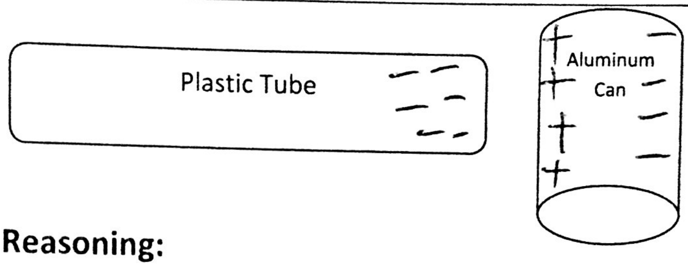
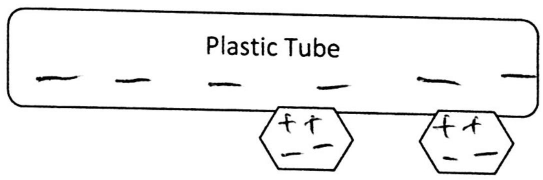
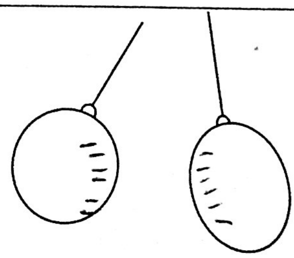
Names: Key

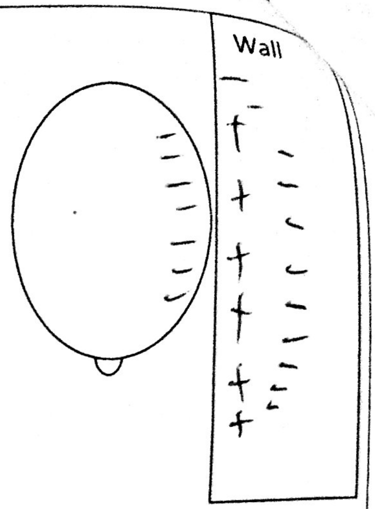
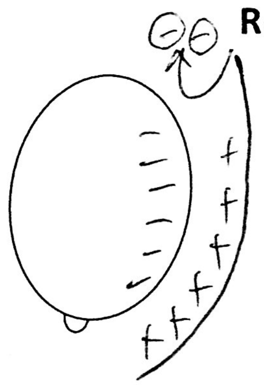
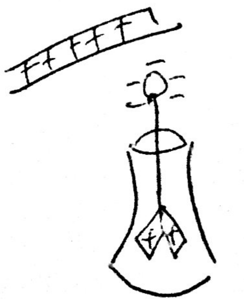
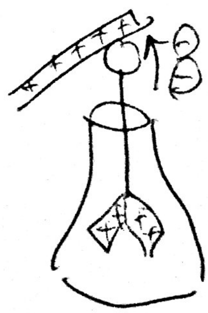
Date:____________ Period:________

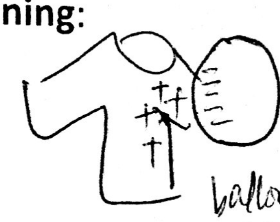
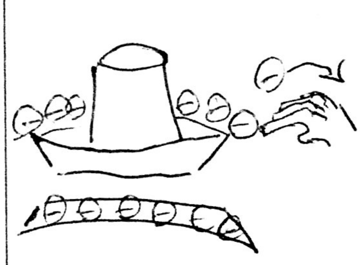
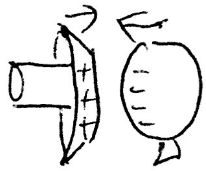
# Electrostatic Stations – Charge Diagrams

One sheet per group. You will have 10 minutes per activity. [redacted]

