

Topic 5 – Practical 4

Simulation experiment to determine the relationship between electric field strength and distance from point charges

Safety

There are no safety issues concerning this experiment.

Apparatus and materials

- laptop with access to the internet

Introduction

In this simulation experiment you will investigate the relationship between electric field strength E and distance r from a point charge. You will also explore the electric field strength around other combinations of charges.

Procedure

- 1 Run the Charges and Fields simulation on the phET website. (<http://phet.colorado.edu/en/simulation/charges-and-fields>).
- 2 Check the 'grid', 'Show numbers' and 'tape measure' boxes on the right-hand side.

Positive charge

- 3 Pick a positive charge of 1 nC from the 'bucket' and place it on the far left edge of the grid. Pick an E-Field sensor and place it at a distance of one large grid box from the charge.
- 4 Use the tape measure to measure the distance of the sensors from the charge and record your measurements a suitable table. Also record the direction of the electric field strength vector.
- 5 Repeat the process nine more times, each time increasing the distance by one large grid box.
- 6 Plot a graph of E against r . Answer question **1a**.
- 7 Add another positive charge of 1 nC on the same position, on top of the first one. Repeat your measurements and plot them on the same axes as the previous measurements. Answer question **1b**.

Negative charge

- 8 Replace both positive charges with a negative one of 1 nC and repeat steps **3–6**. Compare the graph with the one for the single positive charge measurements. Answer question **2**.

Two charges

- 9 Place two positive charges of 1 nC at the ends of a horizontal line eight large grid boxes long. Take seven measurements of the E , each every large grid box. Record your measurements of E and r in a table and plot a graph of E against r .
- 10 Add another positive charge on top of the one existing one on the left. Repeat step **9**.

- 11** Replace the two positive charges on the left with a negative one and repeat step **9**. Answer question **3**.

Questions

- 1** Positive charge:
 - a** What is the shape of the graph? What relationship does it represent? What axes would you use to get a linear graph?

 - b** What effect does doubling the charge have on the graph?

- 2** How does the type of charge affect the electric field strength?

- 3** What are your observations about how the value of E changes depending on the types of charges, their relative amount and distance?