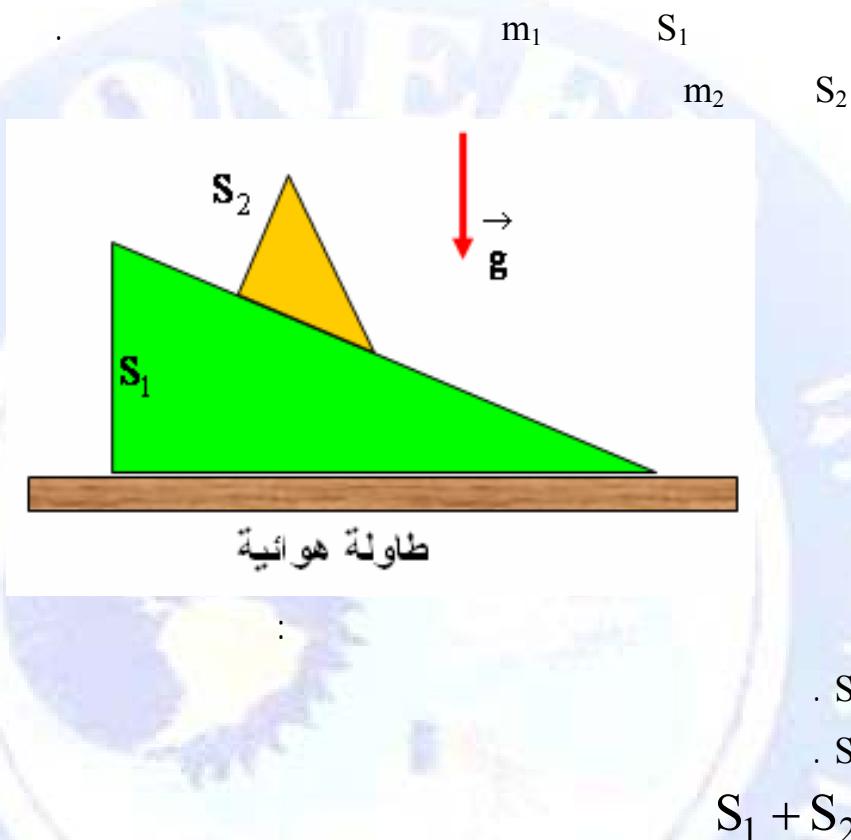


: 1



: 2

$$v_1 = 25 \text{ Km/h} \quad (\text{formule 1})$$

$$10 \text{ m/s}^2$$

2

\rightarrow

$$v_2$$

$$m = 720 \text{ Kg}$$

- 1

- 2

$$\begin{matrix} \rightarrow \\ a \end{matrix}$$

$$\begin{matrix} \rightarrow \\ v_2 \end{matrix} \quad \begin{matrix} \rightarrow \\ v_1 \end{matrix}$$

:

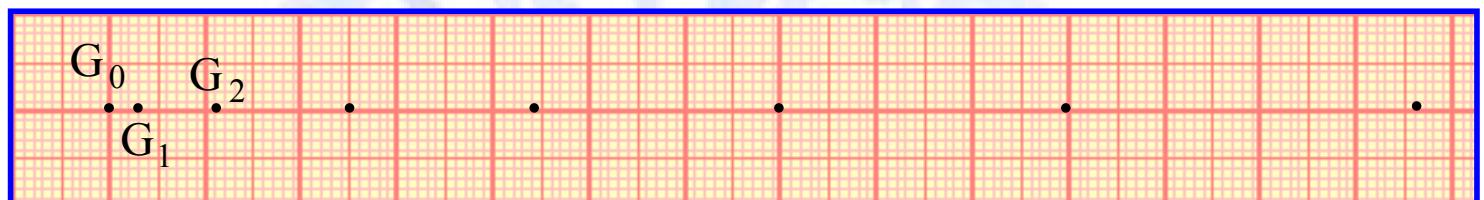
- 3

: 3

$m = 270\text{g}$

$t = 0\text{s}$

80 ms



- 1

- 2

- 3

$x(10^{-2}\text{ m})$	0,0	0,3	1,1	2,5	4,4	7	10	13,6
$v(10^{-2}\text{ m/s})$								
$a(\text{m/s}^2)$								

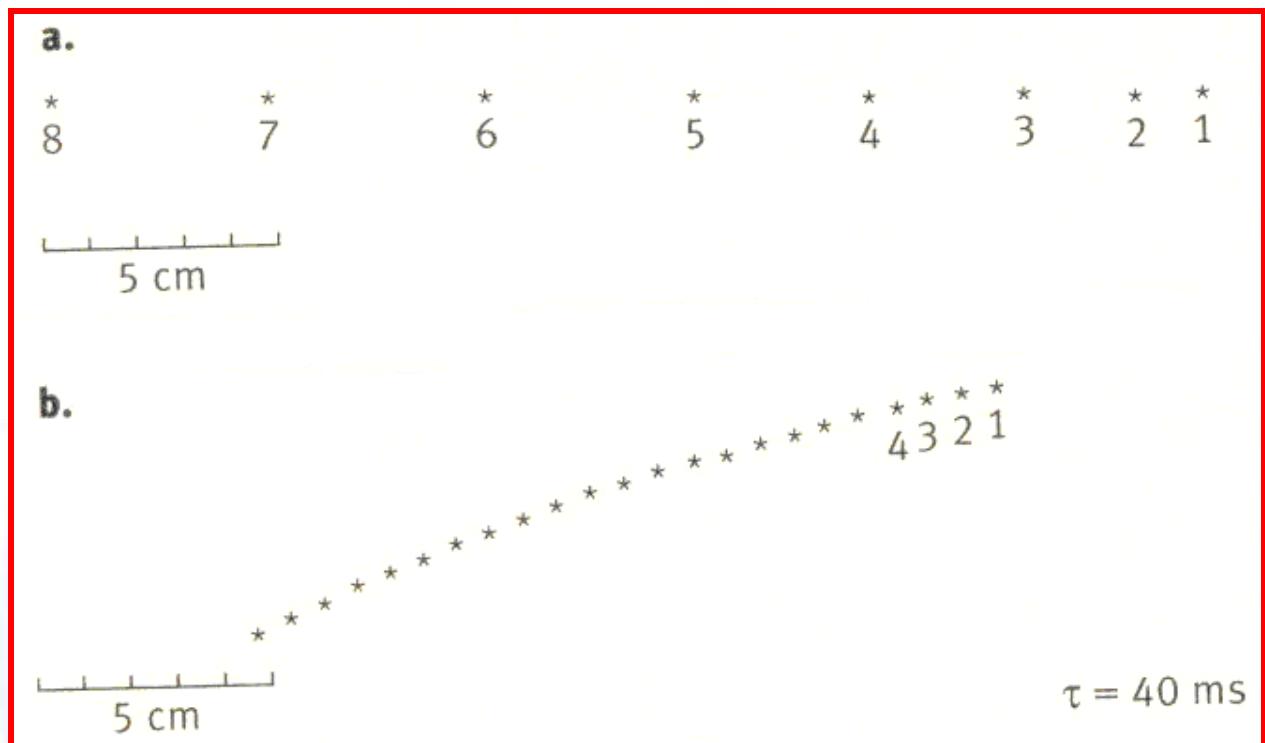
- 4

- 5

- 6

: 4

(b) (a)



(b) (a)

G

- 1

.6 5 4 3
(b)

15

(a)

