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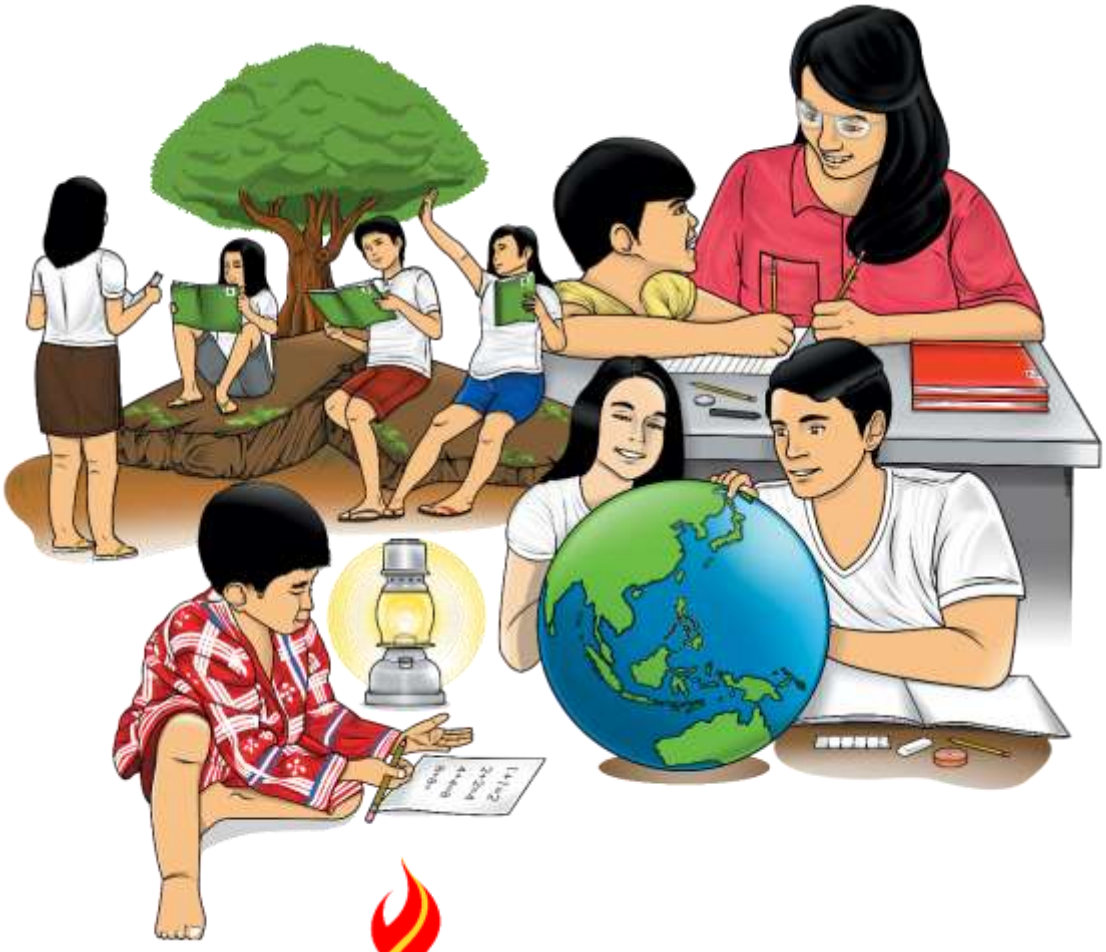
Science

Quarter 3 – Module 7.2:
Be in Charge! Be Electrifying!
(Charging by Conduction)



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Be in Charge! Be Electrifying!
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Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.

What I Need to Know

Hi! Have a great day! Welcome to the nature of Physics, wherein you will learn the nature of electricity around us. Do you know the energy needed to operate your appliances, gadgets and other machines? Yes, electricity is the main reason why those things are functional.