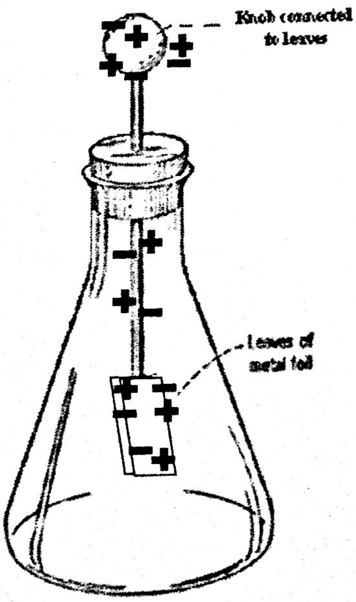
ROLES: The **experimenters** conducts the experiment. The **recorder** writes the information on this sheet or on the worksheet at the station and the **questioner** thinks of one question to ask that the group can test out. That question should be written on this sheet under the questioner's name. If you finish before 10 min, come up with a new question.

| **Station and roles**<br>Switch roles for each task | **Charge Diagram** Draw where the charges would be in the diagrams below |
|---|---|
| **The Can Race**<br>Experimenters:____________<br>Recorder/artist:____________<br>Questioner:____________<br>Question - | <br>**Reasoning:**<br>Induction causes $e^-$ in can to be repelled. Electric force between protons in can & electrons in tube causes attraction, so can moves toward tube |
| **Packing Peanuts**<br>Experimenters:____________<br>Recorder/artist:____________<br>Questioner:____________<br>Question - | <br>**Reasoning:**<br>plastic tube causes induction in the paper. Electrons in paper are pushed away, so paper is attracted to tube |
| **Two hanging Balloons**<br>Experimenters:____________<br>Recorder/artist:____________<br>Questioner:____________<br>Question - | <br>**Reasoning:** $e^-$ in balloons repel each other |

| | |
|---|---|
| **Single Balloon**<br>Experimenters:__________________<br>Recorder/artist:__________________<br>Questioner:__________________<br>Question - | **Reasoning:**<br>$e^-$ in wall are pushed away by induction<br>balloon is attracted to positive surface of wall<br><br> |
| **Charging by induction** | Read about charging by induction in the Conceptual Physics textbook (Chapter 32, section 6). Answer the questions on page 4-5 of your HW packets. |
| **Water Deflection**<br>Experimenters:__________________<br>Recorder/artist:__________________<br>Questioner:__________________<br>Question - | <br>**Reasoning:**<br>balloon repels neg. ions in water, water is left w/ positive ions. so is attracted to balloon |
| **Electroscope**<br>Experimenters:__________________<br>Recorder/artist:__________________<br>Questioner:__________________<br>Question - | **Diagrams and Reasoning:**<br><br>or<br><br>induction causes $e^-$ to attract to rod, leaves are left positive<br>conduction causes $e^-$ to transfer to tube leaves are left positive |

| | |
|---|---|
| **Simulations**<br>Experimenters:__________________<br>Recorder/artist:__________________<br>Questioner:__________________<br>Question - | **Diagrams and Reasoning:**<br><br><br>balloon rips $e^-$ from sweater by friction<br>John is shocked by $e^-$ transferring from him to doorknob |
| **Aluminum and styrofoam plates**<br>Experimenters:__________________<br>Recorder/artist:__________________<br>Questioner:__________________<br>Question - | **Diagrams and Reasoning:**<br><br><br>bringing neg. plate toward aluminum causes $e^-$ to run to the rim of aluminum. Touch the aluminum, and $e^-$ transfer to you. Aluminum is left positive + attracts balloon |

## Conclusion questions

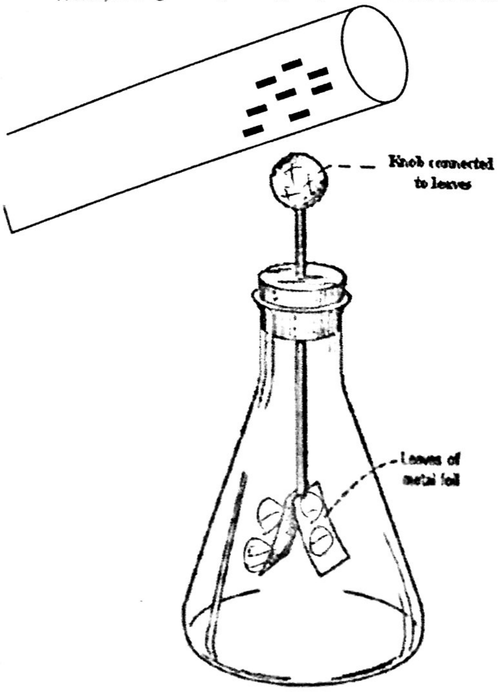



Initially, the wire is neutrally charged and the leaves of the electroscope hang straight down. There is positive and negative charge contained in the wire (pictured), but in equal amounts and evenly distributed. There is no net charge.

