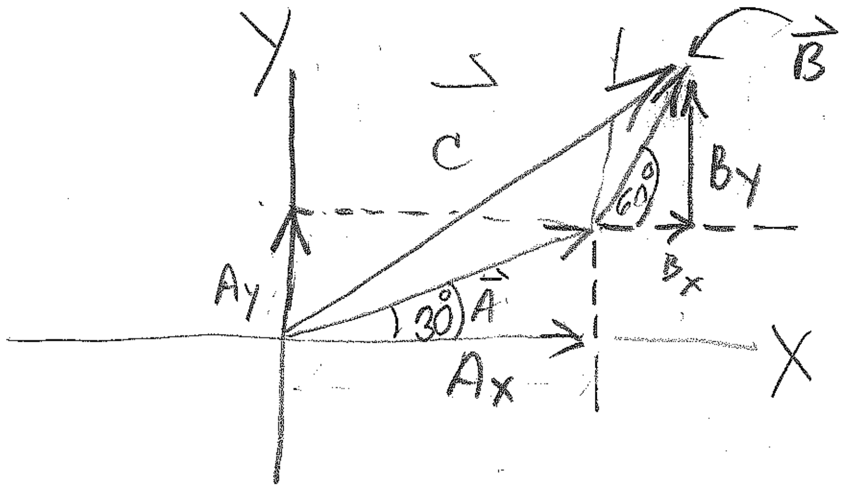
Physics 4A 1-28-13 (SP13) (1

vector components!



see fig. 1.21

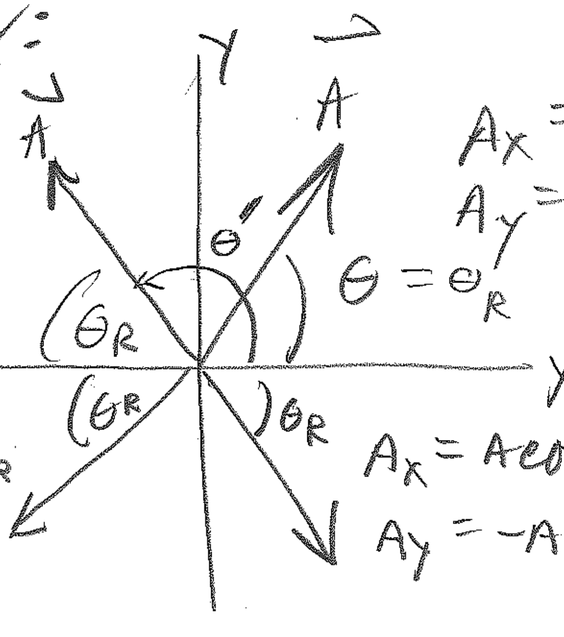
$$\vec{C} = \vec{A} + \vec{B}$$

$$C_x = A_x + B_x$$
$$C_y = A_y + B_y$$

$$C_x = A \cdot \cos 30 + B \cdot \cos 60$$
$$C_y = A \sin 30 + B \sin 60$$

Review:

$\theta_R = 180 - \theta'$



$A_x = A\cos\theta = A\cos\theta_R$
$A_y = A\sin\theta = A\sin\theta_R$

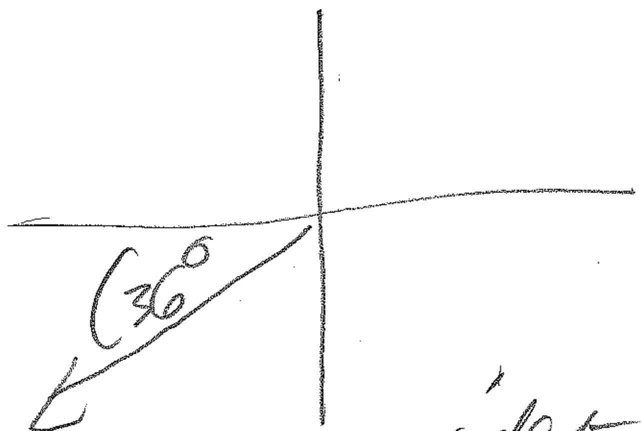
NOTATION: θ_R = related or reference angle

$A_x = -A\cos\theta_R$
$A_y = A\sin\theta_R$

$A_x = -A\cos\theta_R$
$A_y = -A\sin\theta_R$

$A_x = A\cos\theta_R$
$A_y = -A\sin\theta_R$

$0 \le \theta_R \le 90$



video note:
Example 1.7 online
"Chapter 1 Assets"

$B_x = -B\cos 36 = B\cos 216$

$B_y = -B\sin 36 = B\sin 216$

Note: $-\cos 36 = \cos 216$

$-\sin 36 = \sin 216$

Go TO "study area" masteringphysics.com

click CH1 videos, demos, simulations

Also see Activphysics.

