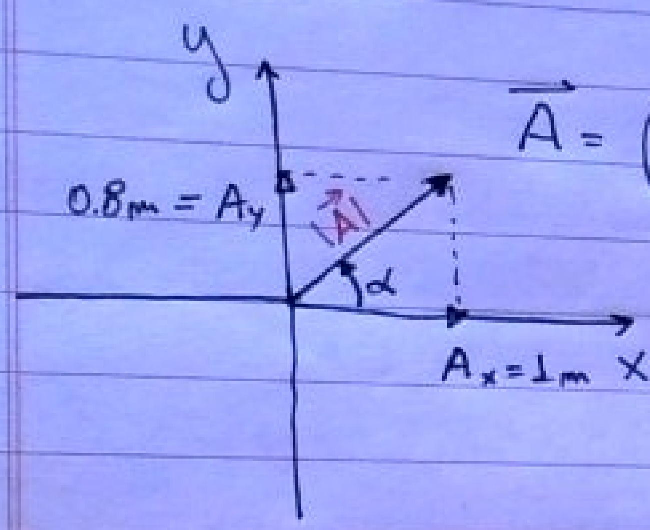
Lecture 2 Phys 203

Chapter 1.

Vectors 2D



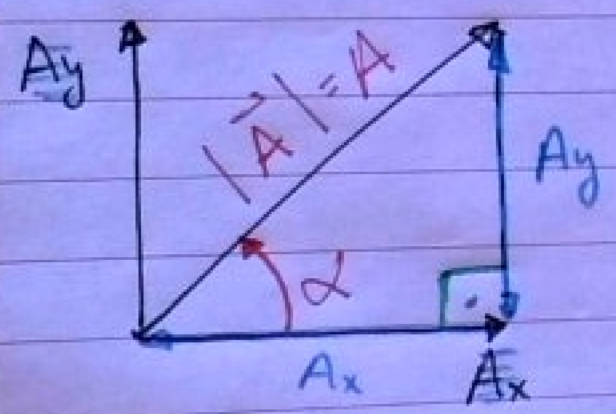
$\vec{A} = \underbrace{(A_x, A_y)}_{\text{components of the vector}}$

absolute value = magnitude =

$= |\vec{A}| = A$

sin = opposite/hypotenuse

direction $\longrightarrow \alpha$

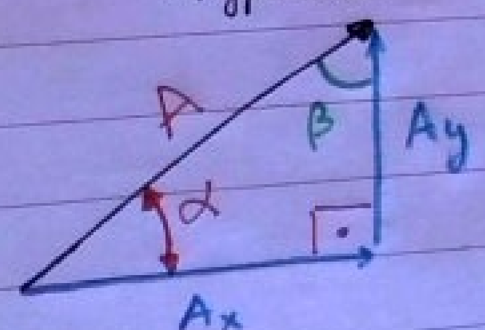


$\sin\alpha = \frac{A_y}{A}$

(1)

$$\boxed{\begin{aligned} A_y &= A \sin\alpha \\ A_x &= A \cos\alpha \end{aligned}} \rightarrow \text{given } (A, \alpha) \downarrow \text{find } (A_x, A_y)$$

cos = adjacent/hypotenuse



(2) Given ~~A, α~~ $\longrightarrow$ A_x and A_y (A_x, A_y) find A, α

$A = \sqrt{A_x^2 + A_y^2}$

$tg\,\alpha = \tan\alpha = \frac{A_y}{A_x} \Rightarrow \alpha = \tan^{-1}\left(\frac{A_y}{A_x}\right)$ → rad, → deg

Chapter 2

Kinematics in 1D

$\downarrow$

describe the motion of an object.

