Electrostatics: controlling charged particles

Student activity • observation and reasoning

YEAR 10 / LESSON 36 / PHYSICS ONLY

The question

How can electric forces control where small charged particles go?

Use simplified diagrams of a photocopier and a continuous-inkjet system to connect charging, force and controlled deposition.

Equipment

- Booklet, pencil, ruler and original process diagrams

Paper modelling only. Do not open printers or photocopiers, handle toner powders, use spray aerosols or operate high-voltage apparatus.

Course coverage: Physics only: 2.28P. Photocopiers and inkjet printers.

Plan, model or apparatus sketch

Draw a labelled setup or force diagram; include the measured quantities.

Method and reasoning

Read the whole sequence before starting

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1. Draw a simplified photocopier drum with a charge pattern representing an image. Label the toner as particles selected to be attracted to the required parts.

2. Show transfer of the toner pattern to paper and subsequent fixing. Keep electrostatic attraction separate from the heating or pressure that fixes toner.

3. Draw a simplified continuous-inkjet system with charged droplets passing between charged plates. Use the stated positive-droplet model to predict deflection towards a negative plate.

4. Reverse the droplet charge in the diagram and predict the reversed force. Show that an uncharged droplet is not deflected by the same simple uniform-field model.

5. Compare the applications: both use controlled charge and electric forces, but their materials and mechanisms differ. State that not all printers use this droplet-deflection method.

6. Write a causal explanation for one application using charge, attraction or repulsion, force and deposition. Identify two simplifications in the diagram.

Cleanup

- Return diagram cards and retain corrected explanations.

Record your evidence

Blank spaces are for your own work

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Reference and task data

These are conceptual diagrams, not instructions to dismantle appliances. The inkjet example is a continuous-inkjet design; many domestic inkjet printers use other ejection mechanisms. Charge signs and drum designs vary, so use the signs stated in each model.

Stage	Charge / force	Purpose
Drum pattern		
Toner deposition		
Transfer and fixing		
Ink droplet deflection		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Why can toner be attracted to an image pattern?

2. What fixes toner to paper?

3. Which plate attracts the stated positive droplet?

4. What changes when the droplet charge is reversed?

5. Do all inkjet printers use charged-droplet deflection?

6. Why state the charge signs in a diagram?