## Time Scales

1s ~ Human Heart Beat

1 ms ~ Human Reaction Time

$1\ \mu s = 1 \times 10^{-6}\ s$ ~ Chemical Reaction Rates

$\mu$ ~ micro

## Velocities

1 m/s ~ Walking

4 m/s ~ Running

20 m/s ~ 50 $\frac{mi}{h}$

"Mach 1" $\longrightarrow$ $V_{sound} \sim 340\ m/s$

$V_{air\ molecules} \simeq V_{sound} \sim 340\ m/s$

$V_{normal\ plane} \sim \frac{1}{3} V_s \sim 100\ m/s$

$V_{Bullet} \sim$ mach 2-3 $\sim 600\ m/s$

(1a)

Estimate the time it takes in a car crash to hit the steering wheel? Compare this to reaction times of humans

$$V_{car} = \frac{\Delta d}{\Delta t} \Longrightarrow \Delta t = \frac{d}{V_{car}}$$

The distance between you and the steering wheel is

$$d \sim 30\ cm$$

The velocity of the car is $V_{car} \sim 30 \frac{m}{s}$

$$\Delta t = \frac{30\ cm}{30\ m/s} = \frac{30 \times 10^{-2}\ m}{30\ m/s}$$

$$\boxed{\Delta t = 10^{-2}\ s}$$

~ This is of order human reaction times

(2)

# Displacement vs. Distance

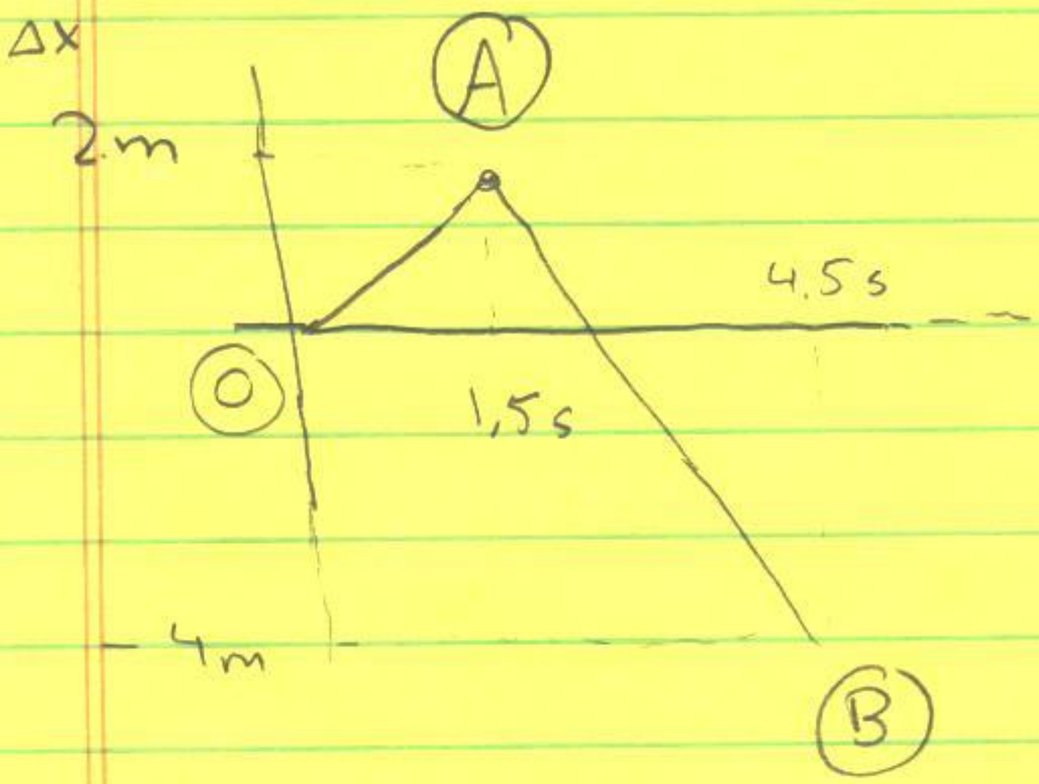
- Throw keys up and they land at the place

(1) Displacement $\Delta x = 0$

(2) Distance travelled $\neq 0$

$$\text{Ave. Velocity} = \frac{\Delta \text{Displacement}}{\Delta t}$$

Consider The following position vs. time graph.



(3)

I Calculate the velocity between

point (O) & point (A) and point (A) & (B)

Solution

(O) to (A): $V = \frac{\Delta x}{\Delta t} = \frac{2m - 0m}{1.5s} = 1.33\ m/s$

(A) to (B): $V = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} = \frac{-4m - 2m}{4.5s - 1.5s} = \frac{-6m}{3s} =$

The sign means the professor moves to the left

II Calculate The average velocity between (O) and (B)

$\text{ave velocity} = \frac{\Delta x}{\Delta t} = \frac{-4m - 0}{4.5s - 0} = -0.88\ m/s$

III Calculate the ave speed

(4)

Ave Speed = $\frac{\text{Total Distance moved}}{\text{Total time}}$

= $\frac{2m + 6m}{4.5s} = 1.77\ m/s$

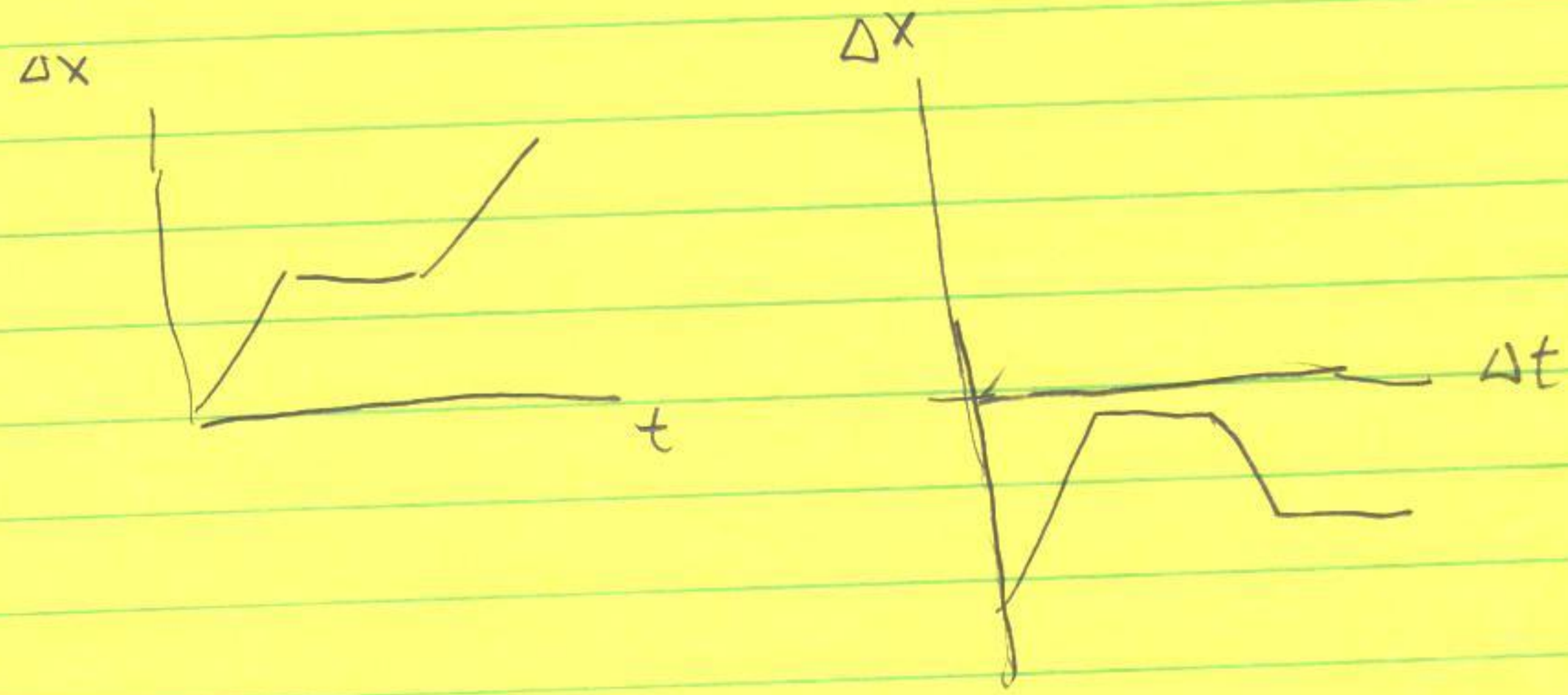
---

Average Speed = $\frac{\Delta t_1 (v_1) + \Delta t_2 (v_2)}{\Delta t_1 + \Delta t_2}$

