Studying physics as resolving paradoxes

Three boys and two girls drank coffee together. The coffee cost 500 won per cup. Three boys paid 1000 won each. So, they paid a total of 3000 won. Since the coffee cost 2500 won, they got 500 won for change. Accordingly, three boys and two girls got back 100 won each. This implies that boys had paid 900 won each. $900 \times 3 = 2700$. Since two girls had 100 won each, this should amount to $2700 + 200 = 2900$ won. Where is the missing 100 won?

I found the above "paradox" via the internet. Of course, it is not really a paradox, even though it looks like one. If it appears to be a paradox, and if you cannot resolve it, the most likely explanation is that you are "confused" or misunderstand something. Nevertheless, if you try to solve this paradox, you may begin to understand what you have misunderstood.

Nobel laureate, late Richard Feynman said:

> When you're thinking about something you don't understand, you have a terrible, uncomfortable feeling called "confusion." It's a very difficult and unhappy business. And so most of the time you are rather unhappy, actually, with this confusion, you can't penetrate this thing. Now, the confusion is because we are all some kind of apes that are kind of stupid, trying to figure out how to put two sticks together to reach the banana, and we can't quite make it, the idea. And I got this feeling all the time that I am an ape trying to put sticks together. So I always feel stupid. Once in a while, though, the sticks go together and I reach the banana!

Every time I encounter new concepts in physics, many things seem confusing and paradoxical at first glance. However, these "paradoxes" are the kind of the paradoxes described above; they are not paradoxes at all. It's just that I am confused, which means that I have a wrong intuition or wrong picture about the things which I am confused about.

As I try to resolve these "paradoxes," either by myself or with help from other people, in order to remove this "unhappiness" and to better understand physics, I learn a lot, and I come to have a better intuition or a better picture about the new concepts.

I want to emphasize that having an accurate mental picture about the concepts is very important. The Nobel Prize equivalent of the mathemat-

ics Fields medal winner and single most renowned string theorist Edward Witten said:

> Most people who haven't been trained in physics probably think of what physicists do as a question of incredibly complicated calculations, but that's not really the essence of it. The essence of it is that physics is about concepts, wanting to understand the concepts, the principles by which the world works.

The late Nobel laureate Paul Dirac said:

> I consider that I understand an equation when I can predict the properties of its solutions, without actually solving it.

It goes without saying that such a profound understanding of an equation is possible only when you have a clear picture and a correct intuition about the concepts.

Indeed, Albert Einstein once said: "Logic will get you from A to B. Imagination will take you everywhere."

Einstein's quote implies that theoretical physicists work by playing around with concepts and imagining them, rather than by proceeding with pure logic and calculations without the sense of what is actually going on behind the numbers. Of course, physicists still need to eventually fill the gaps with logic and calculations but that doesn't diminish the importance of imagination in physics.