- 2

- 3

: 5

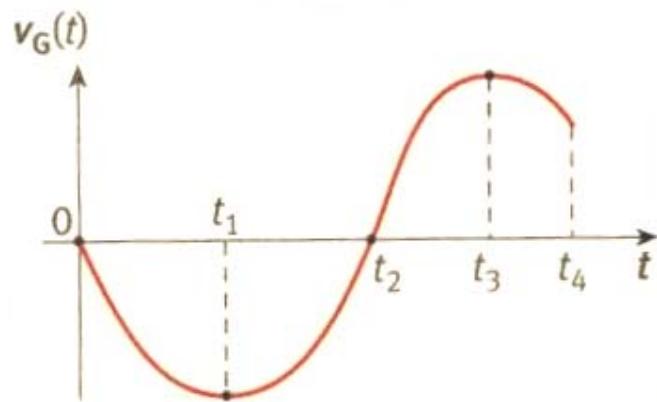
$\left(O; \vec{i} \right)$

G

$\vec{v}_G(t) = v_G(t) \vec{i}$

$t_4 - t_0$

$v_G(t)$



$$(O; \vec{i})$$

$$a_G(t)$$

- 1

$$a_G$$

-

$$a_G > 0$$

-

$$a_G < 0$$

-

$$a_G$$

-

- 2

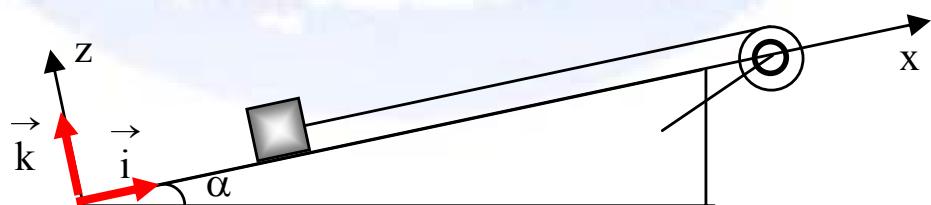
$$a_G(t)$$

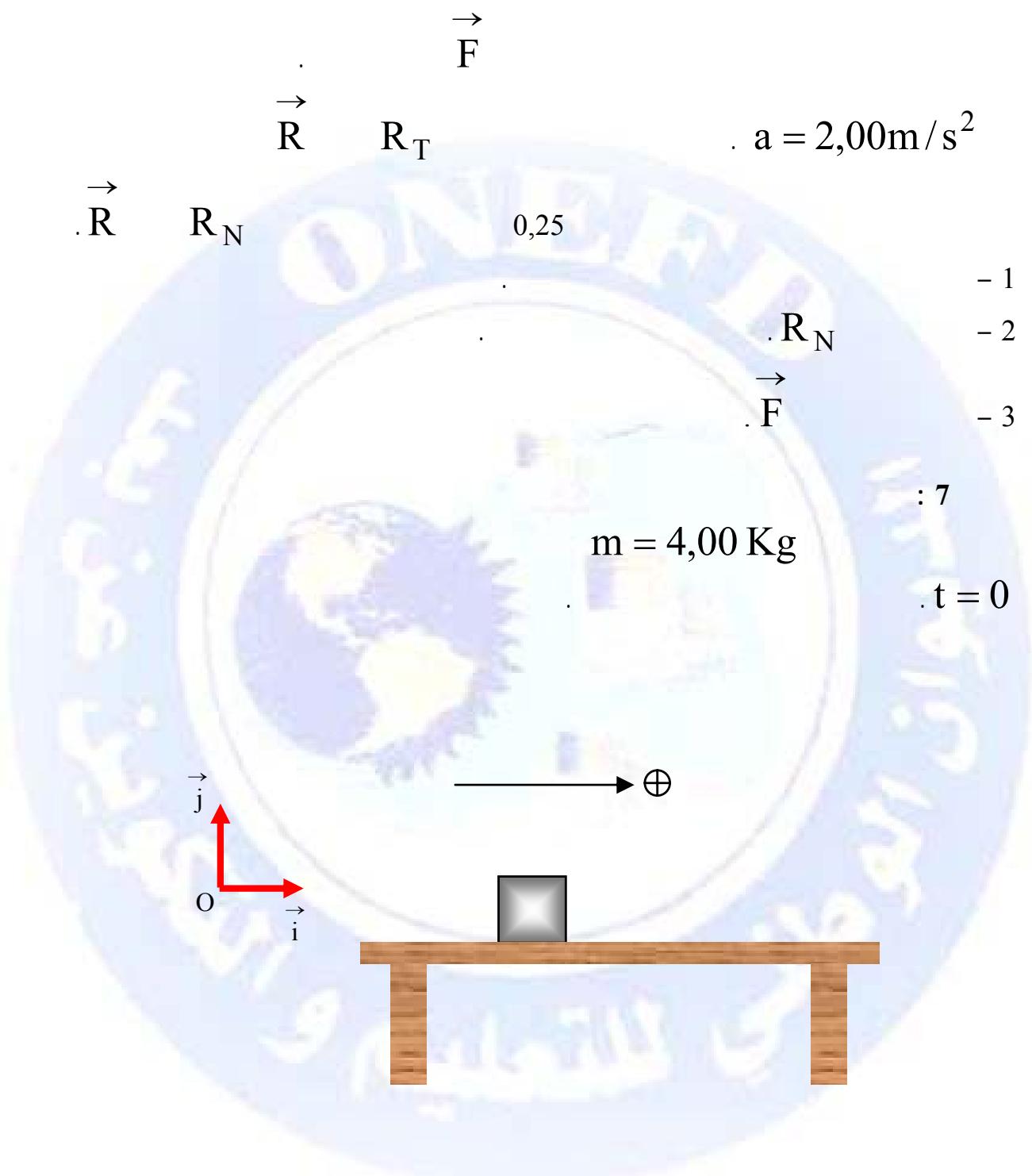
$$t_4 \quad t_0$$

: 6

$$\alpha = 12,0^\circ$$

$$m = 80 \text{ Kg}$$



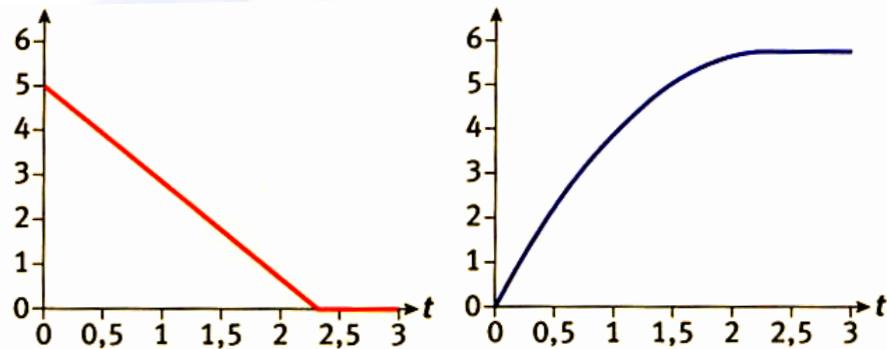


$$\left(O; \vec{i} \right)$$

$$v(t)$$

$$x(t)$$

$$t_1$$



$$\vec{R}$$

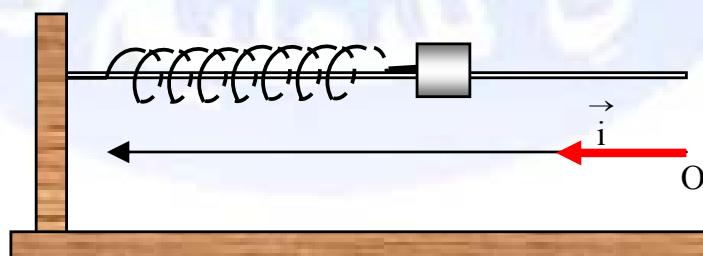
$$\vec{R}_y \quad \vec{R}_x$$

$$t_1$$

- 1
- 2
- 3
- 4
- 4

: 8

250 g



$$\left(O; \vec{i} \right)$$

$$x_i$$

$$\tau = 40 \text{ ms}$$

	1	2	3	4	5	6	7	8	9	10
X (cm)	0,0	2,2	4,2	5,9	7,2	7,9	6,3	4,7	2,7	0,5

$$\left(O; \vec{i} \right)$$

$$\vec{a}_x$$

$$\vec{F}$$

$$-1$$

$$-2$$

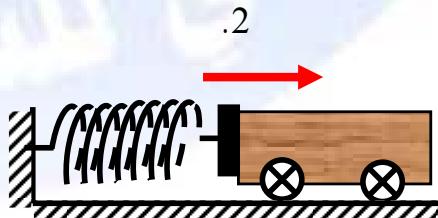
$$: 9$$

$$m = 240 \text{ g}$$

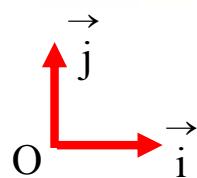
$$t = 0 \text{ s}$$

