Chapter 2: Describing Motion: Kinematics in One Dimension

Giancoli Text Sections

2-1 Reference Frames and Displacement
2-2 Average Velocity
2-3 Instantaneous Velocity
2-4 Acceleration
2-5 Motion at Constant Acceleration
2-6 Solving Problems
2-7 Falling Objects
2-8 Graphical Analysis of Linear Motion

Summary

Chapter 2 begins the real study of physics. One-dimensional kinematics is the study of motion in a straight line without regard to its causes. Many of the concepts in this chapter, such as velocity and acceleration, are familiar from everyday experiences, like driving a car. However, many do not know the physics definitions of these same terms or how they relate to one another. In addition, common misconceptions due to the presence of air resistance and friction in the real world need to be addressed. Chapter 2 lays the foundation for the treatment of two-dimensional motion addressed in later chapters.

Major Concepts

By the end of the chapter, you should understand each of the following and be able to demonstrate their understanding in problem applications as well as in conceptual situations.

- Reference frames
- Position, distance, and displacement
- Speed and velocity
  - Average
  - Instantaneous
  - Constant
- Acceleration
  - Average
  - Instantaneous
  - Constant
- Equations of motion with constant acceleration
- Free fall
- Graphs of position versus time

- Graphs of velocity versus time
- Graphs of acceleration versus time

Formulas

FOR CONSTANT MOTION:

speed = distance / time

$v = \Delta x / t$

FOR ACCELERATED MOTION:

$v = (x_f - x_0) / 2$

$a = \Delta v / t$ OR $a = (v_f - v_0)/ t$

$\Delta x = v_0 t + 1/2\ a\ t^2$

$\Delta x = (v_f^2 - v_0^2) / 2a$

When gravity is involved, change the "a" to "g"

Problem Solving Tips

FOR CONSTANT MOTION (no acceleration), always use $v = \Delta x / t$

FOR ACCELERATED MOTION, use one or more of the following:

$v = (x_f - x_0) / 2$	(use when you need the average velocity)
$a = \Delta v / t$ OR $a = (v_f - v_0)/ t$	(use when you don't know or need how far it went)
$\Delta x = v_0 t + 1/2\ a\ t^2$	(use when you don't have or need the final velocity)
$\Delta x = (v_f^2 - v_0^2) / 2a$	(use when you don't have or need time)

When gravity is involved, change the "a" to "g"

IMPORTANT: Vertical motion (free fall) always involves acceleration (due to gravity). The only exception is when an object reaches "terminal velocity" i.e. it no longer accelerates, At that point, use $v = \Delta x / t$.