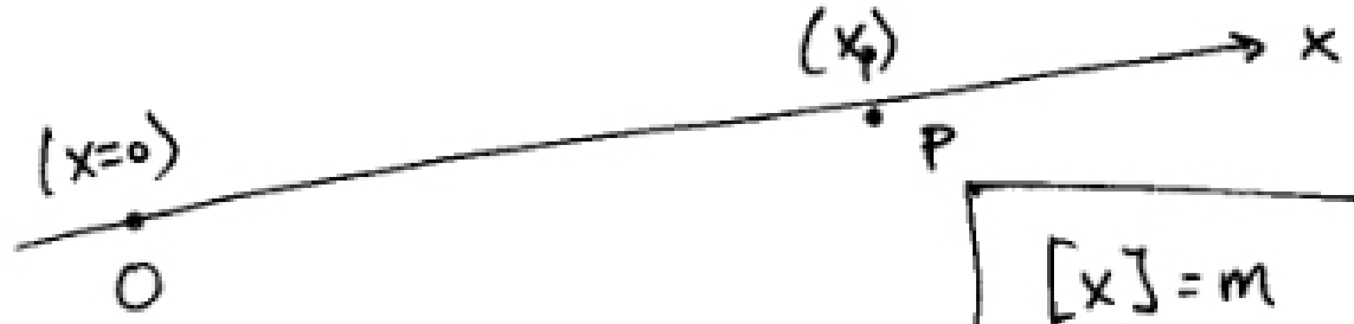
MOTION IN ONE DIMENSION

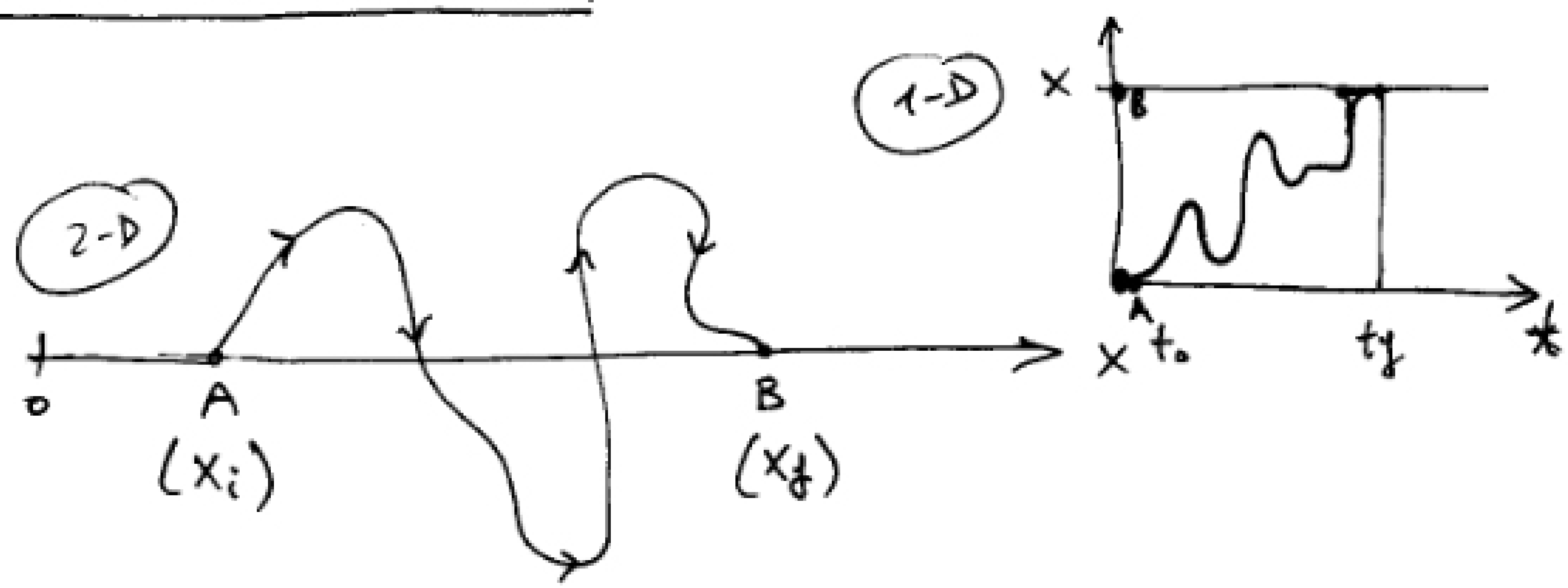
POSITION, VELOCITY AND SPEED

An object's position, x, is the ~~distance~~ location of the object with respect the origin of the system of reference, O.



$$\boxed{[x]=m}$$

DISTANCE VS. DISPLACEMENT