min, come up

re the ch

THEN, a negatively charged plastic tube is brought near the electroscope BUT DOES NOT TOUCH IT! You see the leaves separate.




1. Draw the new charge distribution on the metal wire and leaves.

2. Explain why the leaves are separated. Neg. repel

3. This is charging by (induction) / friction / contact.

4. When you move the charged tube away, the leaves should return to a relaxed position. Explain why.
source of induction removed no transfer of $e^-$

5. If you gently touch the charged tube to the metal and then remove the charged tube, what happens to the leaves? stay separate

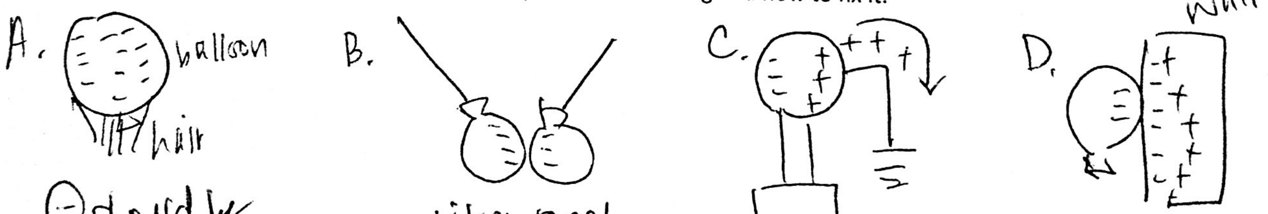
6. This is charging by induction / friction / (contact.)

7. When you move the charged tube away, the leaves should remain separated. Explain why.
$e^-$ transfered from Tube to leaves

8. Why can't you necessarily know just from the electroscope if the leaves are positively or negatively charged?
Tube could be either pos. or neg.

9. When you rub two objects together, how might you tell if the objects are positively or negatively charged? (Hint: Balloons and other rubber material tend to acquire negative charge when rubbed. Why is that?)
Insulators hog $e^-$ so tend to steal $e^-$ from conductors
Conductors give $e^-$, so they tend to become more positive