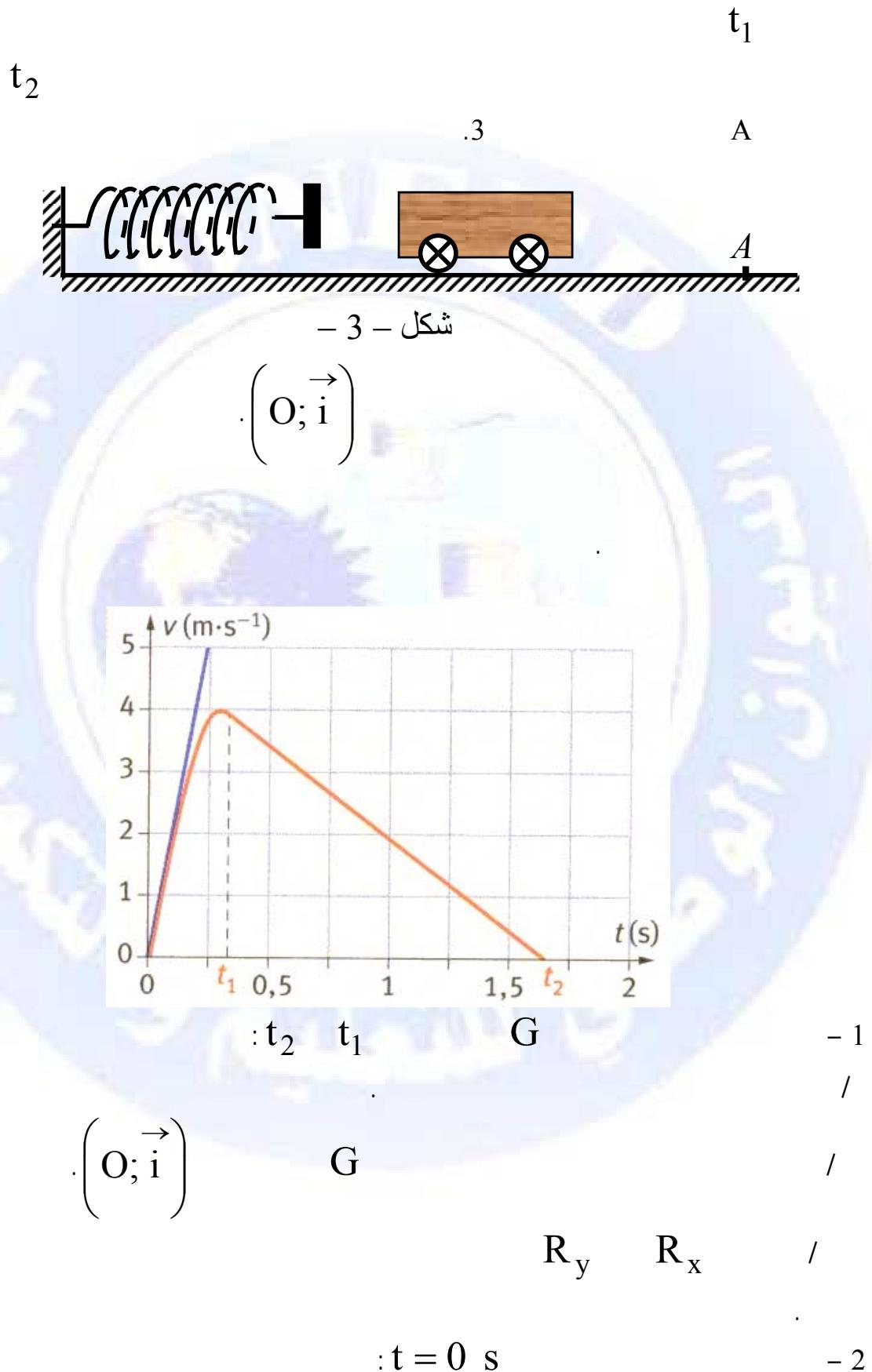


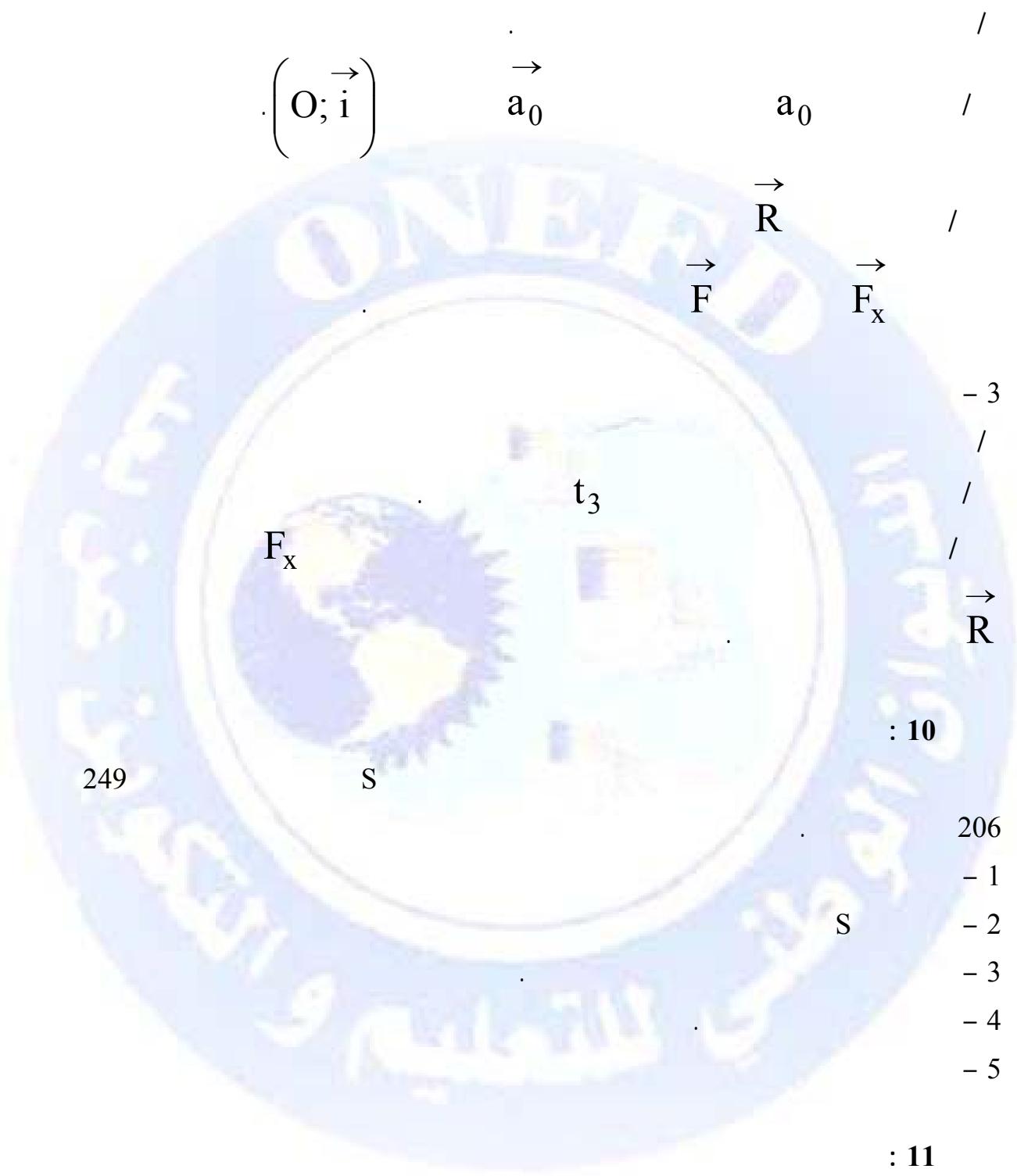
- 1 - شکل



- 2 - شکل







$$1 \text{ U} \cdot \text{A} = 150 \cdot 10^6 \text{ Km}$$

- 1

1) . a - 2

(. 365

.U.A a - 3

: 12

352 Km

) A 1040 Km (périgée) P

(apogée

P A - 1

- 2

- 3

: 13

$z = 300 \text{ Km}$

$T = 1 \text{ h } 32 \text{ min}$

r - 1

- 2

- 3

T_1 - 4

$z_1 = 600 \text{ Km}$

: 14

108,2 million Km r

224,7 j

- 1

- 2

- 3

$$v^2 = \frac{G \cdot m_S}{r}$$

$$m_s$$

$$m_s$$

$$- 4$$

$$: 15$$

$$D = 3,8 \text{ cm}$$

$$0,05 \text{ g}$$

$$m = 2,50 \text{ g}$$

$$v_{\ell\text{im}} = 7,12 \text{ m/s}$$

$$\rho = 1,3 \text{ Kg/m}^3$$

$$- 1$$

$$F = Kv^2$$

$$v(t)$$

$$- 2$$

$$/$$

$$/$$

$$- 3$$

$$K$$

$$v_{\ell\text{im}}$$

$$mg$$

$$K$$

$$/$$

$$K$$

$$/$$

$$- 4$$

$$a_0$$

$$/$$

$$\tau$$

$$/$$

$$v_1 = 4,25 \text{ m/s}$$

$$t_1 = 0,500 \text{ s}$$

$$t_1$$

$$a_1$$

$$/$$

$$t_2 = 0,510 \text{ s}$$

$$/$$

: 16

0 " :

" 10,4 s 100Km/h

- 1

AB

- 2

AB.

