

**Design and carry out an experiment to determine, approximately,  
how much charge is on a piece of charged invisible tape.**

***Available equipment: invisible tape, ruler.***

**1, 2, 3. AUTHORS, TITLE, INTRODUCTION**

See Guidelines for Written Lab Reports.

**4. PROCEDURE**

Make a clear and understandable diagram of your experimental setup.

In this diagram, show **and label** all objects.

Show **and label** any quantities (distances, masses, etc.) that you will need to measure.

(Do not show forces on this diagram; they will be shown in a separate diagram below.)

From your diagram it must be clear exactly what you will measure.

Another person should be able to repeat your experiment from looking at your diagram.

Use tapes about 20 to 30 cm long. The mass of 20 cm of wide tape is about 0.16 grams.

**In designing your experiment, think about the whiteboard problems you've done, which may provide some ideas.**

**CHECKPOINT: Discuss your design with a neighboring group.  
Do you understand their design? Do they understand your design?**

**5. RESULTS**

***MEASUREMENTS / DATA***

Clearly record all measurements you made.

Make sure you measure all relevant distances and masses.

***PHYSICS DIAGRAM ("freebody" diagram)***

Provide a clear physics "freebody" diagram showing all forces represented as arrows, with appropriate symbolic labels.

***APPROXIMATE CHARGE ON A TAPE, IN COULOMBS***

Calculate the amount of charge on one of your tapes, in coulombs, and state the length of the tape.

Show every step in your work, starting from fundamental physics principles.

Use the symbols/labels shown in your diagram of the experimental setup and in your "freebody" diagram.

**CHECKPOINT: Compare your result with a neighboring group.**

**6. CONCLUSION (Be sure to address all of the following questions in your report)**

(a) What approximations did you make in your analysis?

State these clearly. (This is important!)

(b) What is the number of excess electrons to which the charge in coulombs corresponds?

Show your work.

(c) Calculate the approximate fraction of the molecules on the surface of the tape which gained or lost one electronic charge. Assume that a molecule on the surface occupies a square surface area  $3 \times 10^{-10}$  m on a side. Show all your work clearly.

Given your result, is it a common event or a rare event for a molecule to gain or lose an electron?

(d) To check, what is a lower bound on a reasonable result for the amount of charge on a tape?

What is the smallest amount of charge that could possibly be on a charged tape?

Explain briefly. Is your result larger than this number?

(e) If you assume the tape is made entirely of carbon atoms (atomic mass 12), estimate the largest amount of charge that could possibly be on a charged tape. Show all steps in your work. Make your reasoning clear.

To check, is your result smaller than this number?

**The recorder turns in a group report through WebAssign.  
The report must include titled sections corresponding to the numbered sections above.**