10. What's wrong with these pictures? Explain what's wrong and how to fix it.

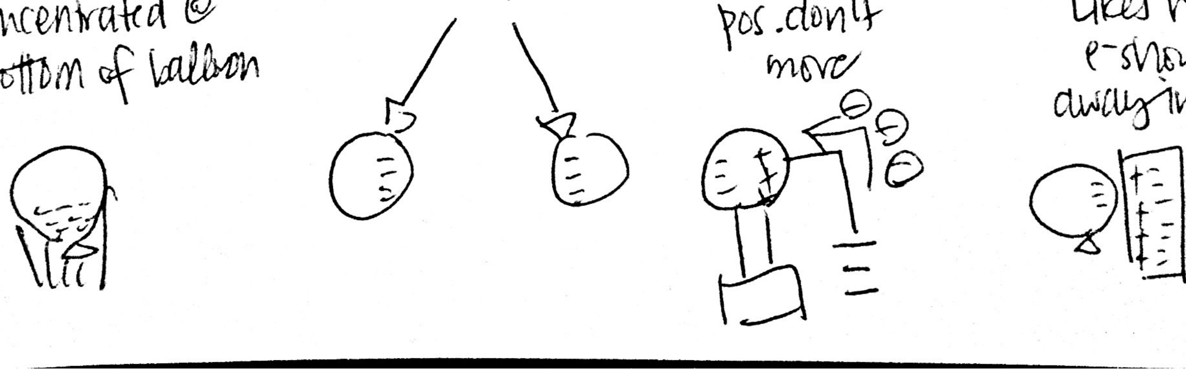



A. ⊖ should be concentrated @ bottom of balloon

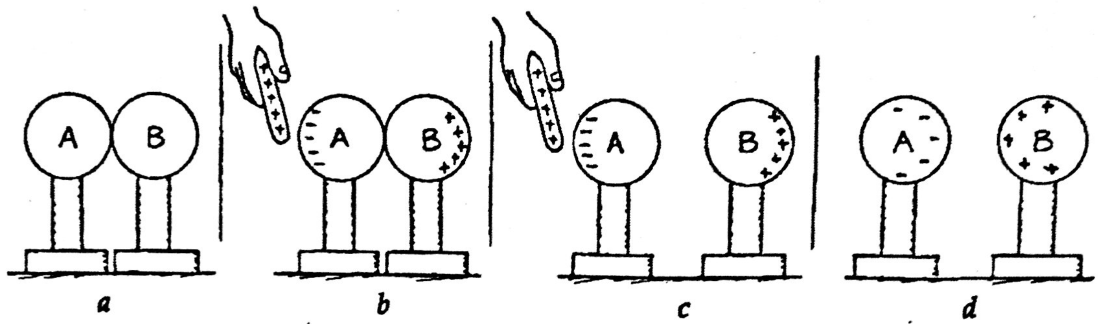
B. Likes repel

C. pos. don't move

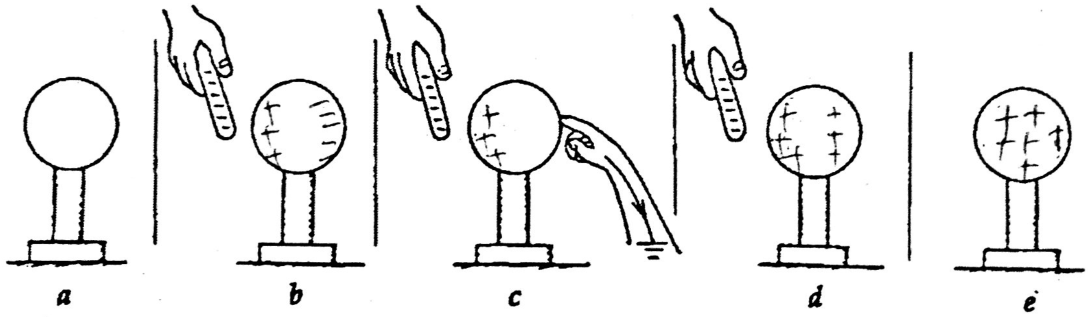
D. Likes repel
e- should be pushed away in wall



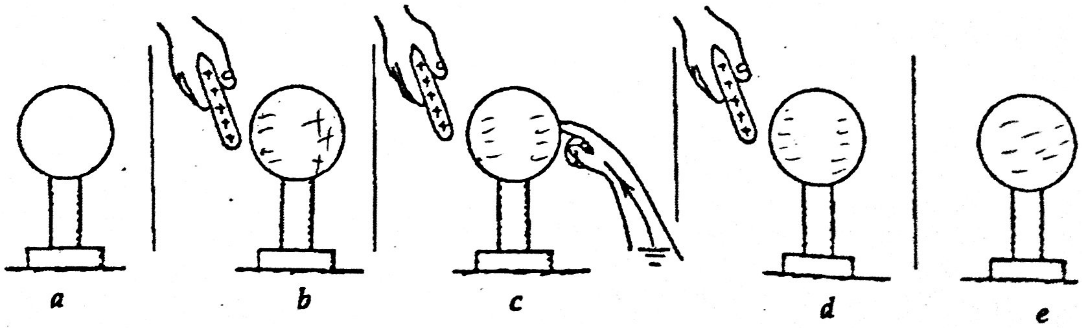
5. Consider the diagrams below. (a) A pair of insulated metal spheres, A and B, touch each other, so in effect they form a single uncharged conductor. (b) A positively charged rod is brought near A, but not touching, and electrons in the metal sphere are attracted toward the rod. Charges in the spheres have redistributed, and the negative charge is labeled. Draw the appropriate + signs that are repelled to the far side of B. (c) Draw the signs of charge in (c), when the spheres are separated while the rod is still present, and in (d) after the rod has been removed. Your completed work should be similar to Figure 32.8 in the textbook. The spheres have been charged by *induction*.




