Name: _____ Date: _____

Physics Lab

Investigation of Electrostatics with Sticky Tape

Part I – Sticky Tape Activity

Purpose: In this investigation you will investigate the interaction between pieces of tape and other objects after the pieces of tape have become charged.

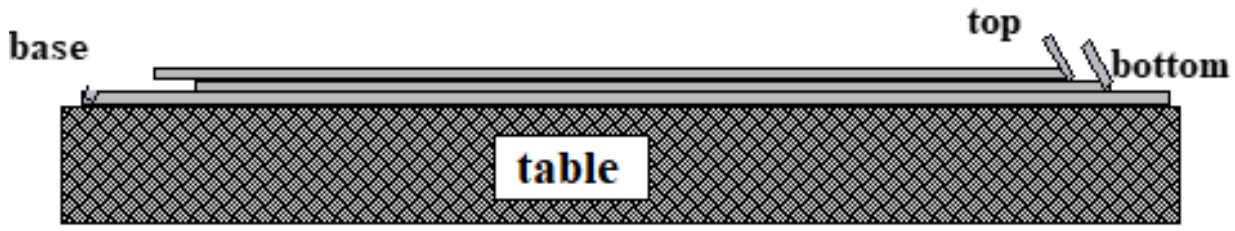
Materials:	Scotch^{TM} tape	PVC pipe
	aluminum foil	plastic bag
	paper	

Procedure:

1. Take about 10 cm of transparent tape and place this tape on the lab table. This is the base tape.

2. Take another 10 cm piece of transparent tape and make a handle on the end by folding under the first cm of tape, sticky side to sticky side. Attach that piece of transparent tape onto the base tape. Label this tape "B" for bottom.

3. Take another 10 cm piece of transparent tape and make a handle on the end by folding under the first cm of tape, sticky side to sticky side. Attach that piece of transparent tape onto the bottom tape. Label this tape "T" for top.



4. While keeping the bottom and top tapes together, gently peel off the top and bottom tapes. Then slowly pinch and rub the two strips of tape using your thumb and index finger 10 times.

5. Using the handle of each piece of tape, quickly separate the top and bottom tapes from each other.

6. Hang each piece of tape away from each other using either the sides of the lab table or metal poles.
   - Make sure the tape remains suspended and does not touch the side of the table.

7. Get 2 pieces of paper and 2 pieces of aluminum foil and hang one piece of paper and one strip of aluminum from the side of the lab table or the metal poles. Set the other pieces of paper and aluminum aside.

8. Repeat steps 2-5 to make a second pair of top and bottom tapes. Have one group member hold each piece of tape in a separate hand, so that they do not touch each other.

10. Observe the interactions between the 4 hanging strips and the 4 strips you have set aside. Record your observations in the table on the next page as either ATTRACTION, REPULSION, or NONE.

	Hanging Strips			
	Top Tape	Bottom Tape	Paper	Aluminum Foil
Top Tape				
Bottom Tape				
Paper				
Aluminum Foil				

For each row on your data table count the number of each interaction you observed.

	Number of **Attractions** Observed	Number of **Repulsions** Observed	Number of **No Interactions** Observed
Top Tape			
Bottom Tape			
Paper			
Aluminum Foil			

Conclusions:

1) We will assign a property called ***CHARGE*** to objects that are able to cause a repulsive interaction.

a) Do two of the same charge (top & top or bottom & bottom) ATTRACT or REPEL? _____

b) Do two different charges (top & bottom) ATTRACT or REPEL? _____

2) Since there are only two interactions observed, we can conclude that there are two charges. In physics we refer to these two different charges as ***POSITIVE (+)*** and ***NEGATIVE (–).***

a) To set a standard, we will define ***NEGATIVE (–)*** as the piece of tape that repels PVC pipe that has been rubbed with a plastic bag. Rub a PVC pipe with a plastic bag. Then observe the interaction of PVC with the top and bottom tapes.

