Name _____ Date _____

Partner _____

Electric Fields: Lab #5

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Objective: to use software to simulate electric fields and to explore graphically the electric fields produced by various spatial distributions of charges.

Preparation: Start, All Programs, EM Field 6, EMField
Authors:

Define: Electric field line:

Equi-potential line:

I. Single Point Charge

a) We will investigate a single positive charge and its electric field lines.
Prediction of field lines:

Make the window full screen.
Pull down Sources, 3D Point Charges.
Now drag a charge of +1 onto the stage (playing field).
Pull down Field and Potential, Field Lines
Click at many various points around your charge.
Sketch the program's field lines:

Compare your prediction and the program's result:

Select Display, Clean up screen

b) We will investigate a single positive charge and its electric field vectors.
Select Field and Potential, Field Vectors
Click at various points around your charge.
Sketch of program's electric field vectors:

c) We will investigate a single positive charge and its electric directional arrows.
Field and Potential, Directional arrows:
Click at various points around your charge.
Sketch of program's electric directional arrows:

Describe the differences between electric field lines, vectors, and directional arrows:

d) Now we will investigate a single negative charge and its electric field vectors.
Prediction of field vectors:

Clean up the display, and place the charge.
Select Field and Potential, Field Vectors
Click at various points around your charge.
Sketch of program's field vectors:

Try a larger negative charge:

Describe how the field vectors of a negative charge are different from those of a positive charge.

II. Two charges on the stage
Display, Clean Up Screen
a) Investigate one positive charge = 1, and one negative charge = -1 a few centimeters apart.
Prediction of field vectors:

Sketch of program's field vectors:

Try click and hold and drag.
Then add field lines also.
Comment on the relationship of field lines and field vectors:

b) Try charges +1, +1
Prediction of field lines:
Sketch of program's field lines:

III. Three Charges
a) Investigate +1, +1, +2 in a straight line
Prediction of electric field lines:

Sketch of program's electric field lines:

b) Try +1, -1, +2 in a straight line
Prediction of field lines:

Put a few vectors, then lots of field lines.
Sketch of program's field lines:

c) Drag one of the charges to another position on the stage, off the straight line.
Prediction of field vectors:

Sketch of program's field vectors:
Isn't this fun?

IV. Equipotential Surfaces
What is the relationship of equipotential surfaces to field lines?

a) Single Point Charge
Prediction of equipotentials:

Select Field and Potential, Field lines, and place some field lines.
Field and Potential, Equipotentials

Click at various points around your charge to place the equipotential lines.
Sketch of program's equipotentials:

b) Now let's get more quantitative. Display, Clean up screen Show grid. Place a charge of +6 on a grid point.
Prediction of equipotentials:

Field and Potential, Equipotentials with numbers.
We want to find out how equipotential values depend on distance from a charge. (Think. Use the grid and click intelligently.)
Sketch (and print) of program's equipotentials with numbers:
Record data of equipotential values vs. distance from the charge. In particular, what is the value of the potential at a distance of one grid point? _____ So, what is k in this program? _____
Put these data into a spreadsheet, make a graph, and fit a trendline. Print the spreadsheet with its small embedded graph.
Write the equation:

V. Ready to test what you have learned? Get ready for a challenge.
Sources, 3D point charges
Option, Challenge game
a) Find one hidden charge by clicking to expose electric field vectors.
When you are confident that you have located a charge, drag a marker to its position.
Challenge, Estimate amount of charge. (Hint: think about the length of the electric field vector at a specific distance from a charge.)
Click on the marker and type your magnitude estimate.
Challenge, Judge.
Describe your method:

b) Option, Challenge game
Find two hidden charges

Can you find three?

Conclusions: