1 Dimensional Motion

I. Vector and Scalar Quantities

Scalar quantities are quantities that are only represented by a numerical (number) value. They have no direction to them, only ***magnitude*** (size).
Vector quantities are quantities that have both magnitude (size) and direction.

Examples: **scalar**	**vector**
Speed (55 mph)	Velocity (55 mph North)
Distance (12 meters)	Displacement (12 m East)
Time (sec, hr)	Acceleration (10 m/sec^2 down)
Mass (kg,g)	Force (4 Newtons upward)

Here is an example of a typical question requiring you to distinguish scalar from vector quantities:

A runner circles a 400m track 6 times and slows to a stop 50m past the point where he started. What ***distance*** *did he run? What is his* ***displacement****?*
Answer: The total distance he ran was (400x6)+50=2450m
His displacement is just 50m in the original direction.

II.Velocity

- Speed and velocity may sometimes be used interchangeably and the letter **"v"** is used for both, but they are not the same. Speed is calculated using distance, whereas velocity is calculated using displacement. In the example question above, the runner's speed and velocity would be very different.

- Equation for velocity: is $\mathbf{v = d/t}$. "v" represents the **average velocity** over some time interval, "d" represents displacement. Displacement is the change in position of an object compared to some reference point.* *This may or may not be the same as the distance that the object travels*. "t" is the time interval the displacement takes place. Another way of writing the equation for velocity is $\mathbf{v = \Delta d/\Delta t}$ which is the change in displacement over the change in time. The Δ symbol in the above equation is the Greek symbol delta and means" change in." Mathematically it is written $\mathbf{d = d_2 - d_1}$ **or** $\mathbf{t = t_2 - t_1}$ **.** Where d_2 and t_2 (also written d_f and t_f) are the **final** displacement and time, and d_1 t_1 (also written d_i/t_i or d_o/t_o) are the **initial** displacement and time.

- Unit for velocity: The velocity unit is always some distance unit (meter, mile, kilometer, etc) over some time unit (s, min, hr, etc).

- Positive or Negative Velocity: In order to define displacement we must have a "coordinate system" (like x, y, and z axes). In the system there will be a positive direction and a negative direction. If the change in displacement of our object is a negative number the velocity will be a negative number.

III. Acceleration

- Acceleration is the rate at which velocity changes. If your velocity is changing at all, either in speed *or in direction*, then you're accelerating.

- Formula for acceleration: the equation for acceleration is **$a = \Delta v/t$.** "a" is acceleration, "Δv" is the change in velocity or "$v_2 - v_1$" or "$v_f = v_i$", and "t" is the time interval

- Direction for acceleration: acceleration is a vector and it must have not only a numerical value (i.e. "magnitude,") but also a direction.

- Positive Acceleration: positive acceleration means that an object is getting faster as it is moving in the positive direction. It also means *getting slower* as it is moving forward in the negative direction.

- Negative Acceleration: negative acceleration means that the object is slowing down while it it moving in the positive direction. It also means *speeding up* while it is moving in the negative direction.

- Constant Acceleration: Any objects undergoing constant/uniform acceleration has its velocity changing by a constant amount during each time interval. For example, if a rocket has a constant acceleration of +500 m/s^2 its velocity changes +500 m/s for every second of time. Falling objects experience uniform acceleration.

- Additional Motion Equations: Other formulas that we use to describe the motion of an object are just derivations of the ones above. These are called the "**kinematic**" equations.

1) $v_f = v_i + at$

2) $d = \frac{1}{2}(v_f + v_i)t$ some texts use "x" for "d", and "v_o" for "v_i".

3) $d = v_i t + \frac{1}{2}at^2$

4) $v_f^2 = v_i^2 + 2ad$

5) $v_{av} = \dfrac{vf + vi}{2}$