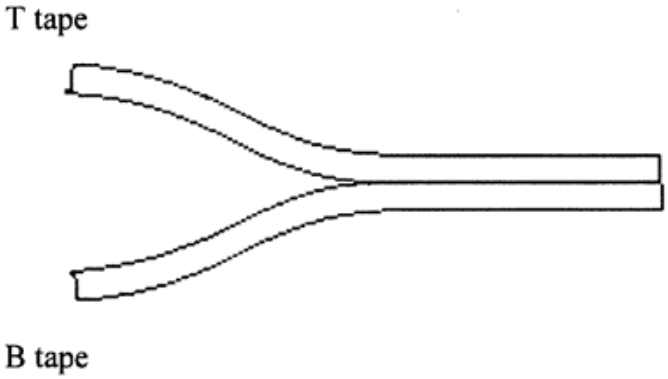
Based on my observations the _____ tape is ***POSITIVE (+)*** and the _____ tape is ***NEGATIVE (–).***

3) What was the paper-paper interaction?	4) What was the foil-foil interaction?
5) What was the top tape-top tape interaction?	6) What was the top tape-bottom tape interaction?

7) Diagram the top tape-top tape interaction with forces.	8) Diagram the top tape-bottom tape interaction with forces.
9) What was the bottom tape-bottom tape interaction?	10) What was the top tape-foil interaction?
11) Diagram the bottom tape-bottom tape interaction with forces.	12) Diagram the top tape-foil interaction with forces.
13) What was the bottom tape-top tape interaction?	14) What was the bottom tape-paper interaction?
15) Diagram the bottom tape-top tape interaction with forces.	16) Diagram the bottom tape-paper interaction with forces.

Thought pages:

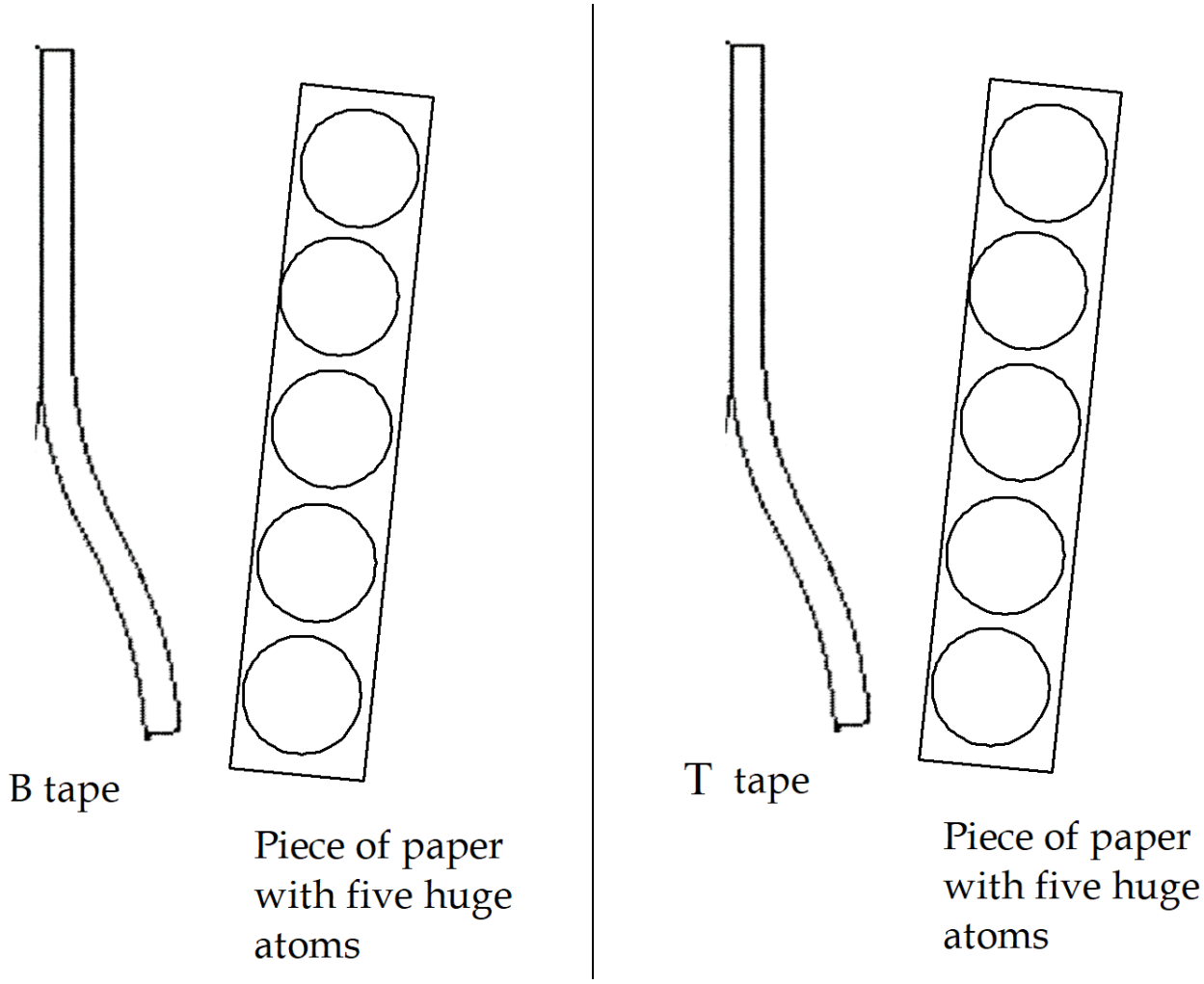
17) Imagine you could see the differences between the top and bottom tapes at the atomic level. On the partially separated T and B tapes invent a way of representing how the tapes change as they are separated in terms of positively (+) and negatively (–) charged particles.