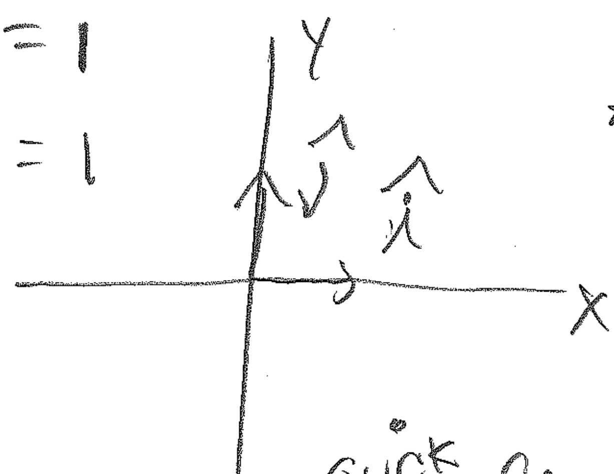
Section 1.9 unit vectors

$\vec{A} = (A_x, A_y)$ OR

$A = A_x \hat{i} + A_y \hat{j}$

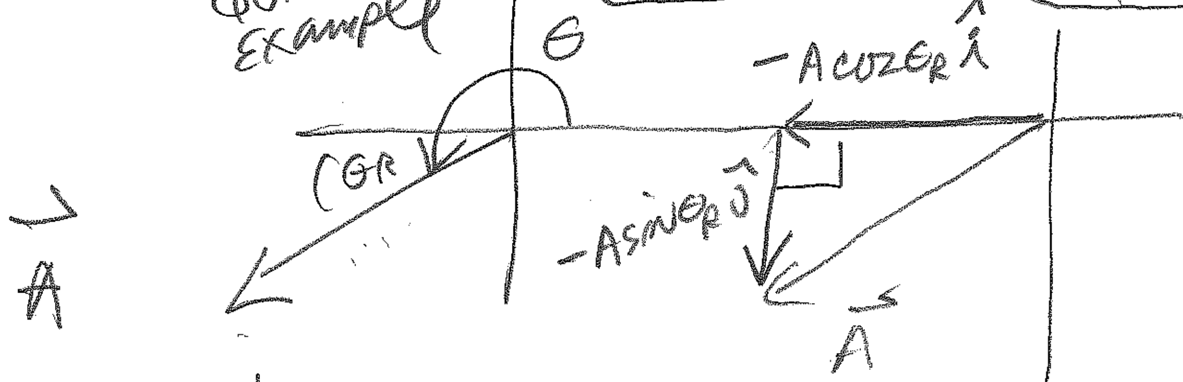
$|\hat{i}| = 1$

$|\hat{j}| = 1$



$\boxed{\vec{A} = -A\cos\theta_R \hat{i} - A\sin\theta_R \hat{j}}$

Quick example



Note:
$\theta_R = \theta - 180^\circ$

Example

Given: $\vec{A} = -\hat{i} + 2\hat{j}$

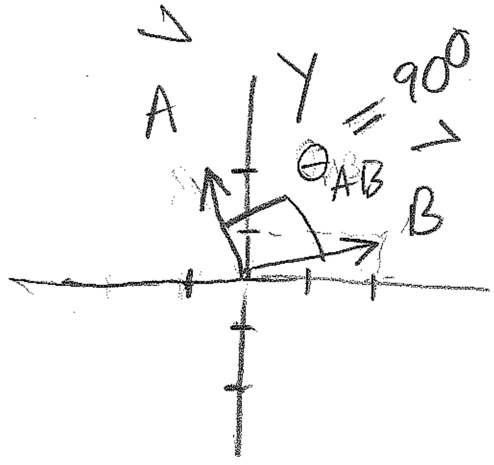
$\vec{B} = 2\hat{i} + \hat{j}$

FIND: $\vec{C} = \vec{A} + \vec{B}$

give angle θ_R, QUADRANT

FIND $|\vec{C}|$.

ICQ1
1-28-13



OBSERVATIONS

Sec 1.10

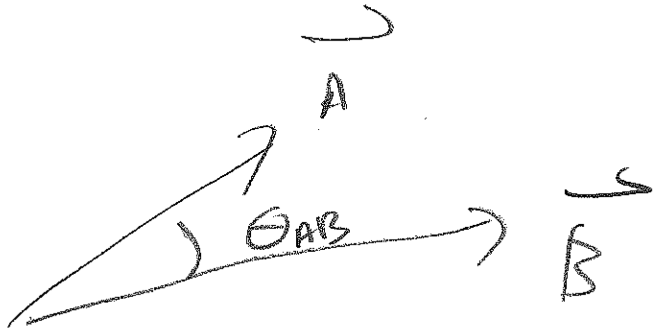
$\vec{A} \cdot \vec{B} = 0$

$A_x \cdot B_x + A_y \cdot B_y = (-1)(2) + (2)(1) = 0$

DOT PRODUCT

Definition: $\vec{A} \cdot \vec{B} = A \cdot B \cdot \cos\theta_{AB}$

YOU TRY TO PROVE $\longrightarrow$ $= A_x \cdot B_x + A_y B_y$

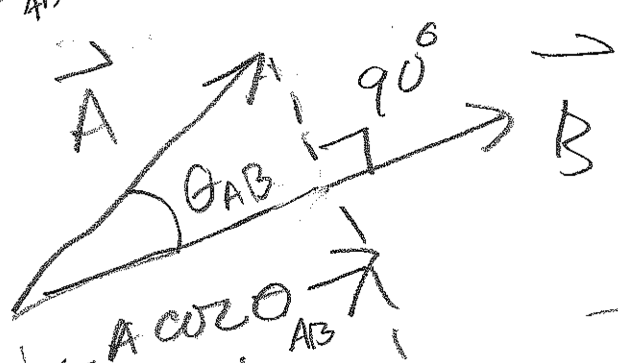


$$\vec{A}\cdot\vec{B} \equiv A\cdot B\cos\theta_{AB}$$

$$\equiv A_x B_x + A_y B_y$$

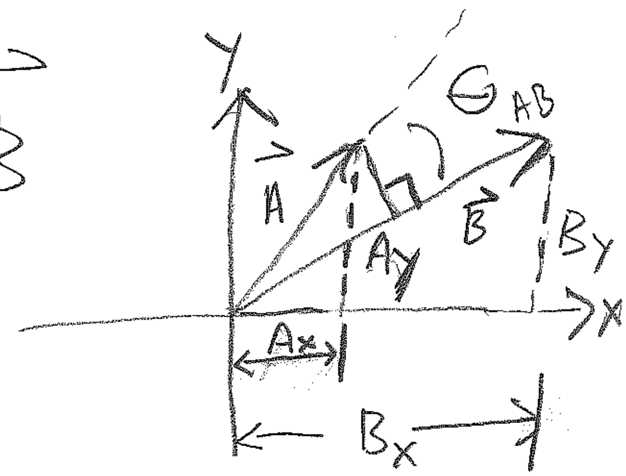
you can prove! *

NOTE: $A\cdot B\cos\theta_{AB} = (A\cos\theta_{AB})\cdot B$



$\leftarrow A\cos\theta_{AB} \rightarrow$

PROJECTION of $\vec{A}$ ONTO $\vec{B}$



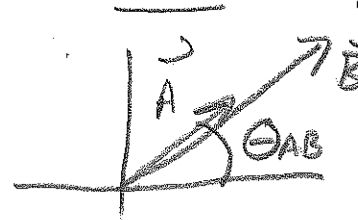
note:

$A = |\vec{A}|$

$B = |\vec{B}|$

MAGNITUDES

* WORKS IF $\vec{A} \parallel \vec{B}$



$A\cdot B\cos\theta_{AB}$

$= AB\cos 0$

$= AB$

$A_x B_x + A_y B_y = AB(\sin^2\theta + \cos^2\theta)$

Example

$$\vec{A} = 3\hat{i} + 4\hat{j} \Rightarrow |\vec{A}| = A = 5$$

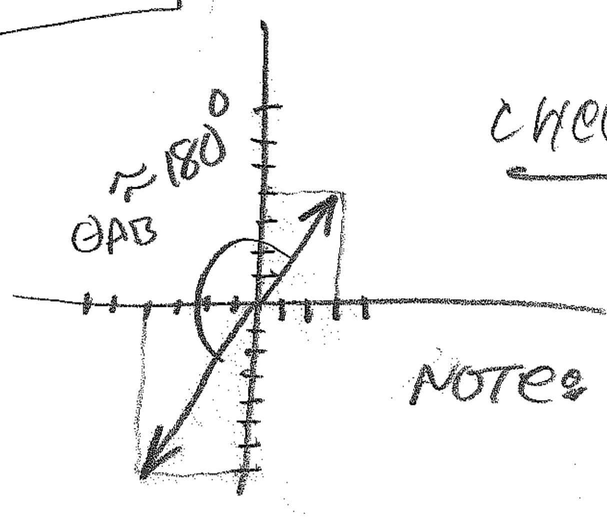
$$\vec{B} = -4\hat{i} - 7\hat{j} \Rightarrow |\vec{B}| = B \approx 8$$

