Unit 1: Particles and Vectors

The universe seems to be not only immense but frequently complex and we perceive a startling diversity of physical phenomena. It has long been a goal of humanity (that’s us) to organize this information. In this course we will attempt to understand a small, relatively well defined class of phenomena.

One of the most prominent features of the universe is matter in motion. In trying to understand this (and indeed any) complicated phenomenon, it is often useful to make some simplifying assumptions. For example, under certain circumstances it makes sense to treat both elementary particles and whole galaxies as point masses. The underlying idea here is that we can understand a lot about motion in nature by understanding the motion of billiard balls.

Since classical mechanics, the study of matter in motion, is applicable to such a wide variety of physical systems, it is important to get a feeling for the magnitude of the physical quantities describing a given system. Atoms and stars may behave like billiard balls, yet one is about $10^{19}$ times larger in linear size than the other.

Many physical quantities, such as velocity and acceleration, are vector quantities, meaning they have both a magnitude and a direction. The ability to use vectors and vector operations is crucial to an understanding of many important physical laws.

Objectives: After completing this unit you should be able to:

1. Express physical quantities in various systems of units, given the necessary conversion factors, and

2. Make order-of-magnitude calculations like the ones discussed in the reading and in the problems, and

3. Use vectors and elementary vector operations confidently.
Suggested Procedure:

1. Read H&R, Chapters 1 and 2. (Don’t be preoccupied with memorizing all the various sizes, conversion factor, etc. You will become familiar with them as the course progresses.)

2. Or, read Berkeley, Chapter 1 and Chapter 2 up to pg. 40.

3. Optional—Read Feynman Chapters 1, 5, and 7.

4. Do the problems in H&R, pg. 13, #2, 9, 8; and in the PANIC problem booklet, chapter 1, #3, 7, 14. By all means try other problems you find interesting. If you need some practice with vectors, try in Berkeley, pg. 49, #1, 5, 13; and in H&R, pg. 28, #28, 35; or anything else you think would help.

5. Look over the math notes at the end of Chapter 2 in Berkeley. If you are not comfortable with the mathematics discussed, please talk to a tutor about it.

6. Take a unit test. For this unit the test will be “open book”.