

Web Based Study Guide
Chapter 2
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Section one: (motion)

The classification and comparison of motions is called **Kinetics**.

The properties of motion are:

- A. The motion must be along a straight line either vertical, horizontal or slanted.
- B. It must be know if the object speeds up, slows down, stops, or goes in the reverse direction, and how time is related to any change.
- C. The moving object must move like a particle such that every portion moves in the same direction and at the same rate.

Section 2: (position and displacement)

To locate an object means to find its **position** relative to some reference point mainly the **origin** of an axis. The positive direction of the axis is in the direction of increasing numbers. The opposite direction is the negative direction.

A change from one position (X_1) to another position (X_2) is called a **displacement** (ΔX) where

$$\Delta X = X_2 - X_1$$

If we ignore the sign of a displacement we are left with the **magnitude** of the displacement (ΔX) which is always positive.

Displacement is an example of a **vector quantity**, which is a quantity that has both magnitude and direction.

Section 3: (average velocity and average speed)

Several quantities are associated with "how fast" something moves. Average Velocity, or the ratio of position displacement to time, is one such quantity.

$$V = (X_2 - X_1) / (T_2 - T_1)$$

If one were to graph time versus position of a moving object, the average velocity would be the slope of a straight line that connects any two points on that graph, (X_1, T_1) and (X_2, T_2) .

Average velocity is a vector quantity; thus, it has both magnitude and direction. A positive slope, or average velocity, indicates that the line is slanting up to the right; similarly, a negative slope indicates that the line slopes down to the right.

Average speed is another way to show "how fast" an object moves. However, average speed involves the total distance covered by an object, not just its displacement. Average speed also lacks direction; thus, it is a scalar quantity.

$$S = \text{total distance} / (T_2 - T_1)$$

Section 4: (instantaneous velocity and speed)

Instantaneous velocity refers to the velocity of an object at a specific point in time. The instantaneous velocity is the derivative of the object's position.

$$V = dX / dT$$

Instantaneous speed is simply the magnitude of an object's instantaneous velocity.

Again, whereas velocity is vector and has direction, speed is scalar and does not.

Section 5: (acceleration)

Acceleration is the change in the velocity of a particle (m / s^2) . **Average acceleration:**

$$\bar{a} = (v_2 - v_1) / (t_2 - t_1) = \Delta v / \Delta t$$

Instantaneous velocity: $a = dv / dt = d^2 x / dt^2$

Acceleration is the slope of the velocity curve at a certain point. Large accelerations are sometimes expressed in terms of “g” units ($1g=9.8\text{m/s}^2$). This is also the magnitude of the acceleration of a free falling object near the earth’s surface.

Some major problem types when dealing with acceleration:

A. Finding average acceleration given starting and final velocities. ($\Delta v / \Delta t$)

B. Finding instantaneous acceleration given an equation for position

(ex: $x = 4 - 27t + t^3$). (take second derivative)

C. Graph v vs. t and indicate how to find average acceleration on the graph.

D. Given the position curve, sketch velocity and acceleration. Remember:

instantaneous acceleration is the slope of the position graph and acceleration is the slope of the graph .

If the signs of velocity and acceleration of a particle are the same, the speed increases. If the signs are different the speed decreases.

Section 6: (constant acceleration)

Most problems (and real life situations) involve acceleration that is constant.

Some equations used in constant acceleration situations:

$$v = v_0 + at$$

$$x = x_0 + \bar{v}t$$

$$x - x_0 = v_0t + \frac{1}{2}at^2$$

$$v^2 = v_0^2 + 2a(x - x_0)$$

Some problems dealing with constant acceleration are:

A. To realize what quantities are missing in a problem and use the correct equation to find them.

B. Find the acceleration from point A to point B.

If a problem states that there is a uniform change in velocity, use one of the constant acceleration equations, but make sure you understand which equation to use.

Section 7: (another look at constant acceleration)

There are two basic equations when dealing with constant acceleration. They are:

$$v = v_0 + at$$
$$x - x_0 = v_0t + \frac{1}{2}at^2$$

These two equations came from the integration of the acceleration where a is constant.

The definition of a is:

$$a = \frac{dv}{dt}$$

which can be rewritten as:

$$dv = a \times dt$$

By taking the indefinite integral of both sides of this equation. You then are given:

$$v = at + c$$

To evaluate the constant (C) let $t = 0$ and $v = v_0$. By substituting these values into our equation

we now have our first basic equation. The second basic equation is based on velocity. The

definition of velocity is:

$$dx = v \times dt$$

By substituting v with $(v_0 + at)$ and taking the indefinite integral of both sides we get the following equation:

$$x = v_0t + \frac{1}{2}at^2 + C'$$

C' is a new constant of integration. At time $t = 0$ we have $x = x_0$. By substituting these values into our equation, our C' is replaced by x_0 . This yields our second basic equation.

Section 9: (particle physics)

An atom consists of a compact and dense **nucleus** made up of **neutrons** and **protons** that is surrounded by lightweight **electrons**. The radius of an electron is $10E-10m$. The atom is held together by the electrical attraction between the electrons. Electrons are negatively charged, the neutrons are neutral and the protons are positively charged (The nucleus is therefore positively charged). Electrons appear to be point like particles called **leptons**. They have no size or internal structure. Neutrons and protons appear to have size and contain elementary particles called **quarks**. Both leptons and quarks have an anti-particle version as well.

Hydrogen has the simplest nucleus. It only has a single proton. The number of neutrons in its nucleus distinguishes each element.

An **isotope** is a variation of an element. The number of its neutrons distinguishes it.