$$\vec{A} \cdot \vec{B} = (3)(-4) + (4)(-7)$$

$$= -12 - 28$$

$$= -40$$

$$\boxed{|\vec{A}| = \sqrt{65} = 8.1}$$

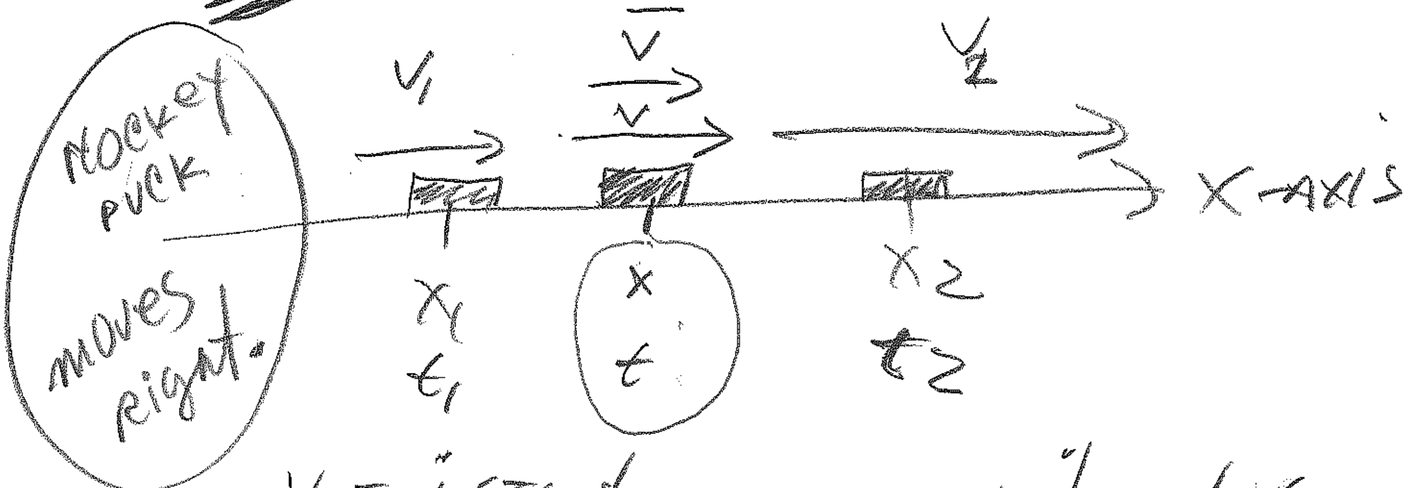


CHECK

ALMOST anti-parallel.

NOTE: $AB \cos 180^\circ = 5 \cdot 8 \cdot (-1) = -40$

CH 2 motion



v_1 = instantaneous velocity at t_1

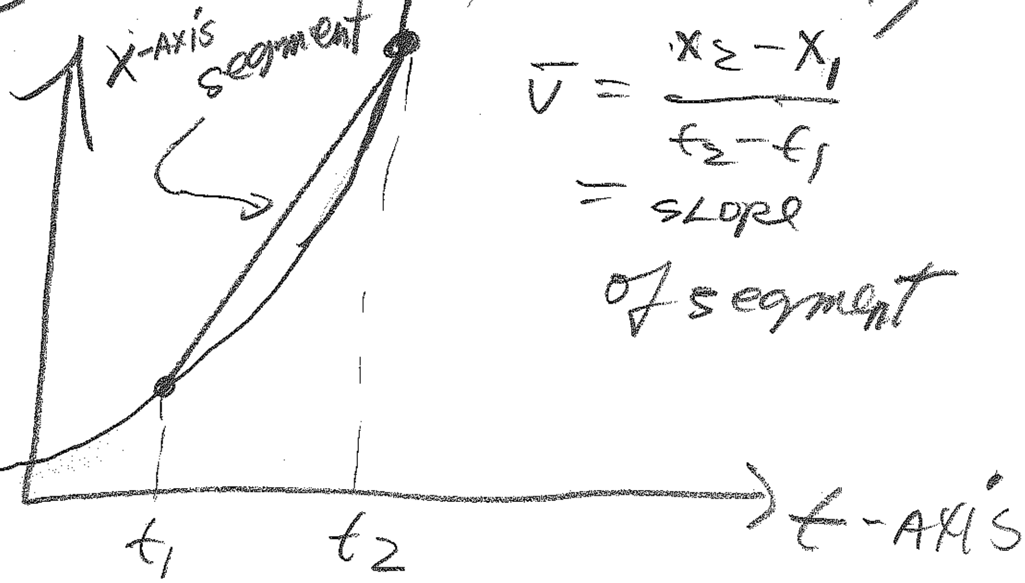
v_2 = " " " t_2

Definitions

(A) $\bar{v} = \dfrac{x_2 - x_1}{t_2 - t_1}$

(B) v = instantaneous velocity

X vs. t
non-linear;
speeding up
(steeper
with time)



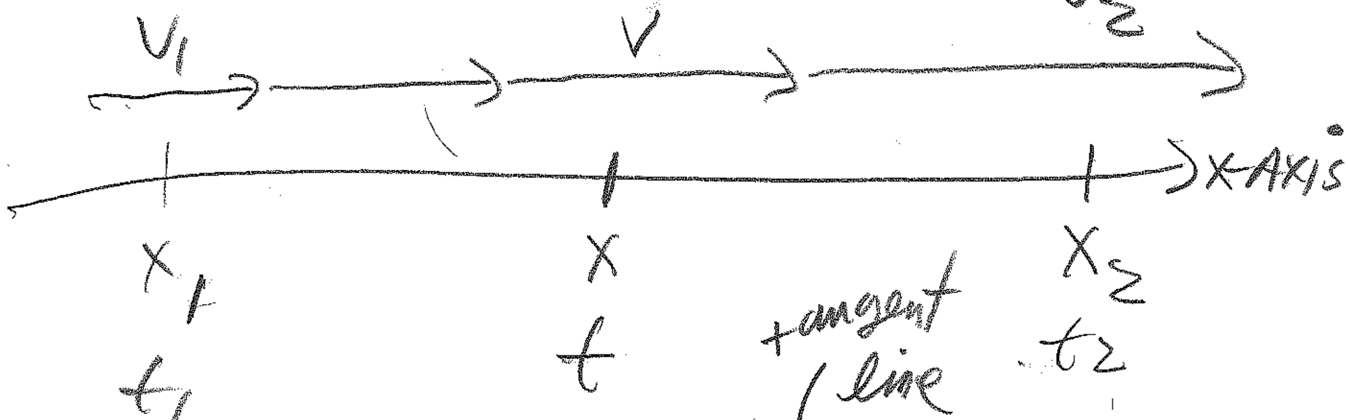
$\bar{v} = \dfrac{x_2 - x_1}{t_2 - t_1}$
= slope
of segment