Electricity is a form of energy we encounter in everyday life. Lightning is an example of static electricity in nature. Electrical discharge is produced by the frictional generation and separation of positive and negative charges. It originates from the motion of charges. We are grateful and lucky enough that this kind of energy is present and available to humans for without it, most of the devices that we use today would be useless. In this module, you will learn the different types of charging processes. You will also study how objects can be charged. Knowing this lesson is very essential in your future use especially in understanding how electricity functions.

Most Essential Learning Competency:

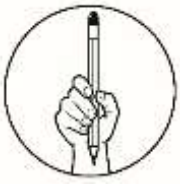
1. Describe the different types of charging processes **(S7LT-IIIj-13)**.

This module focuses specifically on:

1. Charging by Conduction

After going through this module, you are expected to:

1. describe electricity using charges and the motion of these charges;
2. describe the different kinds of charging processes; and
3. differentiate the types of charging processes.



What I Know

Directions: Read each item carefully. Choose the letter of the correct answer. Write the letter of your choice on a separate sheet of paper.

1. Which of the following materials are considered as good conductors?
   A. Copper
   B. Plastic
   C. Porcelain
   D. Rubber

2. What kind of charging process involves the contact of charged object to a neutral object?
    A. Conduction
    B. Fission
    C. Friction
    D. Induction

3. Suppose that a positively charged aluminum plate is brought in contact with a neutral metal sphere, what will happen to the neutral metal sphere?
    A. It will become negatively charged
    B. It will remain in neutral charged
    C. It will become positively charged
    D. The two objects will neutralize each other

4. A negatively charged metal rod is brought in contact with a neutral metal sphere. As a result, what will be the charged of the sphere and the metal rod?
    A. Neutral
    B. Positively charged
    C. Negatively charged
    D. Much more massive

5. Which of the following best characterizes electrical conductors?
    A. Low mass density
    B. Poor heat conductors
    C. Total electric heat is zero
    D. Electric charges move freely

6. Which of the following can be attracted by a positively charged object?
    A. No other object.
    B. A neutral object.
    C. Any other object.
    D. Another positively charged object.

7. If a negatively charged rod touches a conductor, the conductor will be charged by what method?
    A. Conduction
    B. Convection
    C. Friction
    D. Induction

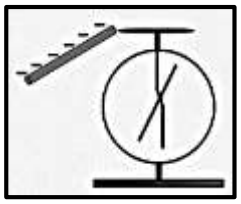
8. When a neutral electroscope is touched with a negatively charged rod, what is the charged of the electroscope after the contact?
    A. Negative
    B. Neutral
    C. Positive
    D. Both positive and negative

9. Of the following materials, which one contains the highest density of free electrons?
    A. Amber
    B. Iron
    C. Glass
    D. Silk

10. If body P, with a positive charge, is placed in contact with body Q (initially uncharged), what will be the nature of the charge left on Q?
    A. Must be negative.
    B. Must be positive.
    C. Must be equal in magnitude to that on P.
    D. Must be greater in magnitude to that on P.

11. When a negatively charged balloon is used to charge a neutral object by contact, what would be the result?
    A. Both the balloon and the object would become positively charged.
    B. Both the balloon and the object would become negatively charged.
    C. The balloon would become neutral, and the object would become negatively charged.
    D. The balloon would become positively charged, and the object ~~is~~ would become negatively charged.

12. A neutral electroscope is touched with a negatively charged rod. What is the charge on the electroscope after the rod is removed?



    A. Negative
    B. Neutral
    C. Positive
    D. Both positive & negative

13. A metal sphere is electrically neutral. It is touched by a positively charged metal rod. As a result, the metal sphere becomes charged positively. Which of the following occurred during the process?

I. The metal sphere loses electrons. II. The metal sphere gains some protons. III. The overall charge of the system is conserved. IV. Electrons are transferred from the sphere to the rod.

    A. I, II, & III
    B. II, III, & IV
    C. I, III, & IV
    D. I, II, III, & IV

14. How is charging by conduction carried out?
    A. By gaining protons.
    B. By rubbing two objects.
    C. By bringing two objects in contact with each other.
    D. By bringing two objects close together without touching.