d: **Distance**: The lenght of the path followed by the object in going from point A to B.

Δx: **Displacement**: $\Delta x = x_f - x_i$, is the linear distance separating points A and B.

VELOCITY VS. SPEED

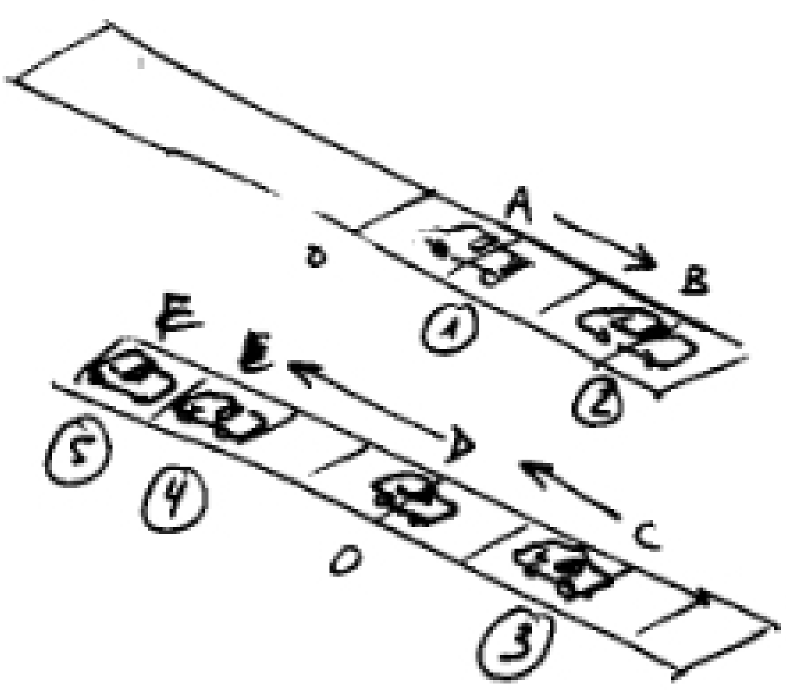
V_{avg} : <u>Average speed</u> : $\boxed{V_{avg} = d/\Delta t}$, is the total distance covered on a time interval Δt.