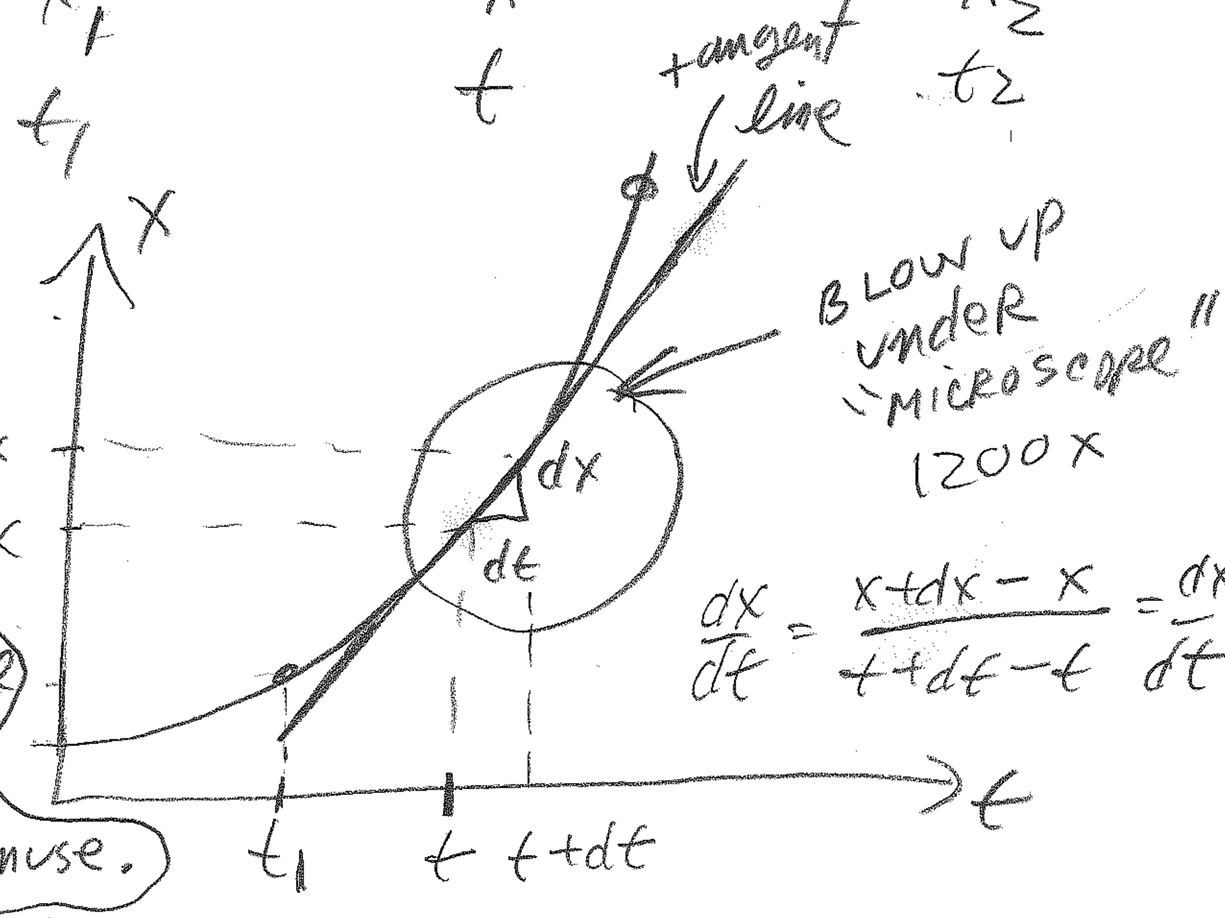
SHOWING instantaneous velocity at various times

$$\bar{V} = \frac{X_2 - X_1}{t_2 - t_1} = \frac{\Delta x}{\Delta t}$$

$\vec{\bar{v}}$

$v = \frac{dx}{dt}$ @ t and X.

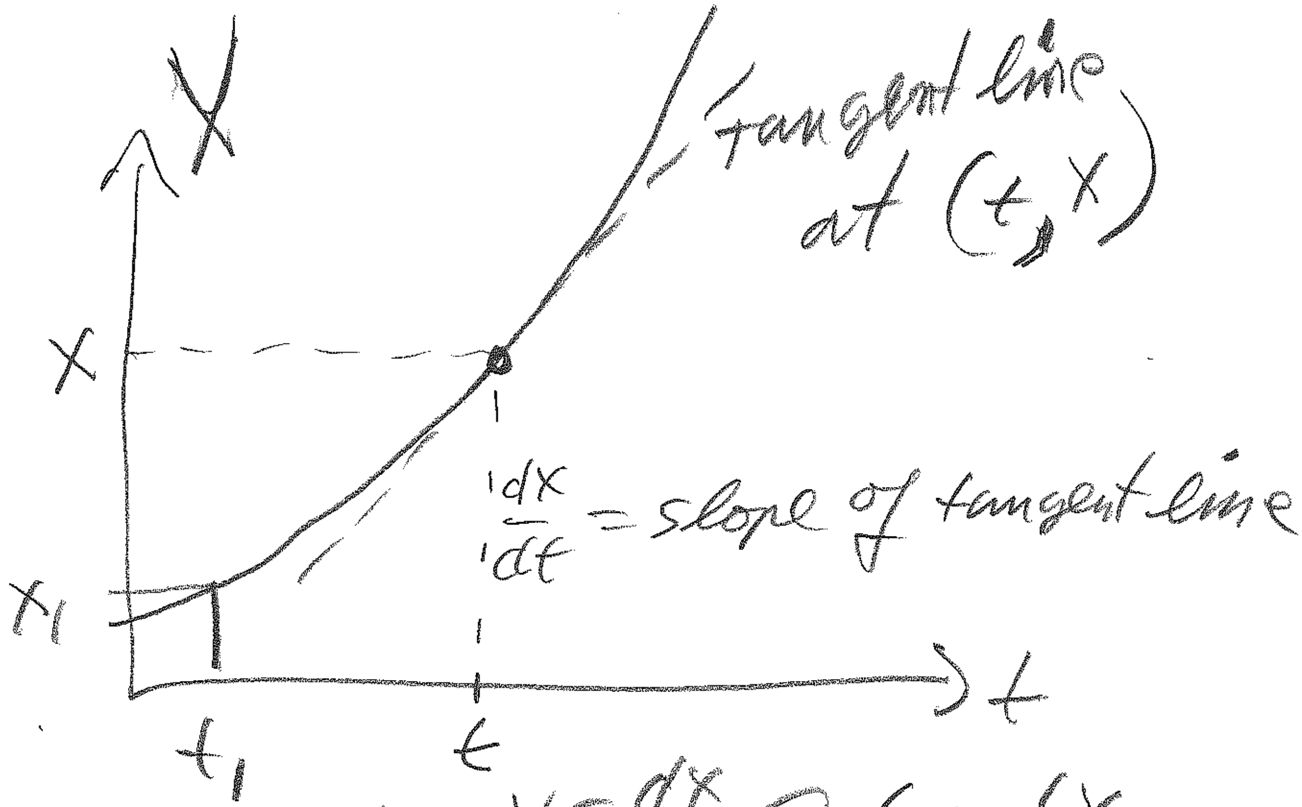




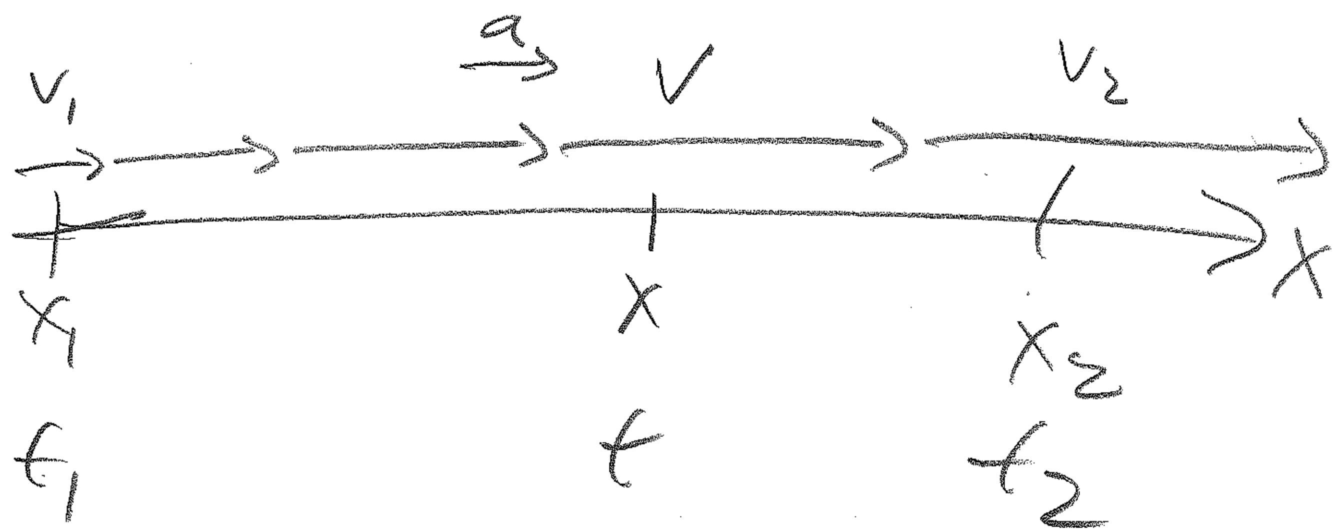
$$\frac{dx}{dt} = \frac{x+dx-x}{t+dt-t} = \frac{dx}{dt}$$

$\frac{dx}{dt}$ = SLOPE of HYPOTENUSE.