: 17

t_1

\vec{F}

$m = 46,0g$

$K = 4,34 \cdot 10^{-4} \text{ kg/m}$

$F = Kv^2$

$\left(O; \vec{k} \right)$

t_1

t_1

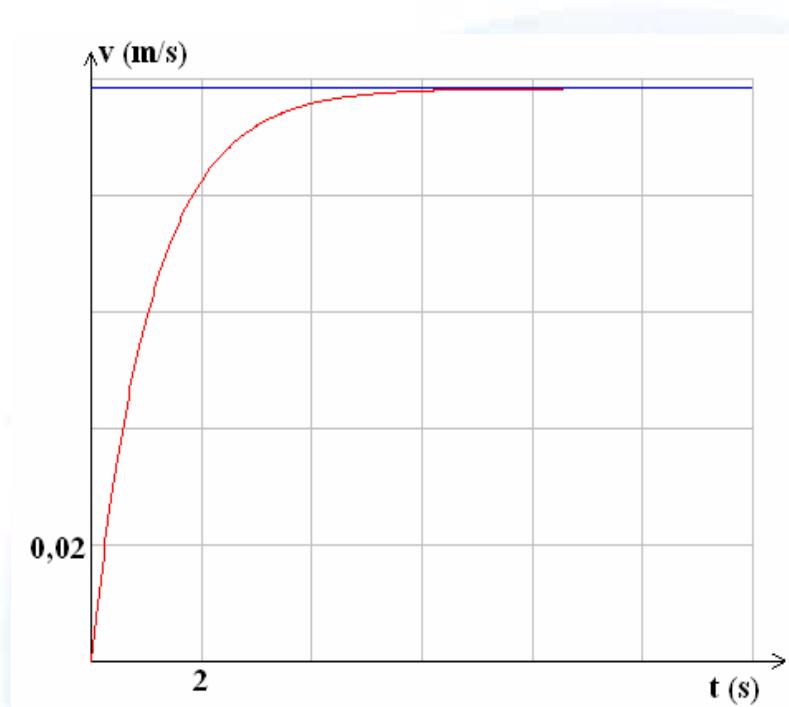
- 1

a_1 - 2

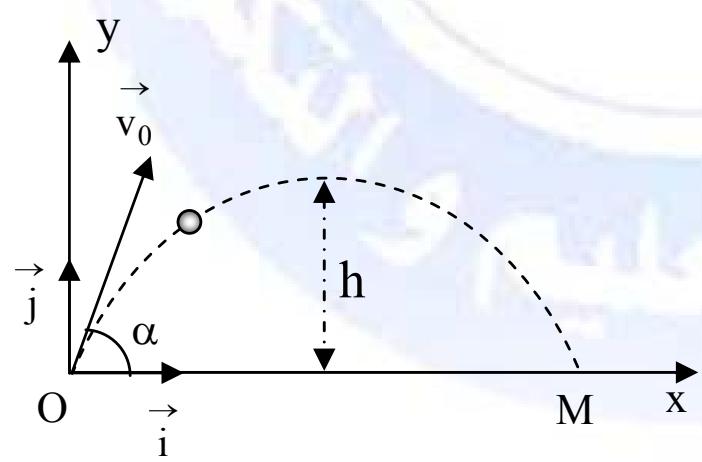
- 3

$t_2 = t_1 + 0,0200 \text{ s}$

: 18



: 19

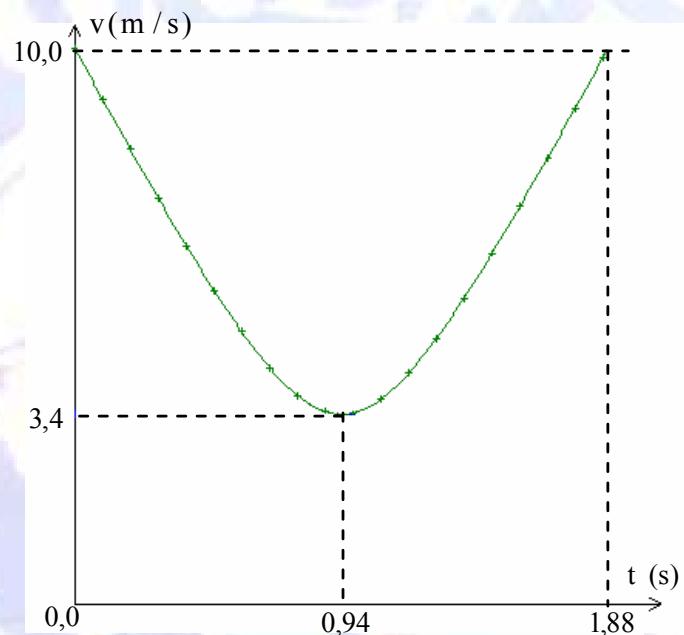


$$\left(0; \vec{i}; \vec{j} \right)$$

$t = 0$ s

$$\vec{v}_0 = v_{0x} \vec{i} + v_{0y} \vec{j} \quad \vec{OG}_0 = 0 \cdot \vec{i} + 0 \cdot \vec{j}$$