6. Consider below a single metal insulated sphere, (a) initially uncharged. When a negatively charged rod is nearby, (b), charges in the metal are separated. Electrons are repelled to the far side. When the sphere is touched with your finger, (c), electrons flow out to the sphere to the earth through the hand. The sphere is "grounded." Note the positive charge left (d) while the rod is still present and your finger removed, and (e) when the rod is removed. This is an example of *charge induction by grounding*. In this procedure the negative rod "gives" a positive charge to the sphere.




The diagrams below show a similar procedure with a positive rod. Draw the correct charges in the diagrams.



Name

Period Date

## Concept-Development Practice Page 32-2

### *Electrostatics*

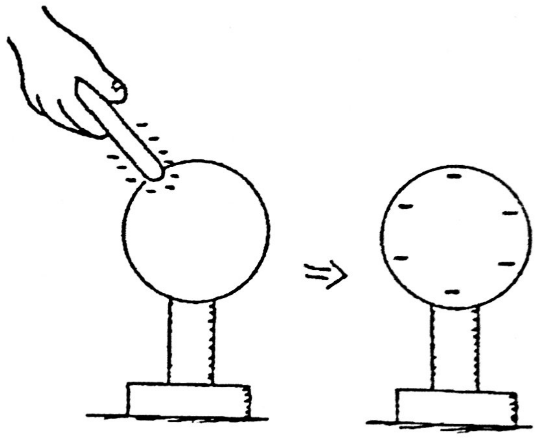
1. The outer electrons in metals are not tightly bound to the atomic nuclei. They are free to roam in the material. Such materials are good

   (conductors) (insulators)

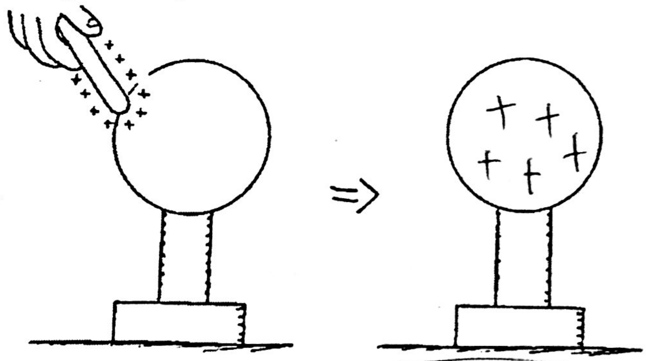
   Electrons in other materials are tightly bound to the atomic nuclei, and are not free to roam in the material. These materials are good

   (conductors) (insulators)

2. A rubber rod that has been rubbed with fur is negatively charged because rubber holds electrons better than fur does. When the rod touches a metal sphere, some of the charge from the rod spreads onto the metal sphere because like charges repel one another. When the rod is removed the charge spreads evenly over the metal sphere and remains there because the insulating stand prevents its flow to the ground. The negatively charged rod has given the sphere a negative charge. This is *charging by contact*, and is shown to the right.



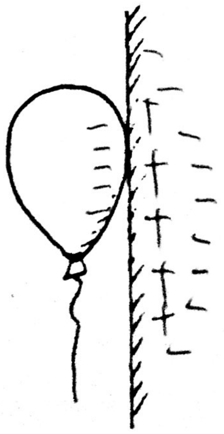
Label the right-hand sphere below with the appropriate charges below for a positively-charged rod touching a metal sphere.



3. In the examples above, electric charge is

   (created from nothing) (simply transferred from one body to another)

4. A positively-charged balloon will stick to a wooden wall. It does this by polarizing molecules in the wooden wall to create an oppositely-charged surface. Draw the appropriate charges on both the balloon and in the wall. Your completed diagram should be similar to Figure 32.13 in your textbook.



*Conceptual* **PHYSICS**