$\frac{dx}{dt} = \bar{V}$ when TRIANGLE is infinitesimally small.



$V = \frac{dx}{dt}$ @ t and X

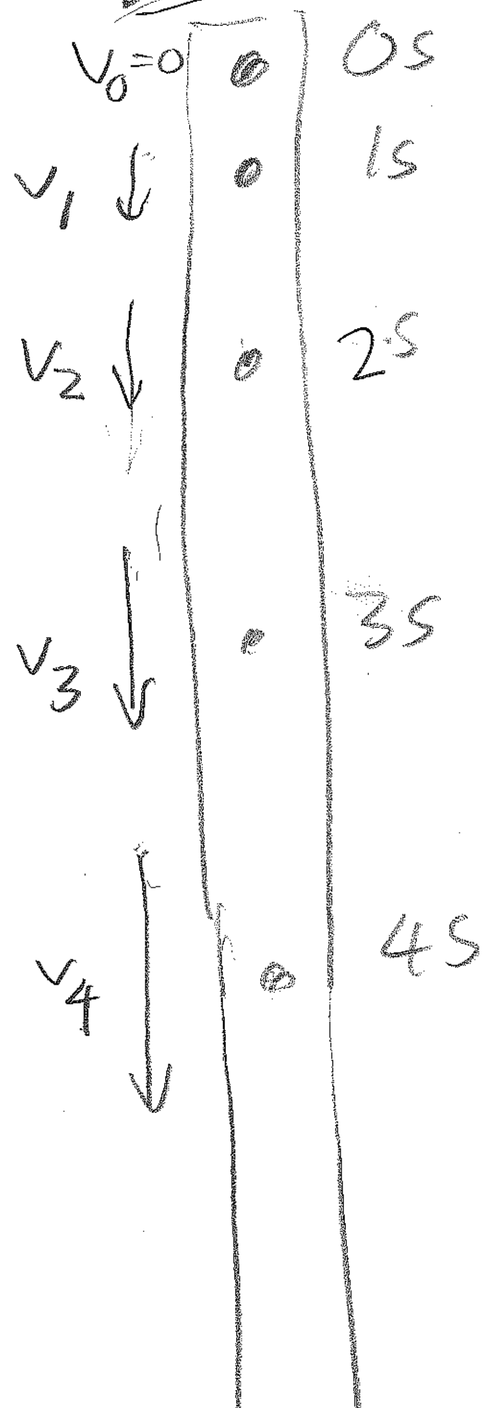


$\bar{a}$ = average acceleration

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

Lab 1 measure the acceleration of gravity

DROP A Ball:



$\downarrow$ Y (POS)