15. Why are metals useful for making electrical wires?
    A. Metals do not bend.
    B. Metals are insulator.
    C. Metals are conductors.
    D. Metals hold much heat.

Lesson 3 Charging by Conduction

What's In

In the previous module, you learned the other types of charging processes, charging by friction, or rubbing. This means that a material can be charged by rubbing them together. Charging by induction, where an object can be charged without actual contact to any charged object.

Try to identify the following charging processes as charging by friction or charging by induction by putting a check in it. Write your answer on a separate sheet of paper.

CHARGING PROCESSES	CHARGING BY FRICTION	CHARGING BY INDUCTION
1. A rubber balloon is rubbed with an animal fur.		
2. A positively charged balloon is brought near to a neutral conducting pop can.		
3. Rub a glass with a piece of silk		
4. The negatively charged balloon		
5. A student rub a beach ball against the lab station top. The beach ball becomes negatively charged.		

What's New

Great job! You made it! In the previous activities, you were able to tell how charging process occurs through friction and induction. I hope you can use the same skills about the activities we will discuss in this module. Are you excited? Let's start!

Let us try this task.

Activity 3.1: Let's Keep in Touch!

Materials: 2 Styrofoam cups, 2 empty soft drink cans, balloon

Procedures:

1. Mount the soft drink can on the Styrofoam cup.
2. Let the charged can-cup set-up from Activity 2 touch a neutral can-up set-up as shown in figure 3.

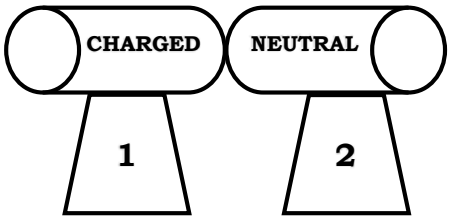


Figure 3: Putting the two set-ups into contact

3. Separate the two set-ups then observe how the charged balloon interacts with the first and second set-ups.
4. Answer the guide questions below and write your answers on a separate sheet of paper.

5. Touch the can with your finger at the end opposite of the balloon. *(By touching the can, a path provided for the charges to be transferred.)*
6. Remove your hand. (*The soft drink can will be charged. The hand provided a path for negative charges to move away from the can. When the hand was removed the can was left with a net charge.)*
7. Let the charged can- cup touch a neutral can- cup set- up as shown in Figure 3.

1. Were you able to charge the can in the second set-up? Explain how this happened?
2. From your observation in step 3, infer the charge acquire by the can in the second set-up?

Here are your criteria to follow in answering this task for you to be guided and lead to an appropriate answer.

FEATURES	4	3	2	1
Ideas	Demonstrates in depth understanding of the topic. It uses scientific reasoning to address ideas.	Demonstrates understanding of the topic. Somewhat uses scientific reasoning to address ideas.	Demonstrates little understanding of the topic. Gives some new information but poorly organized.	Lacks understanding of the topic. Gives no new information and very poorly organized.
Grammar, Usage & Mechanics	No incorrect spelling, punctuation or grammatical errors.	Few spelling and punctuations, errors, minor grammatical errors.	A number of spelling, punctuation or grammatical errors.	So many spelling, punctuation and grammatical errors that it interferes with the meaning.

What is It

In the two previous lessons, the process of charging by friction and charging by induction were described and explained. In this section, the third method of charging- charging by conduction- will be discussed.

The charging process you had made in Activity 3 is called charging by conduction, and is also known as charging by contact, where an object can be charged with actual contact of a charged object to a neutral object.