(M) (O)
- 1



$\left(O; \vec{i} \right)$ - 2

$\left(O; \vec{j} \right)$ - 3

\vec{v}_0 v_0 /

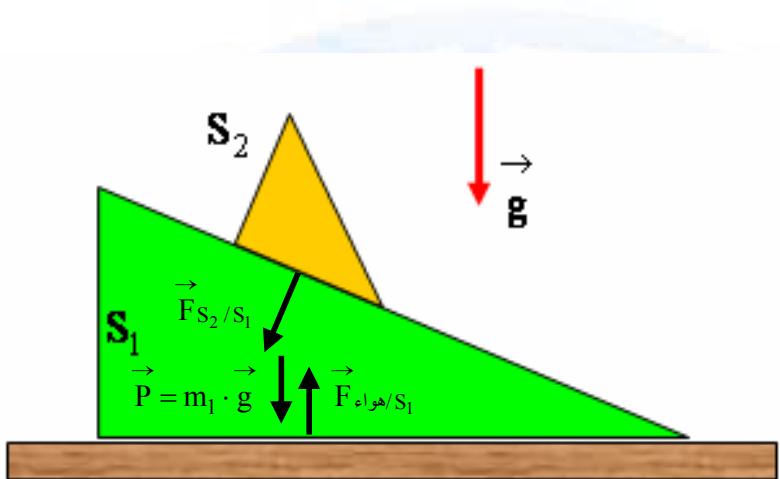
\vec{v}_0 v_{0x} /

v_{0y} α - 4

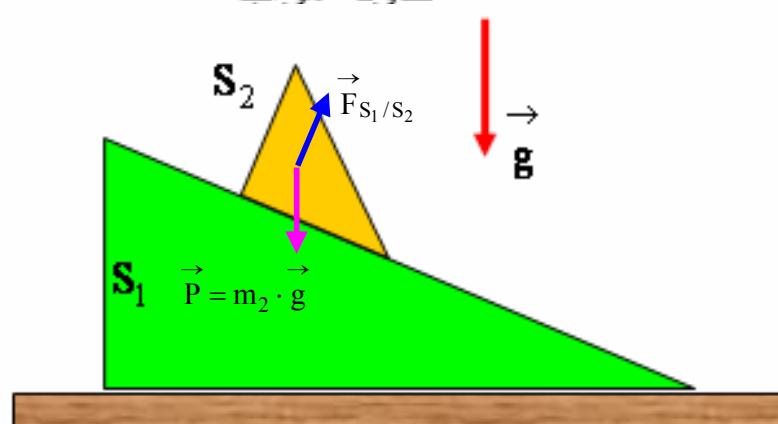
$[0; 1,88]$ s $v_y(t)$ $v_x(t)$ - 5

h OM - 6

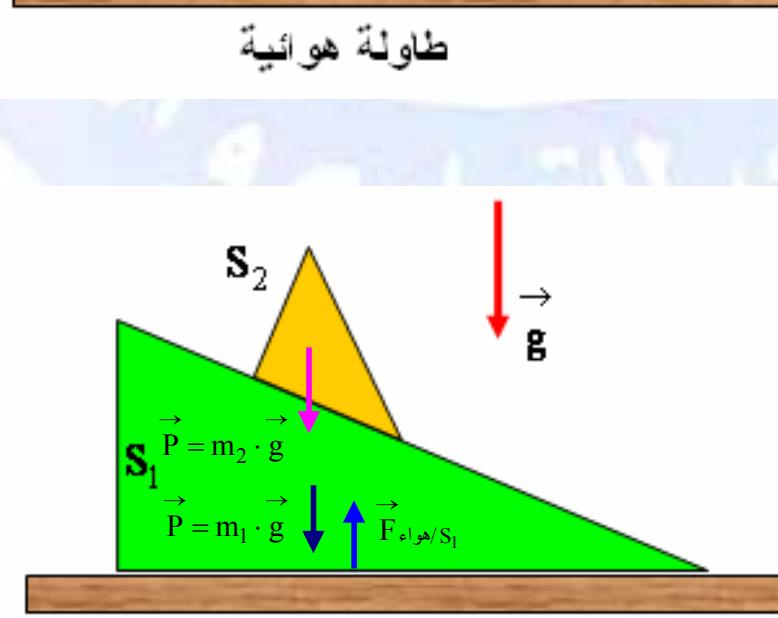
: 1



. S_1 -



. S_2 -



. $S_2 + S_1$ -

طاولة هوائية

: 2

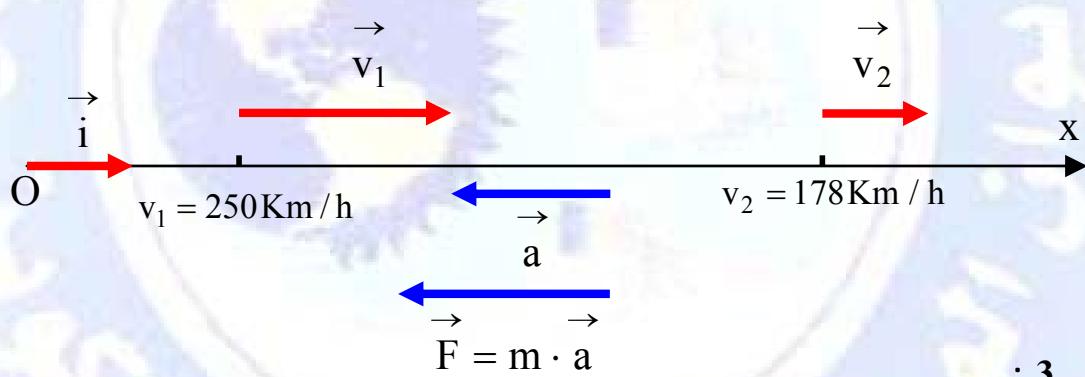
$$a = \frac{v_2 - v_1}{\Delta t} : - 1$$

$$v_2 = v_1 + a\Delta t : :$$

$$v_2 = 250 \times \frac{1000}{3600} + (-10) \times 2 = 49,44 \text{ m/s} = 178 \text{ Km/h}$$

$$F = m \cdot a : - 2$$

$$F = 720 \times (-10) = 7200 \text{ N} : - 3$$



: 3
- 1

- 2

- 3

$$a_i = \frac{v_{i+1} - v_{i-1}}{2\tau} \quad v_i = \frac{x_{i+1} - x_{i-1}}{2\tau}$$

$x(10^{-2} \text{ m})$	0,0	0,3	1,1	2,5	4,4	7	10	13,6
$v(10^{-2} \text{ m/s})$	/	6,87	13,75	20,62	28,12	35	41,25	/
$a(\text{m/s}^2)$	/	/	0,86	0,90	0,90	0,82	/	/

- 4

$$\vec{F} \quad : \quad - 5$$

$$\vec{F} = \sum \vec{F}_{\text{ext}} = m \vec{a} \quad : \quad - 6$$

$$\vec{\Delta v} \quad : \quad - 7$$

$$F = m \cdot a \quad : \quad a$$

$$a = 0,87 \text{ m/s}^2$$

$$F = 0,3 \times 0,87 = 0,261 \text{ N}$$

(b)

(a)

: 4 - 1

(b)

- 2

	1	2	3	4	5	6	7	8
$v (\text{ m/s})$	/	0,47	0,68	0,86	1,0	1,1	1,13	/
$a (\text{ m/s}^2)$	/	/	4,9	4,0	3,0	1,6	/	/

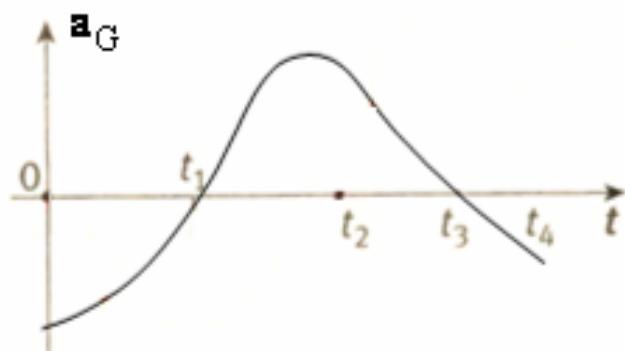
15 (b) - 3

: 5

- 1

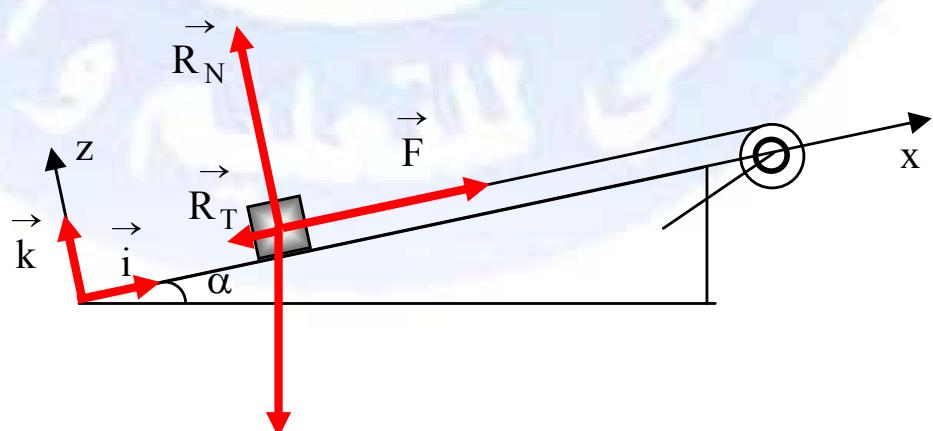
$t_3 < t_1$	$\frac{dv}{dt} = 0$	$a_G = 0$	-
$t_1 < t < t_3$	$\frac{dv}{dt} > 0$	$a_G > 0$	-
$0 \leq t < t_1$	$\frac{dv}{dt} < 0$	$a_G < 0$	-

$t_3 < t \leq t_4$	a_G	-
$t = 0$	$a_G(t)$	- 2



: 6

- 1



$$\vec{P} + \vec{F} + \vec{R}_T + \vec{R}_N = m \cdot \vec{a}$$

$$\left(O; \vec{k} \right)$$

$$R_N = mg \cos \alpha$$

$$R_N = 80 \times 9,81 \times \cos 12 = 662,2 \text{ N}$$

$$\frac{R_T}{R_N} = 0,25$$

$$R_T = 0,25 \times 662,2 = 165,6 \text{ N}$$

$$\left(O; \vec{i} \right)$$

$$F - R_T = ma$$

$$F = R_T + ma$$

$$F = 165,6 + 80 \times 2 = 325,6 \text{ N}$$

: 7

$$x(t)$$

2

1

$$v(t)$$

- 1

$$t_1$$

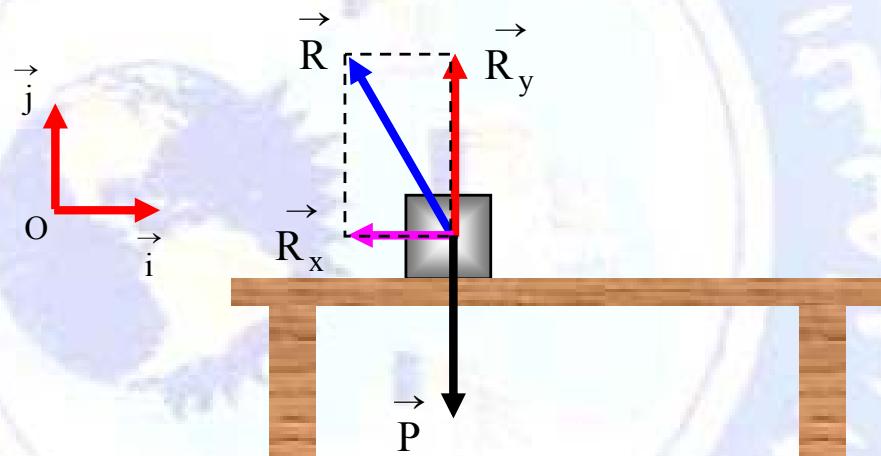
- 2

- 3

:

$$a = \frac{5 - 0}{0 - 2,3} = -2,2 \text{ m/s}^2$$

- 4



$$\sum \vec{F} = m \vec{a} : \quad$$

$$\vec{P} + \vec{R} = m \vec{a}$$

:

$$\left(O; \vec{j} \right)$$

$$R_y - mg = 0$$

:

$$R_y = 5 \times 9,81 = 49 \text{ N}$$

- 5

-

$$: \quad \left(O; \vec{i} \right) \quad -$$

$$-R_x = ma$$

$$R_x = -5 \times (-2,2) = 11 \text{ N}$$

: 8

- 1

	1	2	3	4	5	6	7	8	9	10
X (cm)	0,0	2,2	4,2	5,9	7,2	7,9	6,3	4,7	2,7	0,5
V (m/s)		0,52		0,38			-0,40		-0,52	
a (m/s ²)			-1,9					-1,5		