$\vec{x}(t)$ — time

(1) position $\vec{x}(t)$

$\downarrow$

(2) velocity. $\vec{v}(t)$

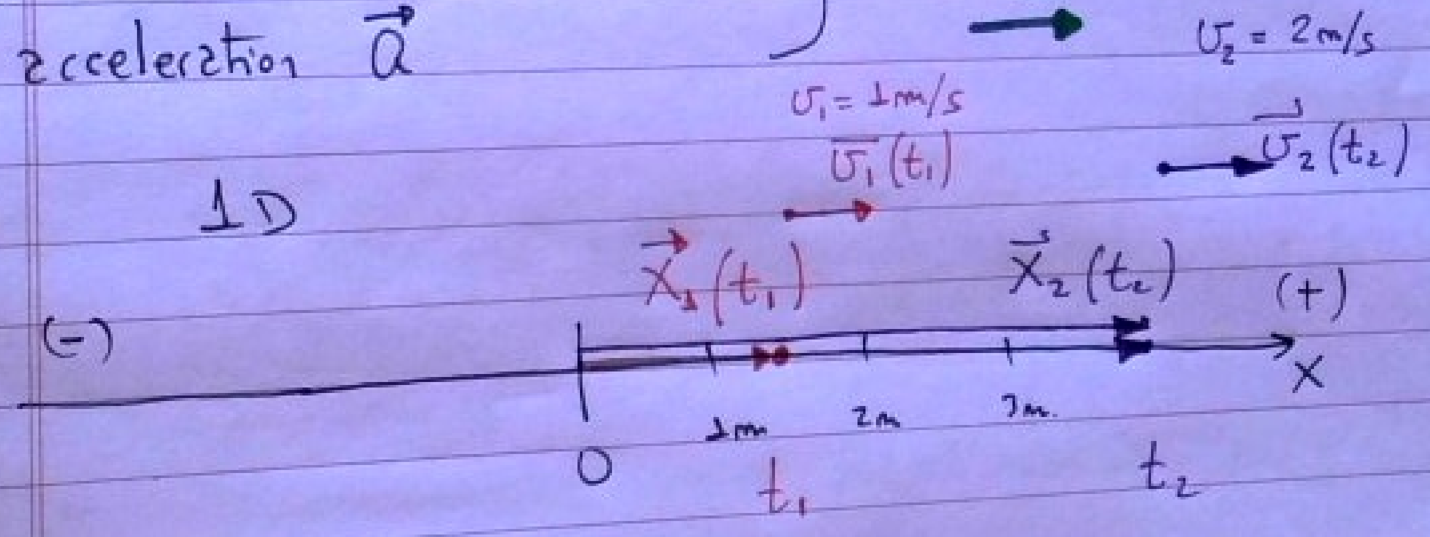
$\downarrow$

(3) acceleration $\vec{a}$

in general.

$\vec{a}$

1D



$\Delta t = t_2 - t_1$

↓ delta

displacement $\Delta \vec{x} = \vec{x}_2 - \vec{x}_1$

$|\Delta \vec{x}| = \Delta x = |\vec{x}_2 - \vec{x}_1|$

$$\vec{v}_{AV} = \frac{\Delta \vec{x}}{\Delta t} = \frac{\vec{x}_2 - \vec{x}_1}{\Delta t}$$

average velocity.

Instantaneous velocity. (at a given t)

$$\vec{v}(t) = \lim_{\Delta t \to 0} \frac{\Delta \vec{x}}{\Delta t} = \vec{v}(t)$$

$$\vec{a}_{AV} = \frac{\vec{v}_2(t_2) - \vec{v}_1(t_1)}{\Delta t} = \frac{\Delta \vec{v}}{\Delta t}$$

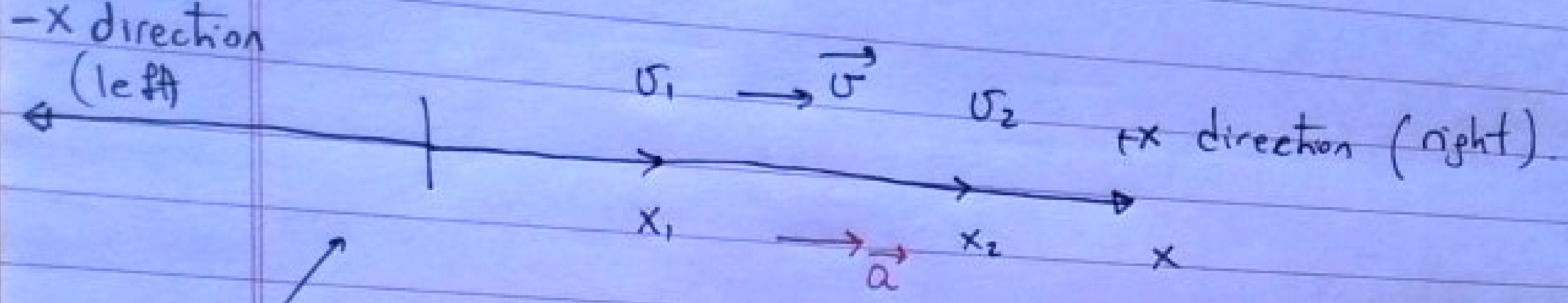
average acceleration

$$\vec{a}(t) = \lim_{\Delta t \to 0} \frac{\Delta \vec{v}}{\Delta t}$$

acceleration is constant. $\Rightarrow a(t) = a = a_{AV}$
in all problems.