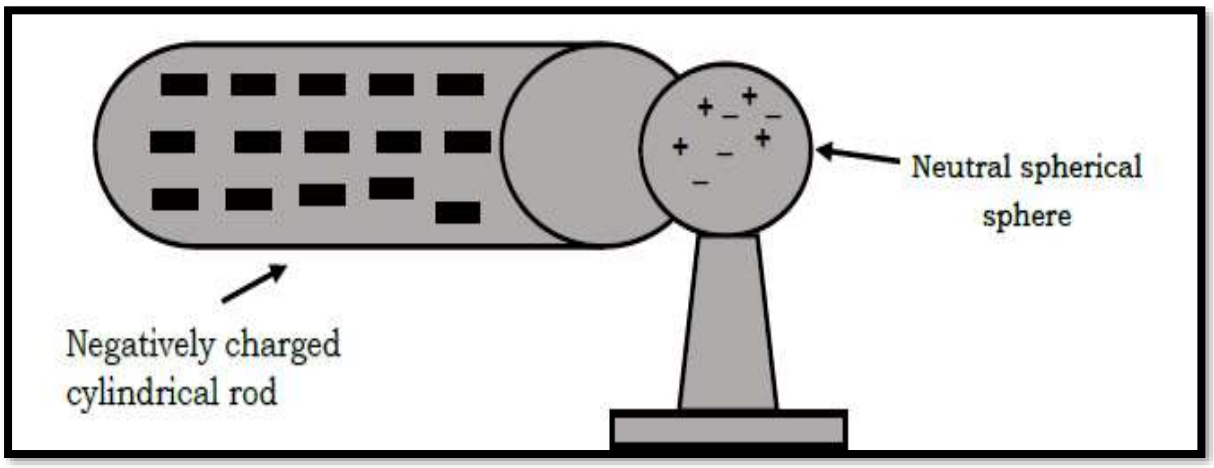


Figure 4: Charging by Conduction

Suppose that a positively charged aluminum plate is touched to a neutral metal sphere. The neutral metal sphere becomes charged as the result of being contacted by the charged aluminum plate. The uncharged metal object will now have a net positive charge because it has lost some of its electrons. On the other hand, the positively charged metal becomes less positively charged after the conduction process because electrons from the neutral metal transferred to it. Therefore, the two objects end up with the same sign of charge.

Or suppose that a negatively charged metal sphere is touvhed to the top of plate of a neutral needle electroscope. The neutral electroscope becomes charged as the result of being contacted by the metal sphrere.

The process of conduction required both objects to be conductors of electrons to move and redistribute themselves. When charging takes place by conduction, objects involve will acquire the same type of charge.

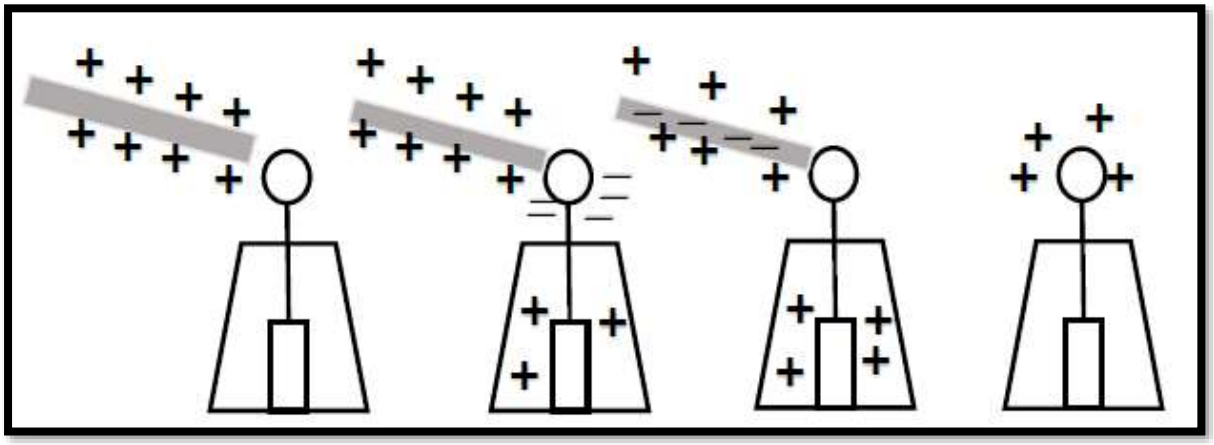
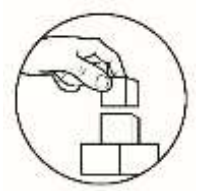