18) Invent a way for the paper to be attracted to both a top and a bottom tape while keeping your representation from 17 and the following facts in mind:

I. The paper is electrically neutral (there is an equal number of positively and negatively charged particles).

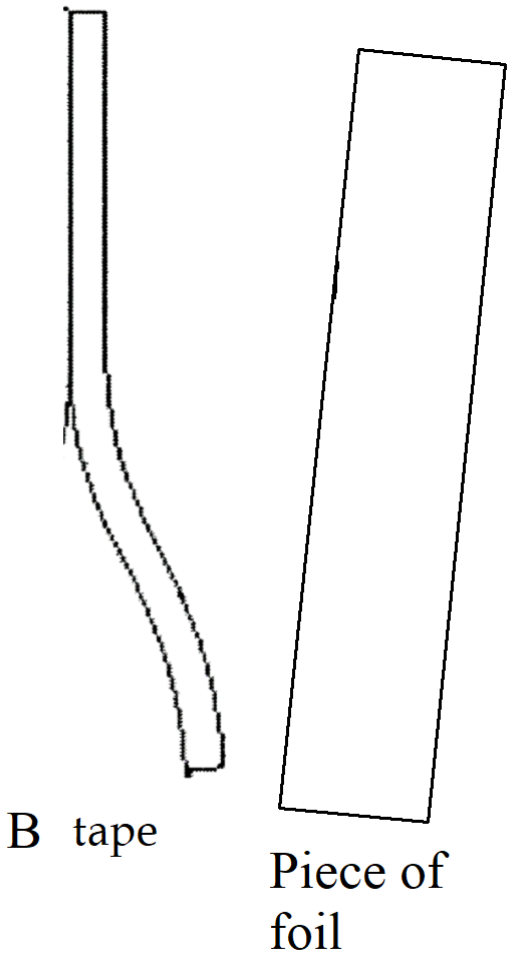
II. Electrons (negatively charged particles) cannot move away from the nucleus (positively charged).

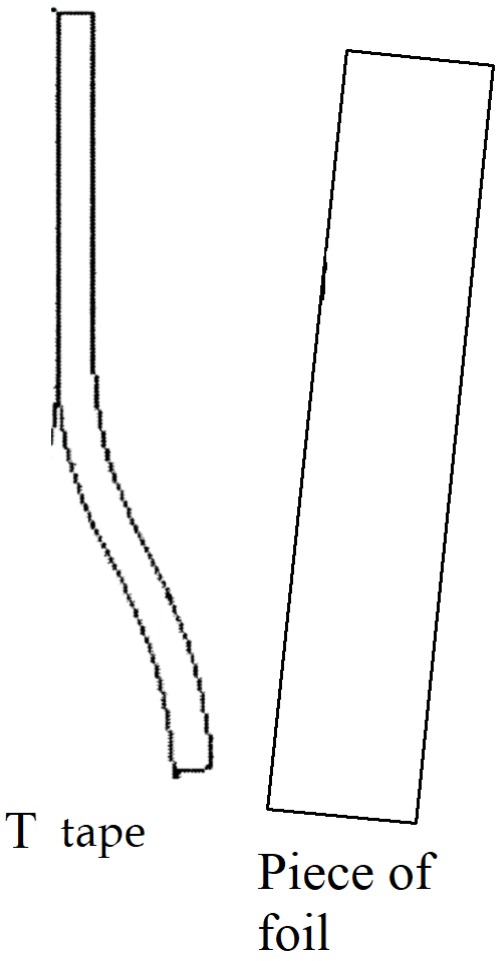


19) Invent a way for the foil to be attracted to both a top and a bottom tape while keeping your representation from 17 and the following facts in mind:

I. The foil is electrically neutral (there is an equal number of positively and negatively charged particles).

II. Electrons (negatively charged particles) are able to move freely within the foil.





Part II – Mapping Electric Field Lines

Purpose: In the lab you will look at the electric force on an "electrostatic compass" and use your observations to identify the key properties of the electric field. You will specifically look at the electric field created by a single "–" charge and a single "+" charge.

