07. Addendum

Algebriac Signs

Confusion about the meaning of algebraic signs is common among beginning physics students. The best way to clarify this confusion is to remember that algebraic signs are simply a mathematical way to describe direction. Instead of saying up and down, or east and west, physicists construct coordinate systems and translate the words east and west into the symbols '+' and '-', or even '-' and '+' if we choose a different coordinate system. The key to the translation is the coordinate system. A coordinate system is very similar to the English-French dictionary you might take with you on your first trip to France. When you see a '-', use your coordinate system to translate it into a verbal description of direction.

Do not fall into the common habit of translating a '-' into the word "decreasing". A negative acceleration, for example, does *NOT* imply that the object is slowing down. It implies an acceleration that points in the negative direction. It is *impossible* to determine whether an object is speeding up or slowing down by looking at the sign of the acceleration! Conversely, the word "deceleration", which does mean that an object is slowing down, does *not* give any information regarding the sign of the acceleration. I can decelerate in the positive direction as easily as I can decelerate in the negative direction.

A guide to determining the correct algebraic sign:

Deriving the kinematic relationships

Let's construct the two independent kinematic relationships that you will use whenever the acceleration is constant. In a later chapter, we will return to the case in which the acceleration is not constant.

From the definition of acceleration:

The above relationship is **our first kinematic relationship**. The acceleration in this relationship is really the average acceleration. However, since the acceleration is constant, the average acceleration is the same as the acceleration at any instant between the initial and final state.

From the definition of velocity:

You must remember, however, that the velocity in this formula is really the average velocity of the object over the time interval selected. To keep you from having to remember this fact, we can rewrite the average velocity as the sum of the initial velocity and the final velocity divided by two:

Substituting in the first kinematic relationship for the final velocity yields:

The above relationship is **our second kinematic relationship**.

Although we could keep deriving new kinematic equations forever, it is *impossible* that any other derived equation could allow us to calculate some quantity that these equations do not allow us to calculate.

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