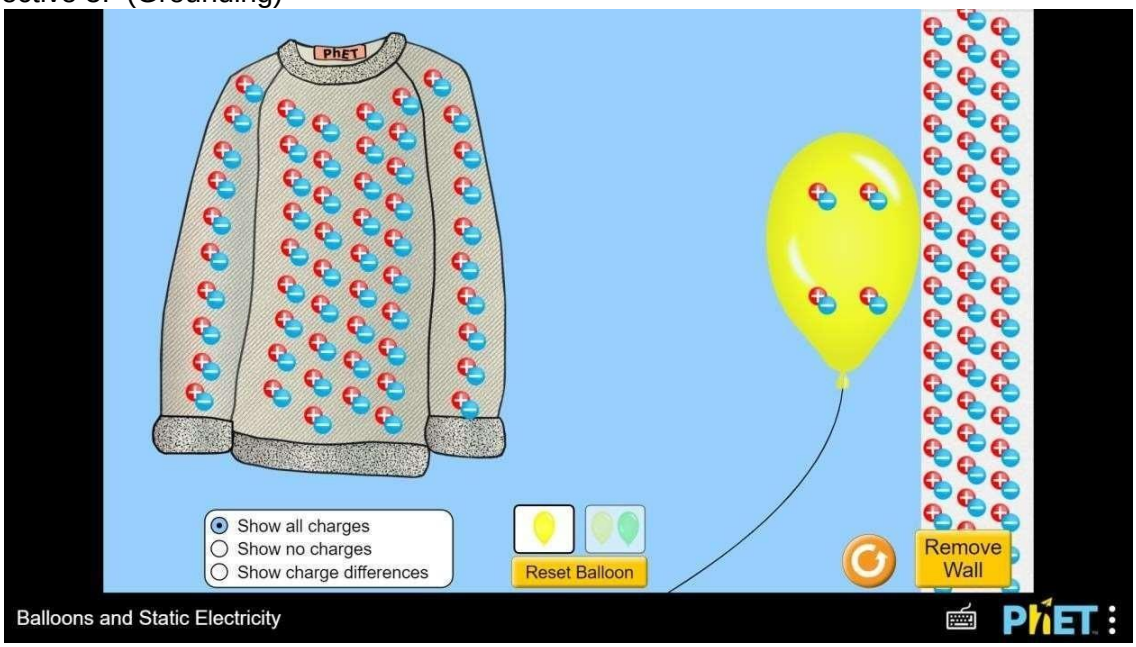
Objective 4:

When the two balloons were given almost equal charges from the t-shirt, and were bought close to each other, they went away as they had same (-ve) charge. (Repulsion)





Objective 5: (Grounding)



ERROR ANALYSIS:

These calculations were all directly from the simulator and hence there will be minimum to no error. The only scope of error would be carelessness in the readings taken, which was avoided on all to most occasions.

RESULT ANALYSIS:

We learned how electric filed lines are for one positive charge, one negative charge, positive and negative charge as dipoles, higher magnitude for positive charge in a dipole ,for a square arrangement, and for a cube arrangement*.
Which all coincided well with our theoretical understanding of field lines.

Then we saw how electric field strength changes for all the above cases, and we saw a gradual decrease in the strength as the distance increased, roughly by 1/r^2.

Then we noticed how our electrostatic potential changes with respect to the distance and nature of charges. The nature of charges, in case of two negative charges and two positive charges was almost equal in magnitude. For the increase in distance we found potential to increase with square of the distance between the two charges.

Lastly, we saw how transfer of charge, induction, attraction, repulsion and grounding take place with the help of a t-shirt, balloons and a wall.

Hence we achieved all our objectives and completed the experiment successfully.

Thank you