

Charge Interactions

It is a well-accepted belief that objects are composed of atoms and that these atoms contain protons, electrons and neutrons. Objects can become charged by gaining or by losing electrons. This gain or loss can occur by a variety of methods. Perhaps the most common method involves rubbing one object against another object. The process of rubbing two different materials together often results in the transfer of electrons. Electrons are transferred from the less electron-loving object to the more electron-loving object. Protons are never transferred since they are tightly bound within the nucleus of atoms.

Electrons are charged negatively and protons are charged positively. So while an electrically neutral object has a balance of protons and electrons, a charged object possesses an imbalance of these two types of subatomic particles. Positively charged objects contain more protons than electrons. Negatively charged objects contain more electrons than protons.

The charge that an object possesses can often be determined by observing how it interacts with objects of known charge. Two like-charged objects will be observed to repel or push away from each other. Two oppositely charged objects will be observed to attract or draw towards each other. And a charged object - whether positive or negative - and a neutral object will also attract each other.

A group of physics students rub several different objects with the same sample of synthetic animal fur. They then test their interactions with one another. **Table 1** shows the results of the various tests. Object A is a negatively charged balloon.

Table 1: Interactions of Six Different Objects

Object A	Object B	Object C	Object D	Object E
Repels Object B	Attracts Object C	Repels Object D	Attracts Object E	Attracts Object B

Use this information to answer the following questions. Before doing so, it might be helpful to identify the type of charge - positive, negative or neutral - of each of the six objects.

Questions:

- Based on this passage, which statement is true of a positively charged object?
 - Positively charged objects do not contain any electrons.
 - Positively charged objects do not contain neutrons or electrons.
 - There are more protons than electrons on a positively charged object.
 - The protons and the electrons are both positively charged on such objects.
- The passage states that when two objects are rubbed together, there is a transfer of electrons. What seems to be the important variable in determining which object acquires the transferred electrons?
 - The relative size of the two objects.
 - The relative roughness of the two objects.
 - The relative affinity that each object has for electrons.
 - The number of electrons initially possessed by each object.
- Object A - the balloon - is made of vinyl. How does the electron affinity of vinyl compare to that of animal fur?
 - Vinyl has a greater affinity for electrons than animal fur.
 - Animal fur has a greater affinity for electrons than vinyl.
 - Both vinyl and animal fur has the same affinity for electrons.
 - Nonsense! It is not possible to compare electron affinities with so little information.
- It is stated in the passage that Object A is negatively charged. What can be concluded about any object that is observed to attract Object A?
 - The object is positively charged.
 - The object is negatively charged.
 - The object is electrically neutral.
 - The object is either neutral or positively charged.
- Which observation is the most important observation for determining the charge on Object B?
 - Object B attracts Object C.
 - Object E attracts Object B.
 - Object B was rubbed with animal fur.
 - Object A and Object B repel each other.
- What conclusion can be made regarding Object B from the sole observation that Object A and Object B repel each other?
 - Object B is charged with a positive type of charge.
 - Object B is charged with a negative type of charge.
 - Object B is charged; more tests must be performed to determine the type of charge it has.
 - Object B is either negatively charged or neutral; additional tests must be performed to be more conclusive.

7. There are two observations listed in **Table 1** regarding Object C. They are:
- Object B and Object C attract each other.
 - Object C and Object D repel each other.

Which conclusion does the second observation allow one to make that cannot be made with just the first observation?

- Object C is neutral.
 - Object D is neutral.
 - Object C is charged.
 - Object B and C cannot be like charged.
8. Which of the following reasons explain why one can conclude that Object E is charged negatively?
- Object D is positively charged and it is observed to attract Object E.
 - Object B is negatively charged and it is observed to attract Object E.
 - Nonsense! Object E must be neutral because it attracts both a positively charged and a negatively charged object.
 - Nonsense? Object E is negatively charged because it attracts both negatively charged Object B and neutral Object D

9. There are two observations listed in **Table 1** regarding Object E. They are:

Observation 1: Object D and Object E attract each other.

Observation 2: Object E and Object B attract each other.

What conclusions can be made about Object E based on these two observations?

- Object E is positive since it attracts the negatively charged Object B.
 - Object E is negative since it attracts the positively charged Object B.
 - Object E is negative since it attracts the positively charged Object D.
 - Object E is neutral since it attracts both a positive (D) and a negative (B) object.
10. Suppose two additional objects – Object F and Object G – are tested for its interaction with Object A. Object F is observed to repel Object A and Object G is observed to attract Object A. Which one of the following interactions would be observed between these two objects and other objects from **Table 1**?
- Object F and Object B will definitely attract each other.
 - Object F and Object D will definitely repel each other.
 - Object G and Object B will definitely attract each other.
 - Object G and Object C will definitely repel each other.
11. Which statement about the interaction between Object A and Object E is correct?
- Object A and Object E will repel each other since they are like charged.
 - Object A and Object E will attract each other since they are oppositely charged.
 - Object A and Object E will repel each other since one is negative and the other neutral.
 - Object A and Object E will attract each other since one is positive and the other neutral.