units $\rightarrow$ $[x] = m$ $[v] = m/s$ $[a] = m/s^2$

Situations



if $x_2 > x_1 \Rightarrow \Delta x > 0 \rightarrow$ motion to +x

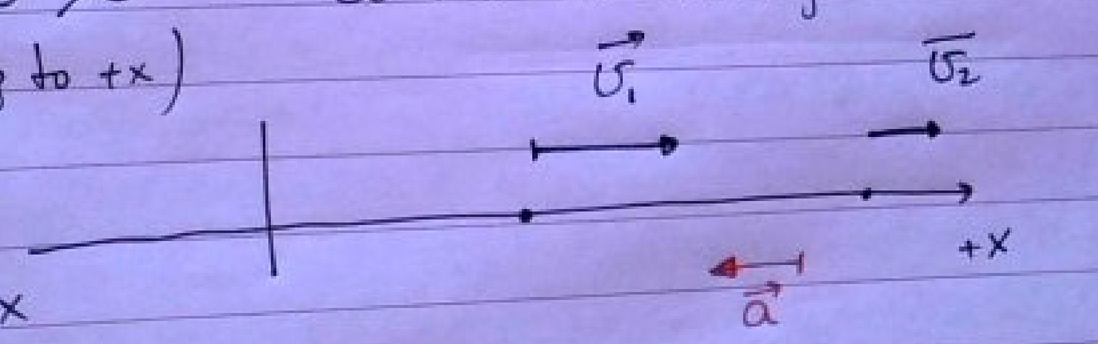
$v > 0$

$v_2 > v_1$ $v \uparrow$ v is increasing and positive

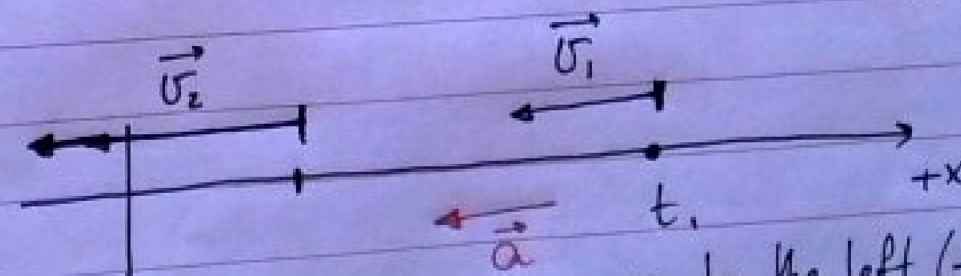
$a > 0$

(1) $v > 0$ $a > 0$ $\Rightarrow$ speeding up in +x (same sign of v and a)
↳ acceleration

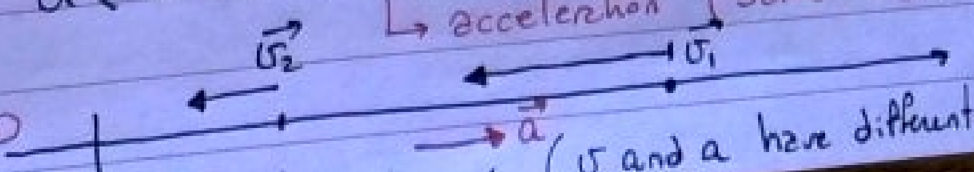
(2) $v > 0$ $a < 0$ $\Rightarrow$ slowing down in +x (v and a have different signs)
(going to +x)



deceleration



(3) $v < 0$
(going to left)
$v < 0$ $a < 0$ $\Rightarrow$ speeding up to the left (-x)
↳ acceleration (same sign for v, a)



(4) $v < 0$ $a > 0$ slowing down in -x (v and a have different signs)
deceleration $\Rightarrow$ slowing down in -x

Section 2.4

Equations of kinematics

for constant acceleration. $a = \text{constant}.$

$$\begin{cases} x(t) = ? \\ v(t) = ? \\ a = \text{constant}. \end{cases} \qquad \begin{Bmatrix} a > 0 \\ a < 0 \end{Bmatrix}$$