- 2

$$\vec{F} = F_x \cdot \vec{i} = ma_x \cdot \vec{i}$$

: 3 -

$$\vec{F} = -0,38 \cdot \vec{i}$$

: 8 -

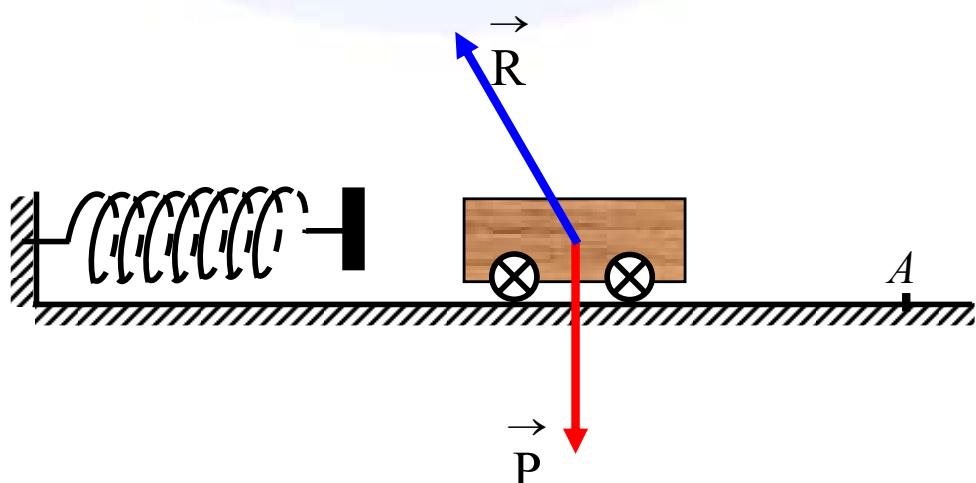
$$\vec{F} = -0,48 \cdot \vec{i}$$

: 9 -

$$\cdot t_2 \quad t_1 \quad G$$

- 1

/



$$v(t)$$

$$\cdot [0,5 \text{ s} ; 1,5 \text{ s}]$$

/

:

$$a = \frac{dv}{dt} = \frac{\Delta v}{\Delta t} = \frac{0,4 - 3,4}{1,5 - 0,5} = -3 \text{ m/s}^2$$

/

$$\vec{P} + \vec{R} = m \cdot \vec{a}$$

$$: \quad \left(O; \vec{i} \right)$$

-

$$R_x = -ma = 0,24 \times (-3) = 0,75 \text{ N}$$

$$: \quad \left(O; \vec{j} \right)$$

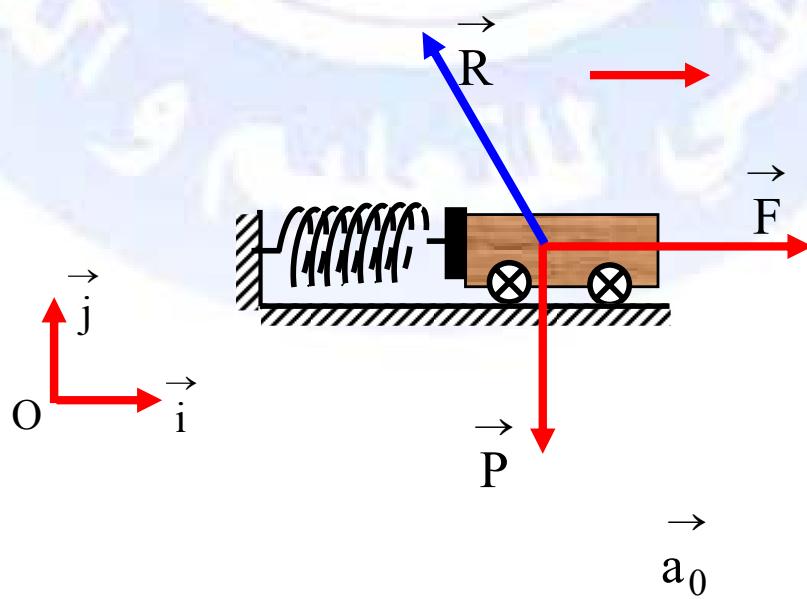
-

$$R_y = mg = 0,24 \times 9,81 = 2,35 \text{ N}$$

$$t = 0 \text{ s}$$

- 2

/



$$a_0 = \frac{dv}{dt} = \frac{\Delta v}{\Delta t} = \frac{(5-0)}{(0,25-0)} = 20,0 \text{ m/s}^2$$

$$\vec{F} + \vec{P} + \vec{R} = m \cdot \vec{a}_0$$

$$F_x - R_x = ma_0$$

$$F_x = ma_0 + R_x = 0,24 \times 20 + 0,75 = 5,55 \text{ N}$$

$$v(t)$$

$$\frac{dv}{dt} = 0$$

$$a = \frac{dv}{dt} = 0$$

$$t_3 = 0,30 \text{ s}$$

$$\vec{F} + \vec{P} + \vec{R} = m \cdot \vec{a}$$

$$(O; \vec{i})$$

$$F_x - R_x = 0$$

$$F_x = R_x = 0,75 \text{ N}$$

: 10

- 1

S

- 2

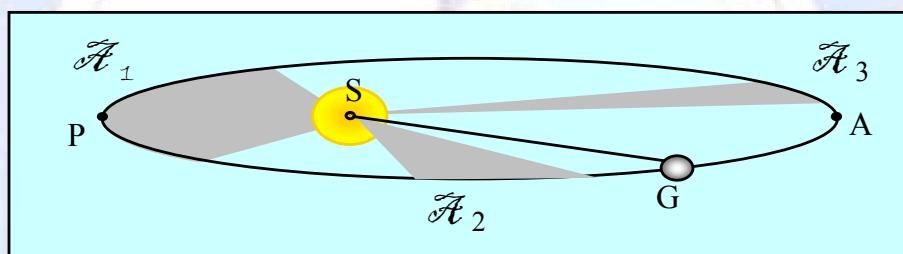
- 3

$$a = \frac{249 + 206}{2} = 228.10^6 \text{ Km}$$

- 4

\mathcal{A}

Δt



- 5

(périhélie)

(aphélie)

: 11

- 1

$$\frac{T^2}{a^3} = K_S$$

$a \quad (s) \quad T$
 s^2/m^3

$$\frac{T_S^2}{a_S^3} = K_S$$

- 2

$$\cdot \frac{T_T^2}{a_T^3} = K_S :$$

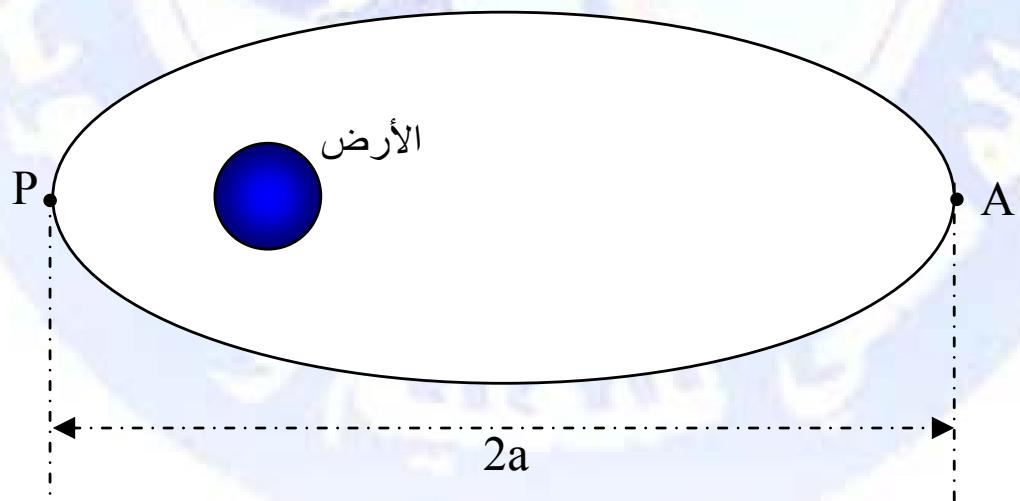
$$a_S = a_T \left(\frac{T_S}{T_T} \right)^{2/3} :$$

$$a_S = 150 \cdot 10^6 \times \left(\frac{10759}{365} \right)^{2/3} = 1431 \cdot 10^6 \text{ Km}$$

