Unit D – Practical 1

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?