Figure 5: A demonstration of charging by conduction

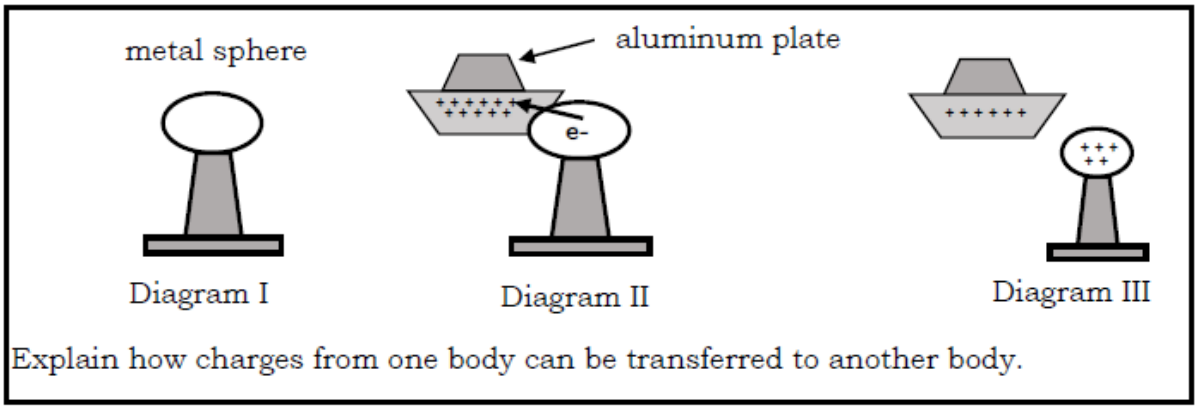
In Figure 5, consider that we have a positively charged cylindrical rod which is placed in contact with a neutral sphere. Upon contact, electrons move from the sphere and onto the rod. The cylindrical rod has less excess positive charge and the metal sphere now has an excess of positive charge. When the process of charging by conduction is complete, cylindrical rod becomes negatively charged and the sphere also becomes positively charged.

Charges cannot be created nor destroyed but can be transferred from one material to another. The total charge in a system must remain constant.



What's More

You did a great job! Now, let us test how far you've gone with our lesson about the process of charging by conduction. Write your answer on a separate sheet of paper. Good luck!



Here are your criteria to follow in answering this task for you to be guided and lead to an appropriate answer.

FEATURES	4	3	2	1
Ideas	Demonstrates in depth understanding of the topic. It uses scientific reasoning to address ideas.	Demonstrates understanding of the topic. Somewhat uses scientific reasoning to address ideas.	Demonstrates little understanding of the topic. Gives some new information but poorly organized.	Lacks understanding of the topic. Gives no new information and very poorly organized.
Grammar, Usage & Mechanics	No incorrect spelling, punctuation or grammatical errors.	Few spelling and punctuations, errors, minor grammatical errors.	A number of spelling, punctuation or grammatical errors.	So many spelling, punctuation and grammatical errors that it interferes with the meaning.

What I Have Learned

A job well- done! It truly shows how much you enjoyed and learned our lesson. Are you ready to have some more? Let's begin.

Directions: Rearranged the jumbled letters to form the word being described by each statement. Write your answer on a separate sheet of paper.

1. Materials that conduct electric charges are called _____.

C N D O C T U O S R

2. _____ do not move from one material to another because they are held firmly in the nucleus.

T R O O N P S

3. Charging by _____ is a process of giving one object a net electric charge by placing it in contact with a charged object.

