Physics Exploration Homework Supplement P111-20.pdf

Exploring Electric Fields and Potential with Computer Simulations

Go to the Physics Exploration Center. Enter through the resource room in 311/312 Thaw Hall. This exploration involves playing with computer simulations related to electric forces and fields.

(1) Go to the computer and double click on the shortcut icon "Hockey 3.0". Click on "skip instruction" on the lower right hand corner to go to level 1. Your goal is to get the negatively charged hockey puck on your screen into the goal post. You can at most use 3 positive and 3 negative charges (provided at the upper right hand corner) to direct your hockey puck appropriately. Use your mouse to drag place the charges anywhere in the field and then click the "begin" button in the lower right hand corner in an attempt to shoot a goal. You can rearrange the charges with your mouse and when you ultimately shoot a goal, print the screen by going to file menu and selecting print screen. Turn it in with your exploration.

(2) What did you learn from this exploration? Is shooting a goal here more challenging than doing a problem of finding the electric field only at one point in space? Why? (Please feel free to play this game at higher Levels in the game menu.)

(3) Use quit to get out of Electric field hockey program. Then, double click on the shortcut icon "EMfield". Now you are ready to draw the electric field lines and equipotential surfaces for a point charge, an electric dipole and a parallel plate capacitor. Draw on the paper a rough sketch of what you expect these lines and surfaces to be for each case.

(4) Use your mouse to go to the file menu and click on "Get charges and currents from file". Find the files Zpoint.emf, Zdipole.emf and ZQplates.emf (these will be the last few files since their names start with z). Click on one of these files to open it. Use your mouse to go to the menu "Field and potential" and click on field lines. Then click on the screen at different places to draw electric field lines through that point. After you have enough field lines to see the whole field pattern, go back to the "Field and potential" menu and click on "Equipotentials with numbers". Then click on the screen at different places to draw equipotential surfaces. Then go to the "Field and potential" menu and click on "Directional arrows" that will show you the direction of electric field at each point. Move that directional arrow on an electric field line that you drew. What do you observe is the direction of electric field at every point on the field line? Move the directional arrow on an equipotential surface. What do you observe is the direction of electric field with respect to the surface? Does it make sense? Print the screen by going to file menu and selecting print screen. Turn it in with your exploration. Do the same with the other two files (for the dipole and capacitor).

(5) Summarize the major differences between the electric field produced at different points by a point charge, an electric dipole and a parallel plate capacitor by looking at your printouts.

(6) What is the angle at which the electric field lines and equipotential surfaces cross each other in your printouts? Is this what you expect? Why?

(7) Is the electrical potential larger closer to the positive charge or negative charge? Does it make sense? Explain.