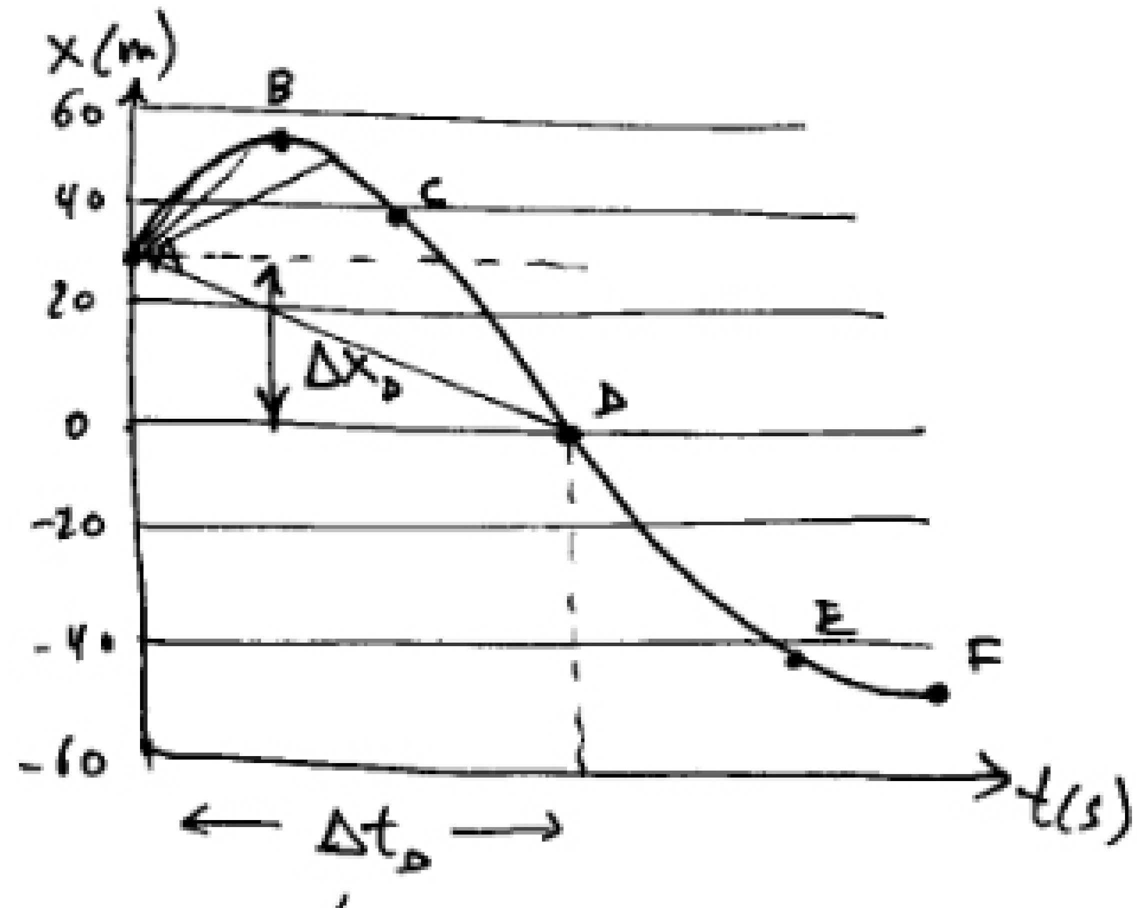
$V_{x,avg}$: <u>Average velocity</u> : $\boxed{V_{x,avg} = \dfrac{\Delta x}{\Delta t}}$, is the displacement divided by the increment of time.

INSTANTANEOUS VELOCITY AND SPEED

$$\boxed{V_x = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}}$$ instantaneous velocity. $$\boxed{[V_x] = \frac{m}{s}}$$

* The instantaneous speed is the magnitude of the instantaneous velocity (easier to see the difference in 2-D).





$\Delta t \to 0 \Rightarrow V_{x,avg} \to V_x = \frac{dx}{dt}$

ACCELERATION

(Motion under constant velocity, section 2.3, will be seen as a special case of motion under constant acceleration, when acceleration is equal to zero).

$$a_{x,avg} = \frac{\Delta v_x}{\Delta t} = \frac{v_{xf} - v_{xi}}{t_f - t_i}$$ average acceleration

Practically, it is more interesting the case of instantaneous acceleration:

$$\boxed{a_x = \lim_{\Delta t \to 0} \frac{\Delta v_x}{\Delta t} = \frac{dv_x}{dt}} \qquad [a_x] = \frac{m}{s^2}$$

Note that since $v_x = \frac{dx}{dt}$, a_x can be written as a function of x:

$$\boxed{a_x = \frac{dv_x}{dt} = \frac{d^2x}{dt^2}} \quad \text{or} \quad \frac{d}{dt}\left(\frac{dx}{dt}\right)$$

It is very important that you refresh your memory on differential and integral calculus. A summary of the fundamentals of calculus is in appendix B.6 of the book (page A-13)