C O D N N U O I T C

4. A neutral metal sphere is touched by a negatively charged metal rod. As a result, the sphere will be negatively charged, and the metal rod will be _____ charged.

N G A E V T I E Y L

5. Metals such as _____, aluminum, gold, and silver conduct electric charges.

P P E R O C

What I Can Do

You're fantastic and really enjoyed your exploration about the three types of charging process. Here is your final challenge to prove what you got.

Directions: Illustrate and explain the underlying concepts by applying the conduction charging process using the given materials below. Write your answer on a separate sheet of paper.

A charged rod and a neutral spherical conductor that will result in a negatively charged sphere.

Here are your criteria to follow in answering this task for you to be guided and lead to an appropriate answer.

FEATURES	4	3	2	1
Following Directions	All directions were followed	Most directions were followed	Some directions were followed	None of the directions were followed
Creativity	Uses own ideas and imagination	Uses own ideas most of the time	Uses some imagination	Did not used own ideas or imagination
Craftmanship	The illustration is neat and carefully made	The illustration has few of erasures	The illustration has numerous of erasures	The illustration has very numerous of erasures
Effort	Took so much of time and worked hard on the activity	Slightly work hard for the activity	Put a small effort into the activity	It was done in a rushed and did not work hard

To evaluate your explanation of the concepts, please be guided by the rubric below.

FEATURES	4	3	2	1
Ideas	Demonstrates in depth understanding of the topic. It uses scientific reasoning to address ideas.	Demonstrates understanding of the topic. Somewhat uses scientific reasoning to address ideas.	Demonstrates little understanding of the topic. Gives some new information but poorly organized.	Lacks understanding of the topic. Gives no new information and very poorly organized.

Grammar, Usage & Mechanics	No incorrect spelling, punctuation or grammatical errors.	Few spelling and punctuations, errors, minor grammatical errors.	A number of spelling, punctuation or grammatical errors.	So many spelling, punctuation and grammatical errors that it interferes with the meaning.

Assessment

Directions: Read each item carefully. Choose the letter of the correct answer. Write the letter of your choice on a separate sheet of paper.

1. Which of the following materials are considered as good conductors?
   A. Aluminum, copper, gold, silver
   B. Glass, rubber, ceramic, dry wood
   C. Glass, rubber, aluminum, ceramic, copper
   D. Silver, rubber, aluminum, ceramic, wet wood

2. Electric charges can move most easily on which of the following objects?
   A. Glass tube
   B. Metal plate
   C. Plastic plate
   D. Rubber plate

3. Which of the following BEST characterizes electrical conductors?
   A. Low mass density.
   B. Poor heat conductors.
   C. Total electric charge is zero.
   D. Electric charges move freely.

4. The following objects are good conductors because they have loose electrons, **EXCEPT**
   A. Copper
   B. Metals
   C. Rubbers
   D. Silvers

5. What kind of materials permit the flow of electric charges?
   A. Conductors
   B. Insulators
   C. Plastics
   D. Rubbers

6. What method of charging an object allows electrons to flow by direct contact from one object to another?
    A. Conduction
    B. Friction
    C. Induction
    D. Polarization

7. Neutral objects become charged when electrons are transferred from a charged object through _____.
    A. charging by friction
    B. transforming charges
    C. charging by induction
    D. charging by conduction

8. Charge is most easily transferred in _____.
    A. conductors
    B. insulators
    C. nonconductors
    D. semiconductors

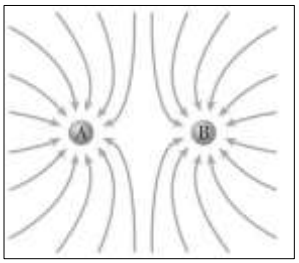
9. An attracting force occurs between two charged objects when the charges are of _____.
    A. like signs
    B. unlike signs
    C. equal magnitude
    D. unequal magnitude

10. A negatively charged metal rod is brought in contact with a neutral metal sphere. What happens during the process?
    A. The electrons are transferred from the charged rod to the neutral sphere and the sphere acquires a negative charge.
    B. The electrons are transferred from the charged rod to the neutral sphere and the sphere acquires a positive charge.
    C. The electrons are transferred from the neutral sphere to the charged rod and the sphere acquires a negative charge.
    D. The electrons are transferred from the neutral sphere to the charged rod and the sphere acquires a positive charge.

