

Preface

Over the last 12 years, I observed, during the experimental classes, the difficulties faced by students that aim to obtain a teaching degree in physics, chemistry or mathematics, as well as technical high school pupils. The experimental data are obtained almost without reflection on the several possible inconveniences that can appear on the subsequent analysis of the results. The results are presented without a detailed discussion of their meaning, and there is a poor connection to the theory that explains them. The estimates of uncertainties, which are essential for a self-criticism of the proposed experiment, are usually missing. Theory and experiment seem to be “two types of physics” who never meet. They live separately from each other, one in the classroom and the other in the laboratory.

This textbook was written in order to help the undergraduate students in physics, chemistry, mathematics and engineering and technical high school students, to unify these “two types of physics”. The textbook aims to be a reference to the physics classes and not only a reference to the basic physics labs of universities, faculties and schools.

Basic didactic laboratory experiments involving Newton’s Laws, the acceleration of gravity, circular motion, the simple and conical pendulums, conservation of mechanical energy and two-dimensional collisions were chosen. Experiments that are important in daily life, like rolling with and without slipping, involving the static, kinetic and rolling (or rolling resistance) frictions are also included.

From a total of 13 chapters, eight of them deal with experiments made with easily accessible materials and investigated by video analysis using the free software *Tracker*. This easy-access technology allows the reader to conduct his/her own experiments in the classroom or in any other place of convenience. Appendix A presents a quick and practical guide for beginners in the *Tracker* software. Video analysis is not only a tool for obtaining experimental data, it can also be used to test theoretical models, as exemplified in the criticism of the experiment presented in Chap. 11. Appendix B suggests a way to make graphs, since in some experiments graphs and linear fits are plotted using paper graph and ruler.

The textbook stands out for the use of the scientific method to conduct a careful analysis of each proposed experiment. Uncertainties and relative errors are estimated whenever possible. The assumptions and proposed models are tested with impartiality, with reasonability prevailing, which can lead the reader to review the initial premise, refuting it or leading to attempt a reformulation of the proposed model. I hope the students realize that physics has its base in the experimentation of high quality.

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