Materials:	Scotch^{TM} tape	PVC pipe
	string	plastic bag
	paperclip	animal fur
	permanent marker	

Making an electrostatic compass:
We have seen that pulling tape off a surface leaves the tape with a net charge. Using oppositely charged tapes, we can make a "compass" where one tape is attracted and the other is repelled from a charged object.

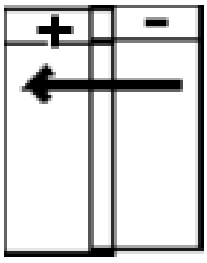
A. Put a 6 cm long base tape on the table with a folded under handle.

B. Place two more tapes on the first. With a pen, label the handle of the middle tape "-" and the handle of the tape on top "+".

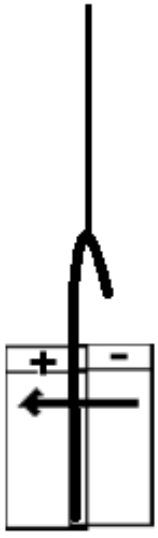
C. Slowly remove the top two tapes together, and then make sure they are not charged by firmly rubbing the slick side of the tape.

D. Briskly separate the two tapes, and sticky side up, overlap the edges of the tapes as shown. (Avoid excessive contact with the tape since this will discharge it.)

E. Draw an arrow across the tapes from the "-" side to the "+" side as shown.



F. Attach the center of the tapes to the straightened-out paper clip so the string extends upward from the handles.



Procedure:

1) From the last two pages of this handout lay out the sheet titled **Electric Field for – Pipe**.

2) Charge a PVC pipe by rubbing it with a plastic bag. Then place the PVC pipe in the center of the paper.

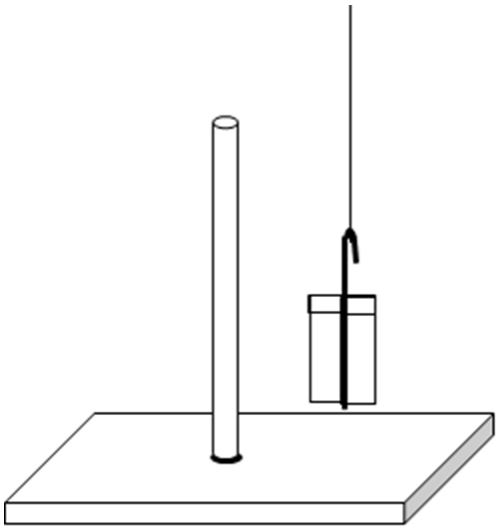
3) Make sure your electrostatic compass is charged and operational.

   a. If not follow steps B – F on the previous page.

4) Start with the electrostatic compass very close to the PVC pipe. Draw an arrow on the paper directly below the arrow on the electrostatic compass indicating the direction of the electric field at that point.

5) Now move the electrostatic compass farther from the PVC pipe and draw an arrow on the paper directly below the arrow on the electrostatic compass. Continue until your arrows go off the edge of the page.

6) Continue drawing arrows indicating the direction of the electric field until you have 20 arrows drawn..



Analysis of Your Electric Field Map for – Pipe

1) Where do the electric field lines begin or seem to originate from?	
2) Where to the electric field lines end or seem to point toward?	
3) How many more electric field lines could you have drawn?	

Procedure (continued):

7) Flip over your sheet with your electric field map. This side should be titled **Electric Field for + Pipe**.

8) Charge a PVC pipe by rubbing it with animal fur. Then place the PVC pipe in the center of the paper.

9) Make a new electrostatic compass following steps B – F on the previous page.

10) Repeat steps 4 – 6 from the procedure.

Analysis of Your Electric Field Map for + Pipe

4) Where do the electric field lines begin or seem to originate from?	
5) Where to the electric field lines end or seem to point toward?	
6) How many more electric field lines could you have drawn?	

NAME: _____

Electric Field for – Pipe

Electric Field for + Pipe