: U.A a - 3

$$a_S = \frac{1431 \cdot 10^6}{150 \cdot 10^6} = 9,54 \text{ U.A}$$

: 12
: - 1



() - 2
: - 3

$$2a = 352 + 1040 = 1392 \text{ Km}$$

: 13

- 1

$$r = 6400 + 300 = 6700 \text{ Km}$$

- 2

$$T = 1 \times 3600 + 32 \times 60 = 5520 \text{ s}$$

$$a^3$$

- 3

:

- 4

$$T^2 = K a^3 :$$

$$T_1^2 = K a_1^3$$

:

$$T_1 = T \left(\frac{R_T + z_1}{R_T + z} \right)^{3/2} = 5520 \times \left(\frac{6400 + 600}{6700} \right)^{3/2} = 5894 \text{ s} = 1 \text{ h } 38' \\ : 14$$

- 1

$$T = \frac{2\pi}{\omega} :$$

$$\omega = \frac{v}{r} :$$

$$T = \frac{2\pi r}{v}$$

$$v = \frac{2\pi \times 108,2 \cdot 10^6}{224,7 \times 24 \times 3600} = 35,0 \text{ Km/s}$$

- 2

- 3

$$\vec{F}_{S/P} = m \cdot \vec{a}$$

$$\vec{F}_{S/P} = \frac{Gm_S m}{r^2} \cdot \vec{n}$$

$$\frac{Gm_S}{r^2} \cdot \vec{n} = \frac{v^2}{r} \cdot \vec{n}$$

$$v^2 = \frac{Gm_S}{r}$$

m_S

- 4

$$m_S = \frac{r \cdot v^2}{G} = \frac{108,2 \cdot 10^9 \times 35000}{6,65 \cdot 10^{-11}} = 2,00 \cdot 10^{30} \text{ Kg}$$

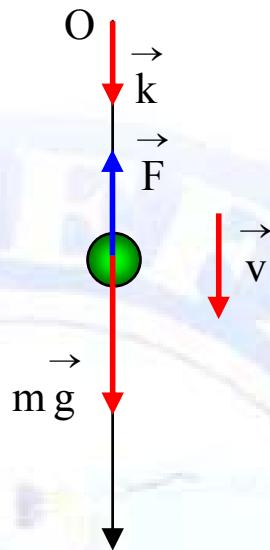
: 15

- 1

$$m = \rho \cdot V = 1,3 \times \frac{4}{3} \pi \left(\frac{3,8 \cdot 10^{-2}}{2} \right)^3 = 0,037 \text{ g}$$

- 2

/



(O, \vec{k})

$$\vec{a} = \frac{d\vec{v}}{dt} \cdot \vec{k}$$

$$\vec{v} = \vec{v} \cdot \vec{k}$$

$$\vec{F} = -Kv^2 \cdot \vec{k} :$$

$$\vec{P} = mg \cdot \vec{k} :$$

$$m \vec{a} = \vec{P} + \vec{F} :$$

: $(O; \vec{k})$

$$m \frac{d\vec{v}}{dt} = mg - Kv^2$$

. $\vec{v}(t)$

- 3

$$\frac{d\vec{v}}{dt} = 0 :$$

$$mg - Kv_{\text{lim}}^2 = 0$$

/

$$K = \frac{mg}{v_{\ell\text{im}}^2}$$

$$[K] = \frac{[m] \times [g]}{[v] \times [v]} = \frac{\text{kg} \times \frac{\text{m}}{\text{s}^2}}{\frac{\text{m}^2}{\text{s}^2}} = \text{kg/m}$$

:K

$$K = \frac{2,5 \cdot 10^{-3} \times 9,81}{7,12^2} = 4,84 \cdot 10^{-4} \text{ Kg/m}$$

- 4
/

$$ma_0 = mg \quad \left(O; \vec{k} \right)$$

$$a_0 = g = 9,81 \text{ m/s}^2$$

$$v_{\ell\text{im}} = a_0 \tau$$

$$\tau = \frac{v_{\ell\text{im}}}{a_0} = \frac{7,12}{9,81} = 0,73 \text{ s}$$

- 4
/

$$a_1 = \frac{(mg - Kv_1^2)}{m} = \frac{(2,5 \cdot 10^{-3} \times 9,81 - 4,84 \cdot 10^{-4} \times 4,25^2)}{2,5 \cdot 10^{-3}}$$

- 5
/

$$a_1 = 6,31 \text{ m/s}^2$$

$$v_2 = v_1 + a_1 \Delta t$$

$$v_2 = 4,25 + 6,31 \times 0,01 = 4,31 \text{ m/s}$$

: 16

$$a = \frac{\Delta v}{\Delta t} = \frac{(100 - 0)}{10,7} \times \frac{1000}{3600} = 2,6 \text{ m/s}^2$$

$$a = \frac{dv}{dt} = \text{cst}$$

$$v = at + C_1$$

$$\therefore C_1 = 0$$

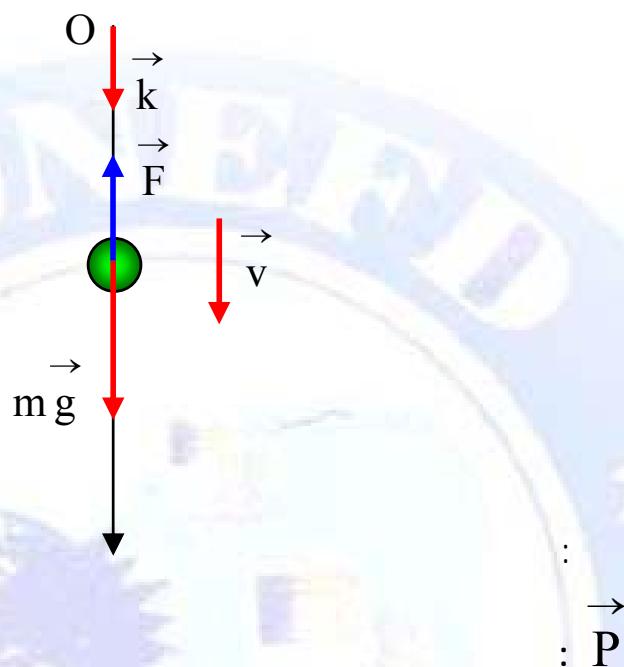
$$t = 0$$

$$v = at$$

. B A

$$v^2 - v_0^2 = 2a(AB)$$

$$AB = \frac{v^2}{2a} = \frac{\left(100 \times \frac{1000}{3600}\right)^2}{2 \times 2,6} = 148,4 \text{ m}$$



$$P = mg = 46 \cdot 10^{-3} \times 9,81 = 0,45 \text{ N}$$

$$F = Kv_1^2 = 4,34 \cdot 10^{-4} \times 20,10^2 = 0,18 \text{ N}$$

$$a_1 - 2$$

$$m \vec{a} = \vec{P} + \vec{F} : \\ m \vec{a} = \vec{P} - \vec{F} : \quad \left(O; \vec{k} \right)$$

$$a_1 = \frac{P - F}{m}$$

$$a_1 = \frac{0,45 - 0,18}{46 \cdot 10^{-3}} = 5,7 \text{ m/s}^2$$

: - 3

$$v_2 = v_1 + a_1 \Delta t$$

:

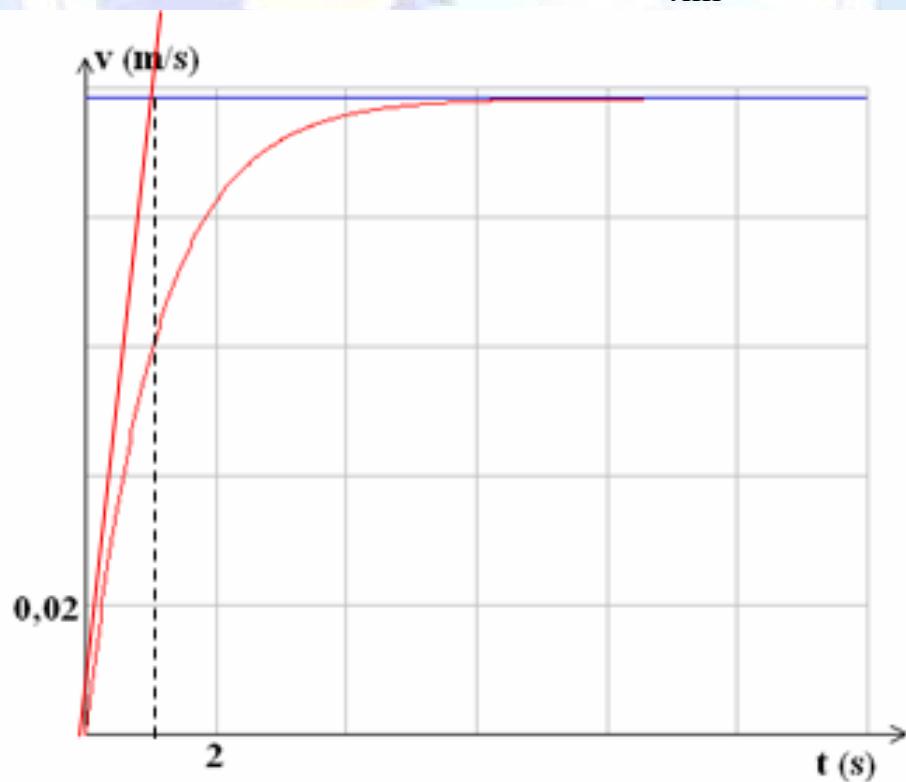
$$v_2 = 20,1 + 5,7 \times 0,02 = 20,20 \text{ m/s}$$