$v_1 > 0$
$v_2 > 0$
$v_3 > 0$
$v_4 > 0$

Show that

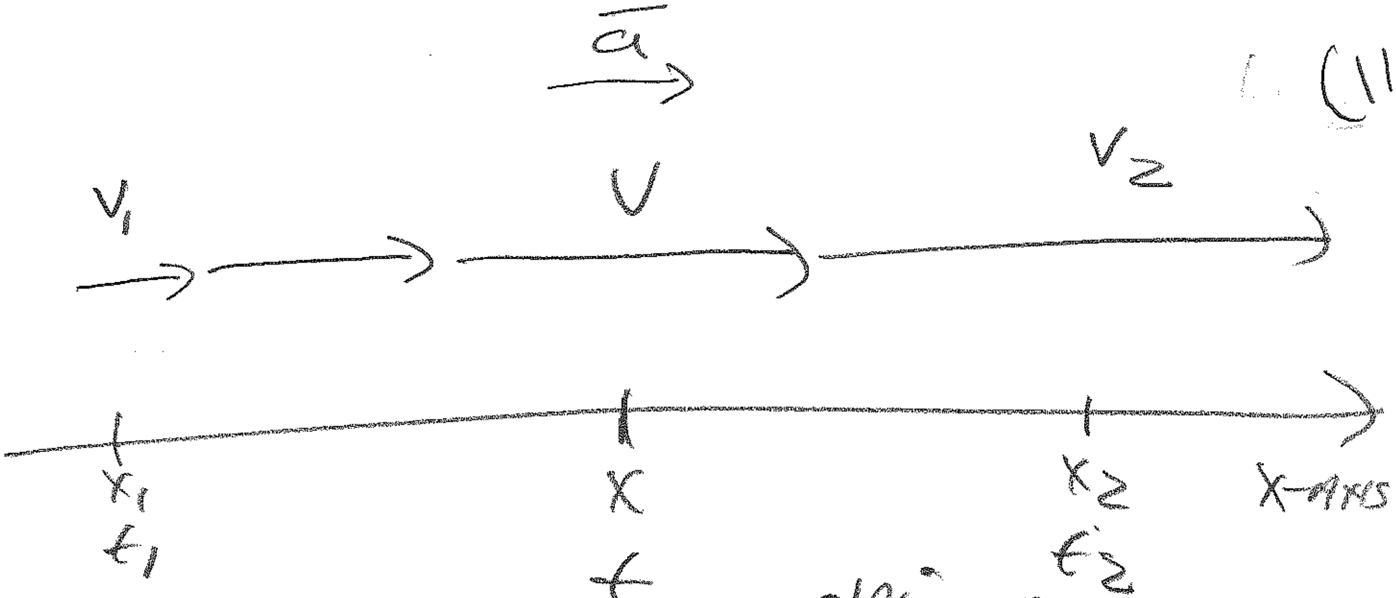
$$v_1 = 9.8\,\frac{m}{s}$$

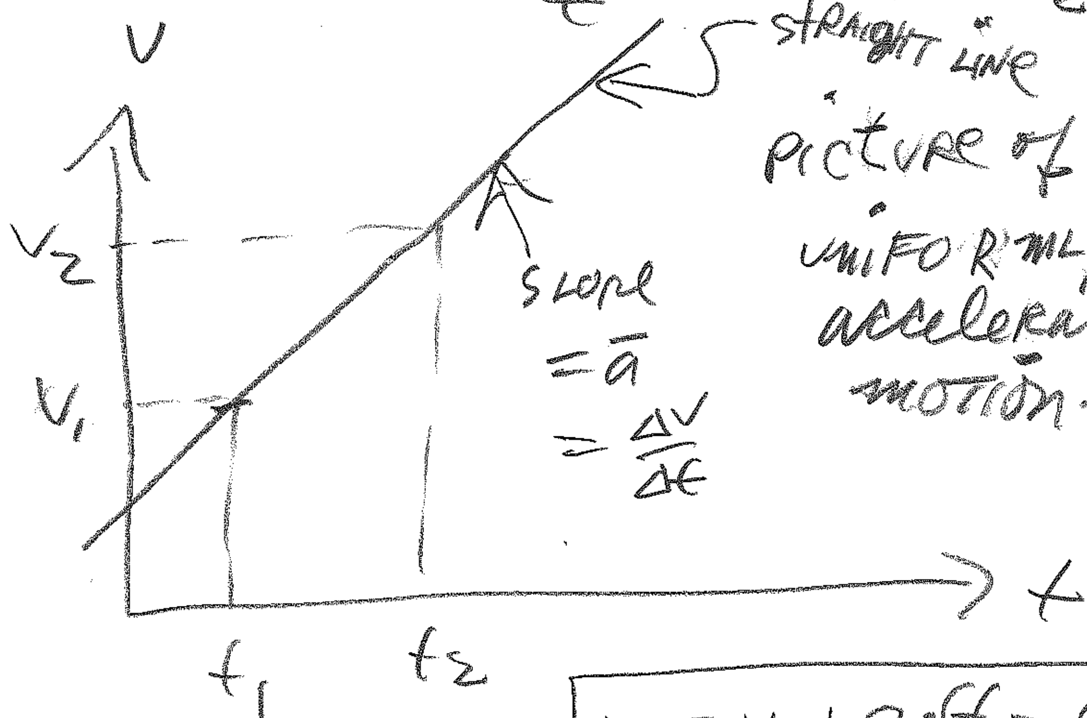
$$v_2 = 19.6\,\frac{m}{s}$$

$$v_3 = 29.4\,\frac{m}{s}$$

$$v_4 = 39.2\,\frac{m}{s}$$

note every second, v increases by $9.8\,\frac{m}{s}$.





picture of uniformly accelerated motion.

$$\boxed{v_2 = v_1 + a \cdot (t_2 - t_1)} \quad \mathrm{I}$$

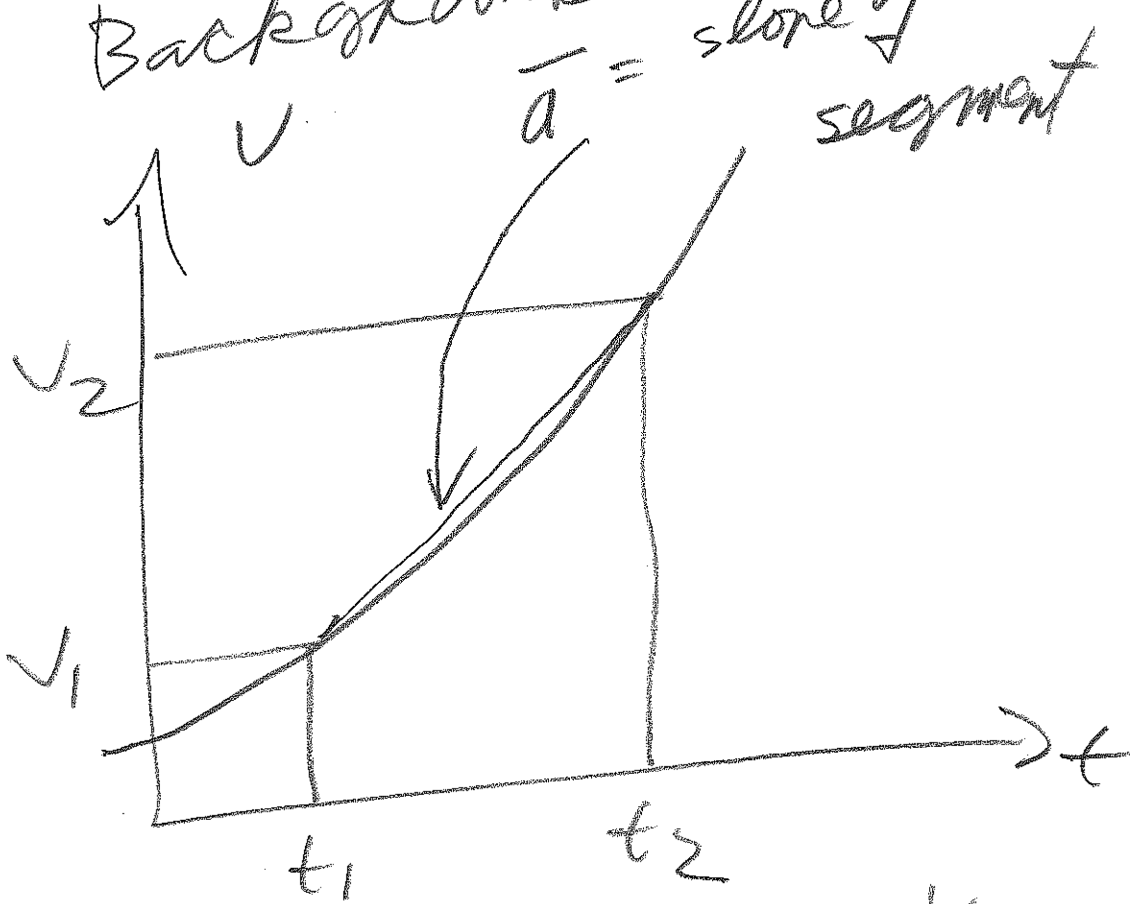
general:

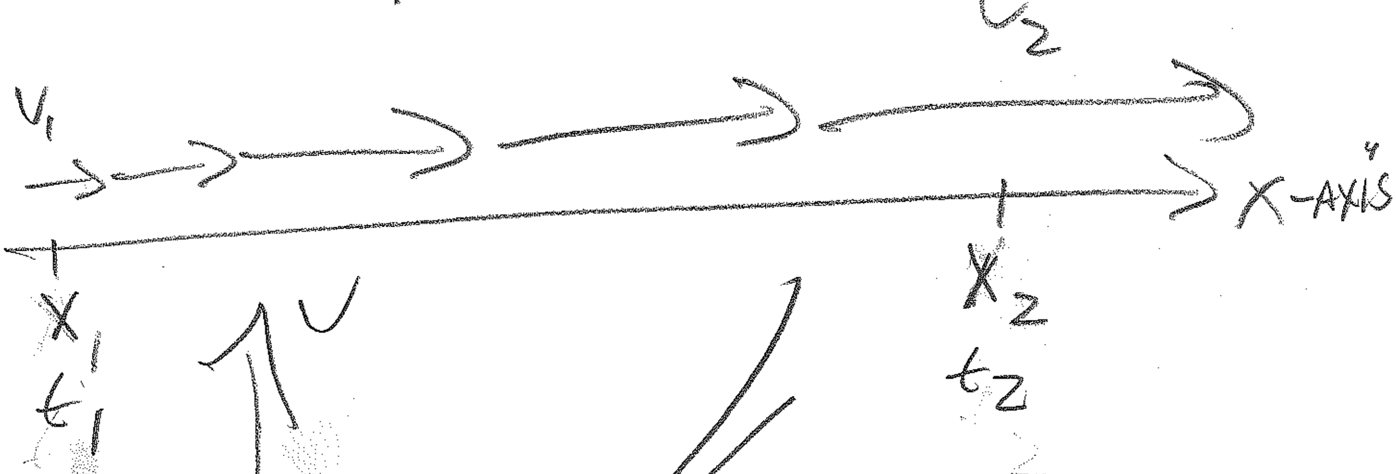
$$\bar{a} \equiv \frac{\Delta v}{\Delta t} = \text{AVERAGE velocity}$$