↖ Total time

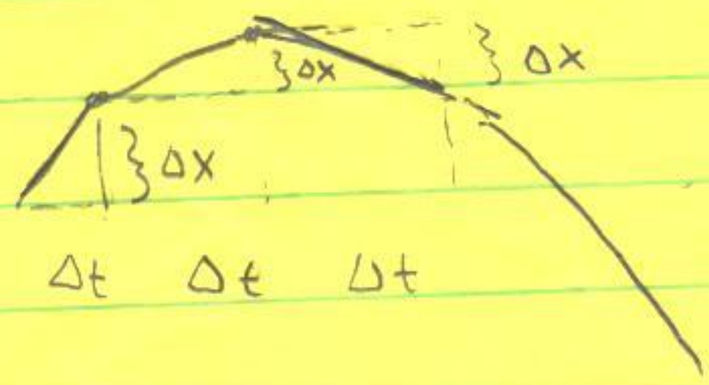
This may
you und
average sp
If not don't
about it.

(5) More Examples of Position Vs. Time diagrams:




etc.

Consider the following:




V in eaach interval = $\frac{\Delta x}{\Delta t}$

Velocity = The slope of the curve

Velocity = $\frac{dx}{dt}$

(6)

A particle moves along a curve

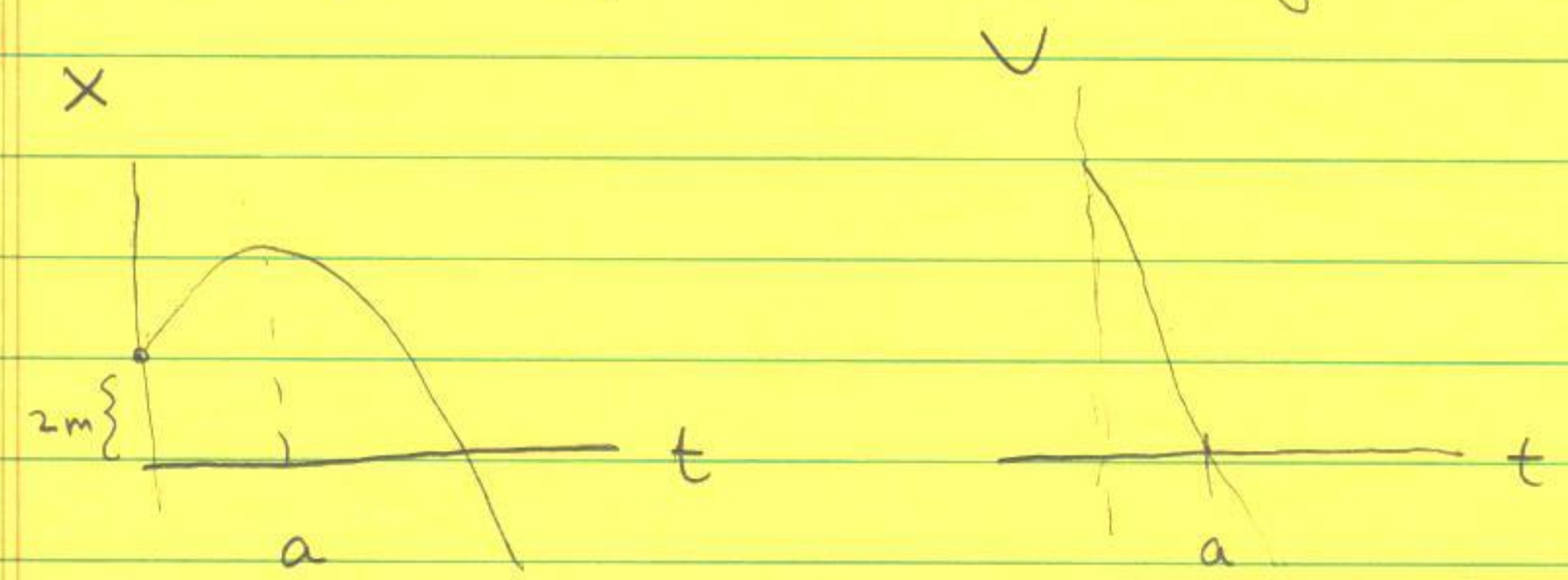
$$x(t) = 2 + 3t - t^2$$

where $x$ is in meters at $t$ is in seconds

(A) Sketch this curve.

(B) Describe what it means in terms of your professor running

(A)




(C) Calculate the velocity:

$$v = \frac{dx}{dt} = 3 - 2t$$