Derive:

if $a = \text{constant} = a_{AV}$

$$a = \frac{v_2 - v_1}{t_2 - t_1}$$

v_1, t_1 → initial velocity / initial time

let's take $t_1 = 0$ $\quad v_1(t_1) = v_1(0) =$

= initial velocity =

$= \underline{v_0}$

notation

start at

initial $\begin{cases} t_0 = 0 \text{ with} \\ \text{initial velocity} = v_0 \neq 0 \end{cases}$

$$a = \frac{v(t) - v_0}{t} \Rightarrow \begin{aligned} at &= v(t) - v_0 \\ v_0 + at &= v(t) \end{aligned}$$

starting at $t_0 = 0$ with v_0 and position x_0

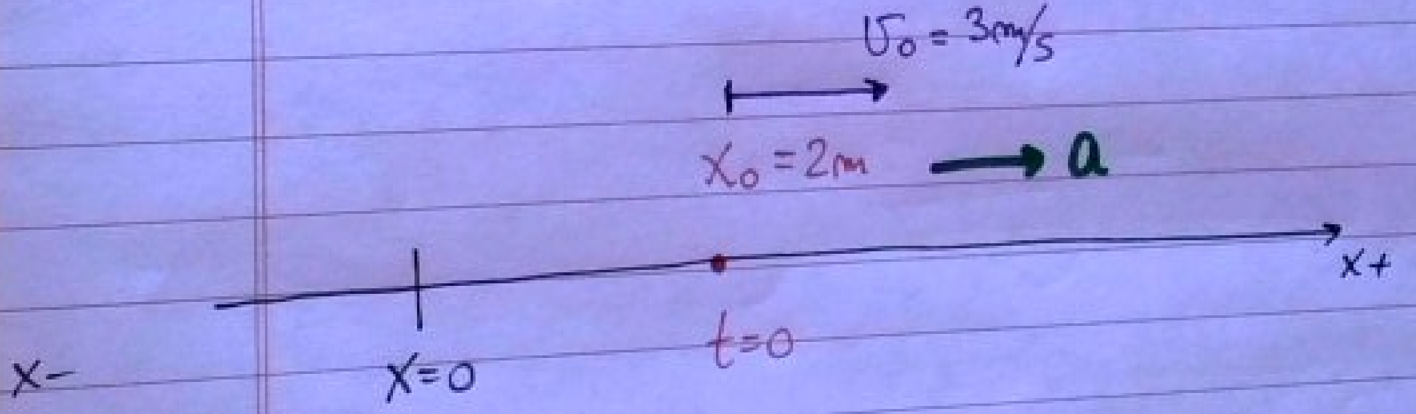
then the velocity at later time t is:

(2) $\boxed{v(t) = v_0 + a t}$ $\longrightarrow t = \dfrac{v(t) - v_0}{a}$

derivation

(1) $\boxed{x(t) = x_0 + v_0 t + \frac{1}{2} a t^2}$

initial position.



(3) $v^2(t) = v_0^2 + 2a\left(x_{(t)} - x_0\right)$

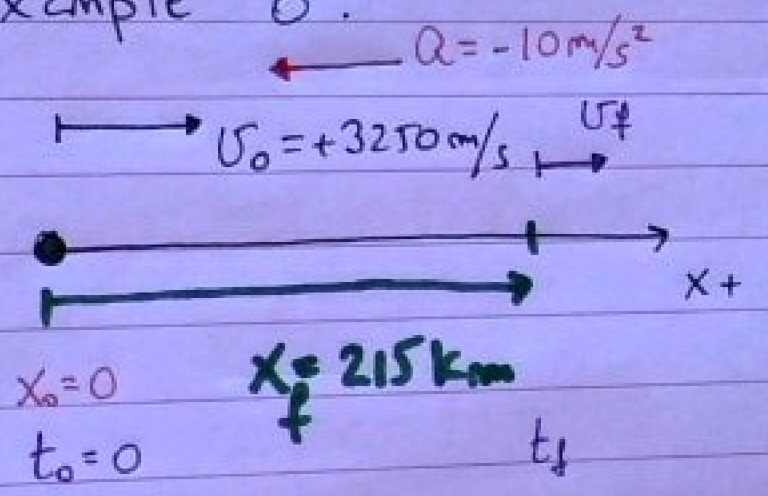
(3) $\boxed{v(t)^2 = v_0^2 + 2a\left(x(t) - x_0\right)}$

initial $\begin{Bmatrix} x_0 \\ v_0 \end{Bmatrix}$ final $\begin{Bmatrix} v_f \\ x_f \end{Bmatrix}$

$$(3) \quad \boxed{v_f^2 = v_0^2 + 2a\left(x_f - x_0\right)}$$

Section 2.5 Applications.

Example 8.



magnitude

$|a| = 10 m/s^2$

Data			Find
x_f	v_0	a	v_f
$215 km = 215 \times 10^3 m = 2.15 \times 10^5 m$	$+3250 m/s$	$-10 m/s^2$	?

use Eq (3) to find v_f.