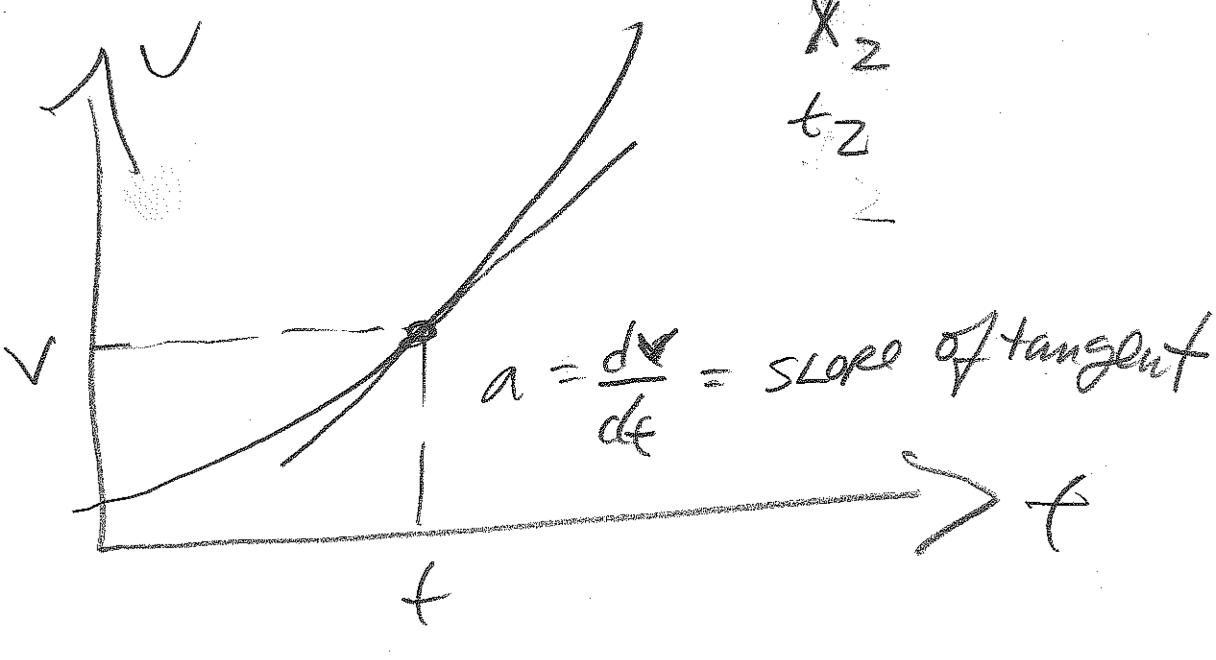
special case of uniformly accelerated motion:

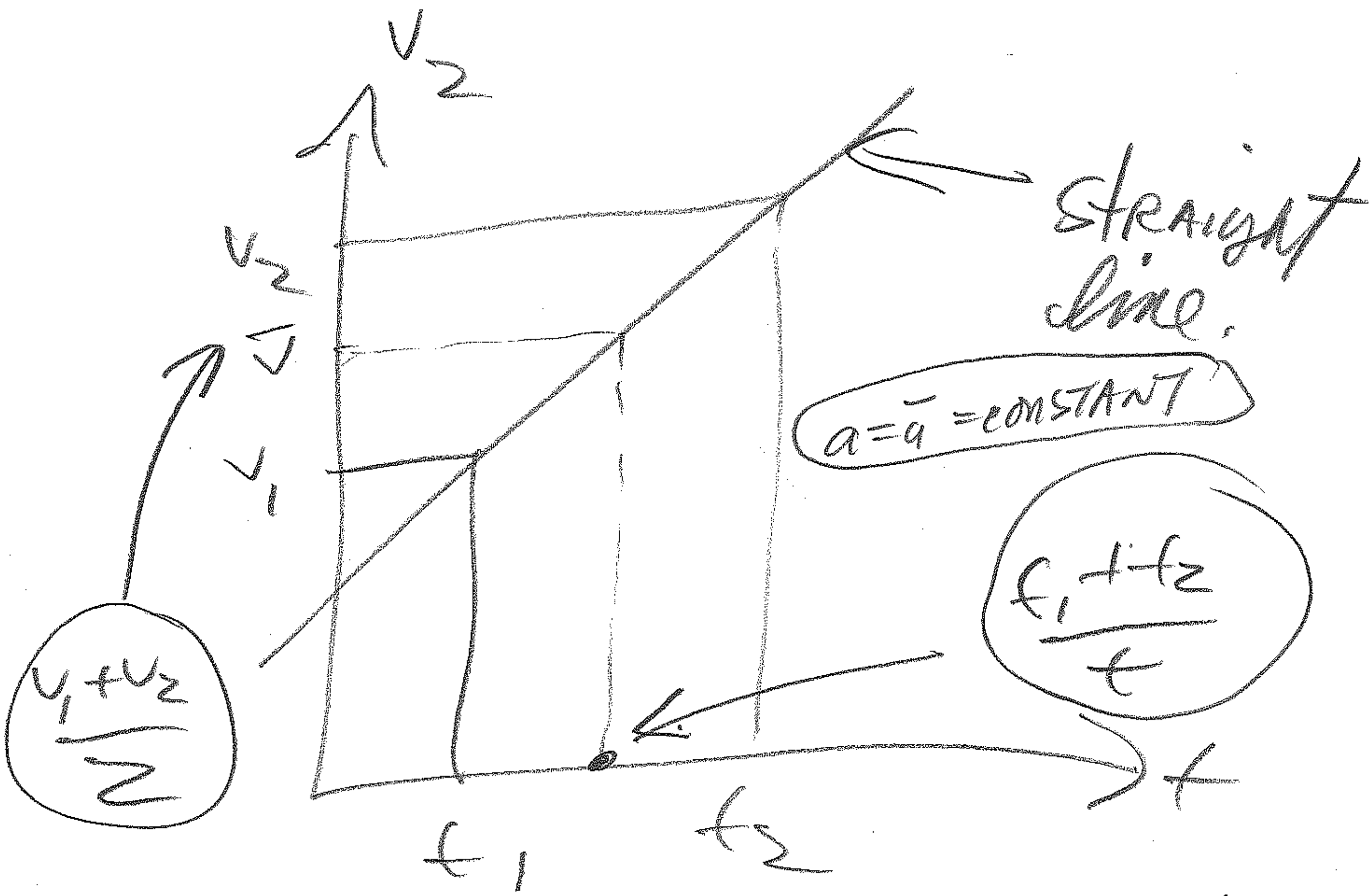
$$\bar{a} = a = \text{instantaneous acceleration}$$

Background


$\bar{a}$ = slope of segment
v
v_2
v_1
t
t_1
t_2

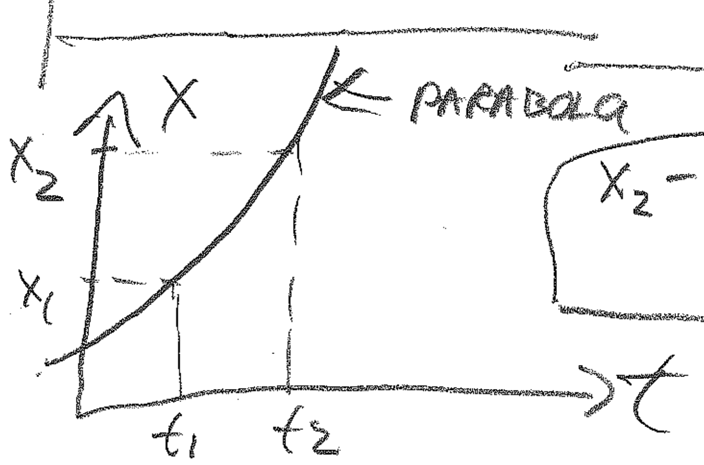

v_1
v_2
X-AXIS
x_1
t_1
x_2
t_2


v
v
$a = \frac{dv}{dt}$ = slope of tangent
t
t



$$\bar{V} = \frac{x_2 - x_1}{t_2 - t_1} \text{ ; ALSO } \bar{V} = \text{another FORMULA}$$