: 18

$$v_{\text{lim}} = 9,84 \cdot 10^{-2} \text{ m/s}$$

- 1

$$v = v_{\text{lim}} = 9,84 \cdot 10^{-2} \text{ m/s}$$



$$\tau = 1,1 \text{ s}$$

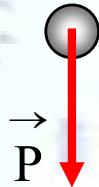
- 2

$$a_0 = \frac{V_{\text{lim}}}{\tau}$$

$$a_0 = \frac{9,84 \cdot 10^{-2}}{1,1} = 8,9 \cdot 10^{-2} \text{ m/s}^2$$

: 19

- 1



$$\sum \vec{F}_{\text{ext}} = m \cdot \vec{a}$$

$$\vec{P} = m \cdot \vec{a}$$

$$(O; \vec{i})$$

$$0 = m \cdot a_x$$

$$a_x = \frac{dV_x}{dt} = 0$$

$$(O; \vec{i})$$

$$\left(O; \vec{j} \right)$$

$$-mg = m \cdot a_x$$

:

$$a_y = \frac{dv_y}{dt} = -g$$

$$\left(0; \vec{i}; \vec{j} \right)$$

$$\vec{a} = 0 \cdot \vec{i} + (-g) \cdot \vec{j}$$

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$$v_0 /$$

$$v_{x0} /$$

$$\vec{v}_y$$

$$v_x = v_{0x}$$

$$\left(O; \vec{i} \right)$$

$$v_x = v_{0x} = 3,4 \text{ m/s}$$

$$\alpha - 4$$

$$v_{0x} = v_0 \cos \alpha$$

$$\cos \alpha = \frac{3,4}{10} = 0,34$$

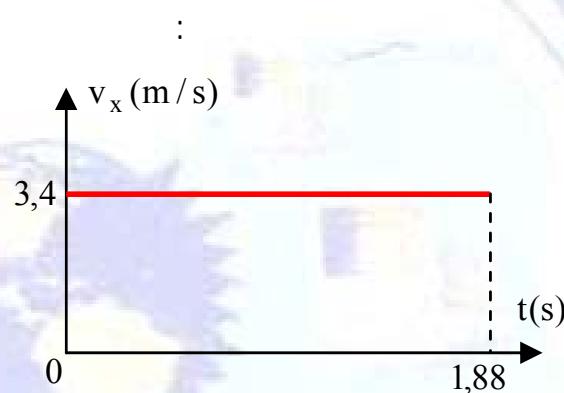
$$\alpha \simeq 70^\circ :$$

$$: v_{0y} = v_0 \sin \alpha :$$

$$v_{0y} = 10 \times \sin 70 = 9,4 \text{ m/s}$$

- 5

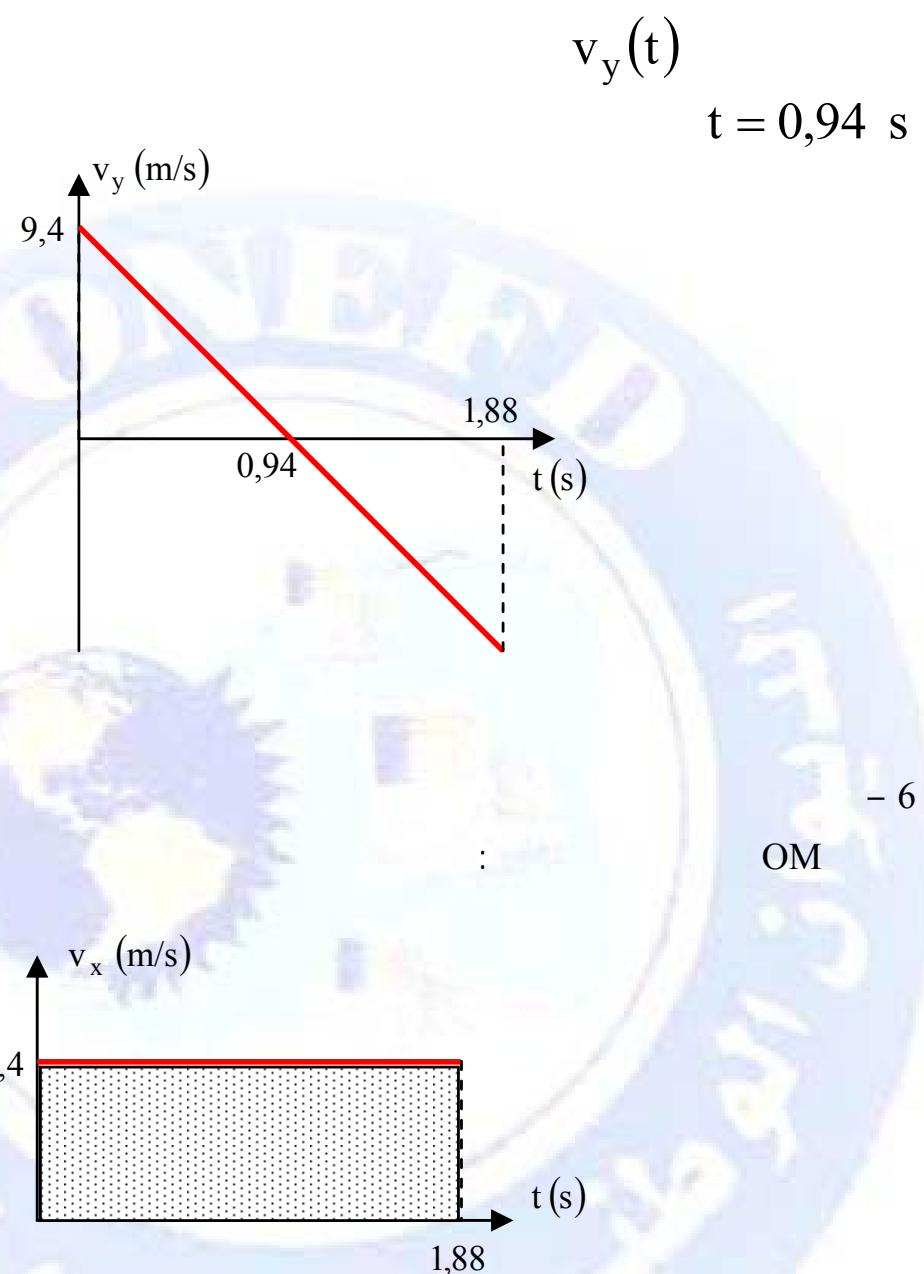
$$\left(O; \vec{i} \right) : v_x(t) -$$



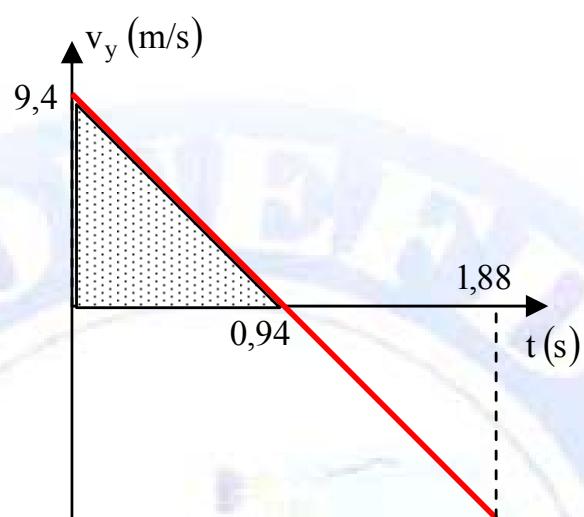
$$\left(O; \vec{j} \right) : v_y(t) -$$

:

$$\frac{dv_y}{dt} = -g = \text{cst}$$



: h



$$h = \frac{1}{2} \times 9,4 \times 0,94 = 4,4 \text{ m}$$