11. If body P, with a positive charge, is placed in contact with body Q (initially uncharged), what will be the nature of the charge left on Q?
    A. It must be neutral.
    B. It must be positive.
    C. It must be negative.
    D. Either negative or neutral.

12. A positively charged metal rod is brought in contact with a neutral metal sphere. What will be the result of the sphere and the metal rod after the process?
    A. The electrons are transferred from the charged rod to the neutral sphere and the sphere acquires a negative charge.
    B. The electrons are transferred from the charged rod to the neutral sphere and the sphere acquires a positive charge.
    C. The electrons are transferred from the neutral sphere to the charged rod and the sphere acquires a negative charge.
    D. The electrons are transferred from the neutral sphere to the charged rod and the sphere acquires a positive charge.

13. What must be the charges be for A and B in the figure so that they produce the electric field lines shown?



A. A and B must both be positive.
B. A and B must both be negative.
C. A must be negative, and B must be positive.
D. A must be positive, and B must be negative.

14. Why are metals useful for making electrical wires?
A. Metals do not blend
B. Metals are insulators
C. Metals hold much heat
D. Metals are good conductors

15. How is the process of charging by conduction possible?
A. By distributing the charges
B. By rubbing the two objects
C. By touching two charged objects
D. By placing it in contact with a charged object

Additional Activities

Directions: Identify the following charging situations whether it is charging by friction, charging by induction or charging by conduction. Write your answer on a separate sheet of paper.

1. A positively charged tin can be brought in contact with a neutral tin can. The neutral tin can becomes charged after being in contact with the charged tin can.
2. In a lab, you take a piece of neutral wool and neutral polyethylene and rub them together.
3. A rubber balloon is charged negatively by rubbing it with an animal fur and the balloon was brought near the spheres.
4. Electrons on the fingertips cause electrons on the doorknob to move away, leaving the doorknob positively charged.
5. You rub your hair with a balloon.
6. Feet rubbing on a carpet.
7. The negatively charged balloon is brought near the two cans.
8. A positively charged rod is brought close to an uncharged metal sphere but does not touch.

Answer Key

Lesson 3 **What I Have Learned** 1. CONDUCTORS 2. PROTONS 3. CONDUCTION 4. NEGATIVELY 5. COPPER	Lesson 3 **What's New** 1. The can in the second setup will be charged since excess charges has been transferred to it from the can in the first setup. 2. The can in the second setup has acquired a net positive charge.	**Lesson 3** **Assessment** 1. A 2. B 3. D 4. C 5. A 6. A 7. D 8. A 9. B 10. A 11. B 12. D 13. D 14. D 15. D	**Lesson 3** **What I Know** 1. A 2. A 3. C 4. C 5. D 6. B 7. A 8. A 9. B 10. B 11. B 12. A 13. C 14. C 15. C

Lesson 3
What I Can Do

The negatively charged metal rod transfers its electrons to the metal sphere through direct contact making the metal sphere to have excess of electron charges. Metal sphere becomes negatively charged object.

Lesson 3
What's More

1. Because of the direct contact, the current flowing through one conductor (i.e., aluminum plate), begins to flow through the neutral body. Both bodies in the field changes its charges simultaneously. The positively charged aluminum plate touched the metal sphere, electrons are drawn off from the sphere and into the plate. The aluminum plate becomes negatively charged and the sphere becomes positively charged.

Lesson 3
Additional Activities

1. Charging by conduction
2. Charging by friction
3. Charging by friction
4. Charging by conduction
5. Charging by friction
6.Charging by friction
7. Charging by induction
8. Charging by induction

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