How to Find Pre-Concepts about Charges and Magnets?

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Abstract

Electric charges and magnetic poles are often confused in the minds of students. It is convenient to remind them that they only interact when they are in relative motion. The force **F** on a charged particle q moving with velocity **V** in a magnetic field **B** is given by **F** = q**V**x**B**. By Newton's Third Law, the force on magnet producing the field B is equal in magnitude and the opposite direction.

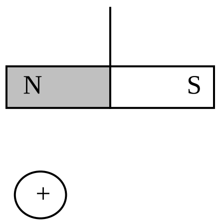
Keywords: Electric charge, magnetic poles, magnetic field.

INTRODUCTION

Knowing the students' preconceptions allows us to avoid repeating what they already know and suggests how to correct the wrong concepts they already have (Turgut, Gürbüz, & Turgut, 2011). The standard procedure of asking students a question on the board requires a lot of time. When any pre-concepts are discovered, the time assigned to the topic has generally been consumed. An alternative approach to catch any pre-concepts is asking all students the same question. Walking between the desks, you can review several answers in a much shorter period. Some concepts allow using multiple-choice questions to measure students' understandings of any physics concepts. Multiple choice questions allow teachers to reveal pre-concepts in a short time or even instantly in some cases (Planinic, 2006).

The most difficult thing is to find good questions that allow us to correct the preconceptions. In the references are mentioned two with internet data. Conceptual teaching encourages reasoning and helps not to confuse memorizing a text with learning it. We suggest the following three conceptual issues related to electric charges and magnets.

1. We have one long magnet suspended by a thread at its center. A positive electrical charge is below its north pole. Find the direction of the force over the north pole.



a) Up

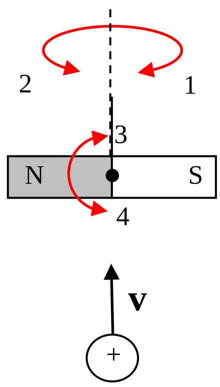
b) Down

c) Into the page

d) Out of the page

e) No force

2. We have one long magnet suspended by a thread at its center. A positive electrical charge moves toward the magnet with velocity V, as shown in the figure. In what sense tends the magnet to turn?



a) Direction 1

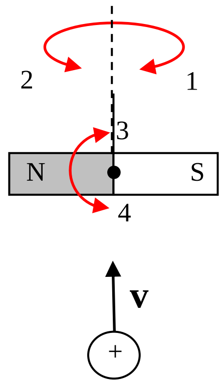
b) Direction 2

c) Direction 3

d) Direction 4

e) No torque, no turn.

3.- We have one long magnet suspended by a thread at its center. A positive electrical charge moves toward the magnet with velocity V, as shown in the figure. In what sense is the force on the magnet?



a) To the right

b) To the left

c) Out of the page

d) Into the page

e) No force

The problem with multiple-choice questions is that the student may give the correct answer with the wrong reasoning. To avoid this problem, we may ask a short paragraph requesting the reason behind their responses with a "Why or How" question. By using three related questions, as in the example, we may infer the wrong pre-concepts related to a wrong answer. In cases 1 and 2, the answer is e), in 3, the answer is c).

To calculate the force on above problems 2 and 3, we may apply the Lorentz force (**F** = q**VxB**) over the approaching charge and by the third Law of Newton found the force on the magnet. Another approach is using the magnetic field produced by a moving charge, circles concentric with the trajectory, creating the same force on each of the magnetic poles. By symmetry, both forces are equal, so there is no torque around the supporting string. We found the following question in a book devoted to Physics teachers (Redish, 2003):

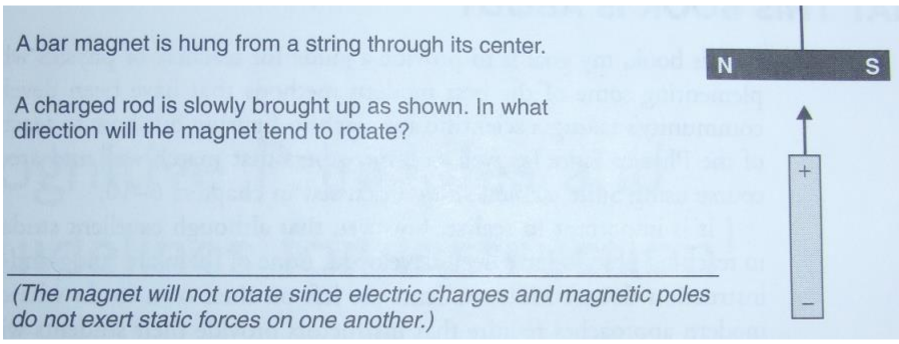


Figure 1. *A sample problem is a textbook (p.15, Redish (2003))*

The author confuses slowly with static, but slowly here means that maybe you don't have enough sensitivity to detect the force or the torque produced. A student who knows the Lorentz force will found that there is no torque, but there is a force. So, the question as presented is confusing, and it is one good example of a wicked problem.

SUMMARY

We need to find the preconceptions of a group of students, in a short time, without passing them to the board. Preconceptions allows us to avoid repeating the correct concepts and suggests how to correct the wrong ones. It is a very valuable tool.

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