$$\boxed{\bar{V} = \frac{V_1 + V_2}{2}} \quad \text{II}$$

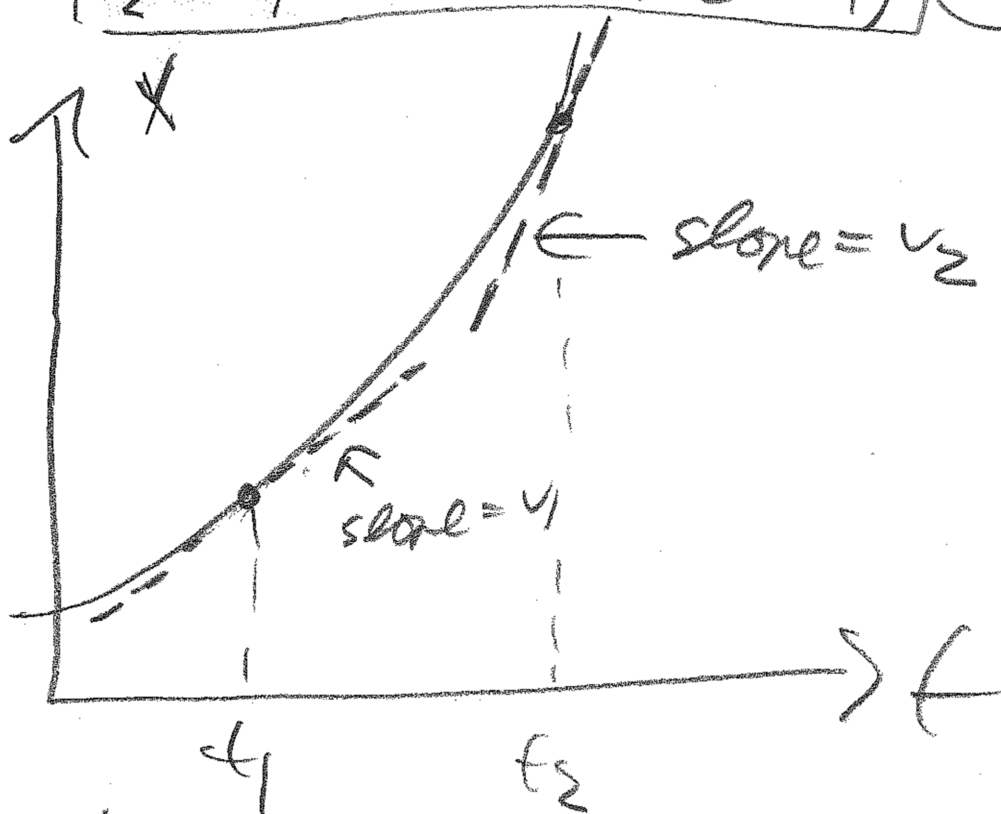


$$X_2 - X_1 = V_1 \Delta t + \frac{1}{2} a \Delta t^2$$

$$\Delta t = t_2 - t_1 \quad \text{III}$$

13

$$\boxed{v_2^2 = v_1^2 + 2\cdot a\cdot(x_2 - x_1)} \quad \text{IV}$$



Quick Example

cop at rest. $a = 2\,\frac{m}{s^2}$ → $2.0\,\frac{m}{s^2}$

cop accelerates uniformly and catches up with CAR.

(a) HOW LONG?

(b) HOW fast is cop moving?

rest $t=0$

COP

prove it!!

$t=0$

CAR → $15\,\frac{m}{s} = 34\,\frac{mi}{h}$ *

$a = 2\,\frac{m}{s^2}$

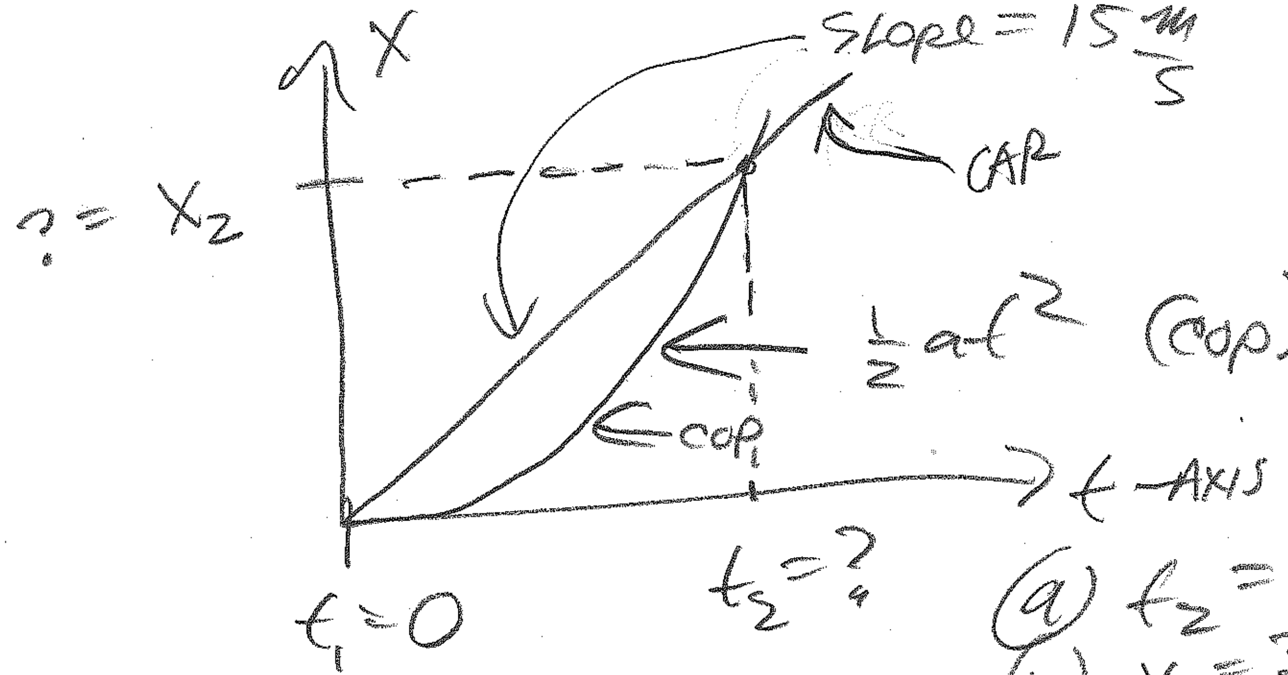
Later time → a → $V_{cop} = ?$

COP

CAR → $15\,\frac{m}{s}$

* $15\,\frac{m}{s}\cdot\frac{1}{1000}\,\frac{km}{m}\cdot\frac{3600\,s}{h}\cdot\frac{0.6\,mi}{km} = 34\,\frac{mi}{h}$

(14



ⓐ $t_2 = ?$
ⓑ $v_2 = ?$ (cop)

<u>cop</u> $x_2 - x_1 = v_1 \Delta t + \frac{1}{2} a \Delta t^2$

$t_1 = 0$, $x_1 = 0$

t_2 and x_2 are at catch up.

$\Delta t = t - t_1 = t - 0 = t$

<u>cop</u> $x_2 = \frac{1}{2} a t^2$

$v_1 = 0$

<u>comment</u>: WHO HAS UNIFORM MOTION? CAR.

WHO HAS UNIFORMLY ACCELERATED MOTION? COP